Fluctuating Fisheries in Africa's Inland Waters: Well Adapted Livelihoods, Maladapted Management

Marie-Therese Sarch, Flood Hazard Research Centre, Middlesex University, Queensway, Enfield EN3 4SF, UK
and
Edward H Allison, School of Development Studies, University of East Anglia, Norwich NR4 7TJ, UK

Abstract. This paper evaluates evidence that fish stocks in Africa's inland waters are climate-driven and cannot be stabilized by conventional fisheries management measures. We draw on published material and our own recent and on-going research in Lake Chad and the East African Great Lakes area to propose that fisherfolk's livelihood strategies are well adapted to both seasonal and inter-annual climate-induced fluctuations. We argue that current State-led fisheries management fails to recognize the significance of these climate-induced fluctuations, and the nature and rationality of fisherfolk's' responses to them. State management therefore potentially or actually undermines the strategies that fisherfolk have evolved to both cope with and benefit from fluctuating resource availability. We conclude with a discussion of how management could adapt to support, rather than hinder, fisherfolk's adaptations to the fluctuating resource base, and how such management needs to be based on a fuller understanding of fisherfolk's livelihood systems.

Keywords: Africa, Inland Fisheries, Fisheries Management, Sustainable Development, Livelihoods.

1. INTRODUCTION

Despite severe droughts and a doubling in population since the 1960's, African fish consumption has increased by one quarter (FAO, 1996). Africa's inland fisheries have played an important role in meeting this demand; fish production from inland waters has almost doubled since 1950 (*Ibid*.). However as fishing effort continues to respond to increased demand, the need for better fisheries management is widely perceived as urgent. One important consideration for better management is that it should be based on existing livelihood strategies that have evolved from a finely developed understanding of the dynamic behavior of the resources and adaptive response to both local environment and broader social context. This paper examines how the fishing communities exploiting inland waters in Africa have responded to fluctuations in the fisheries they rely on and the implications of these responses for the sustainable development of their fisheries.

1.1 Sustainable Development

Sustainability has followed a sequence of goals characteristic of both rural (agricultural) and fisheries development strategies. Post-war development efforts invested heavily in technology intensive irrigation schemes and the biotechnology of the Green Revolution. These were followed by concerns for sustainable and community based development and a focus on the poorest. Bailey, Cycon and Morris (1986) suggest a parallel can be drawn between the Green Revolution in agriculture and a 'production-oriented' 'Blue Revolution' in fisheries - both of which have failed to meet the needs of resource-poor producers, particularly those in Africa.

A further comparison of agricultural and fisheries development, however, illustrates the contrast between strategies for environmental sustainability and those for social sustainability. The prominent concern of many fisheries development efforts has been with conserving fish stocks. Many millions have been spent on calculating what level of production is sustainable and how best to enforce this (Cycon, 1986; Mahon, 1997). It is only relatively recently that a 'trade-off ' between improving the fishing incomes of the poor and conserving fish stocks has been called for (Bailey and Jentoft, 1990). In contrast, the primary focus of agricultural development efforts has been on increasing production and sustaining farming livelihoods (Lele, 1991; Tomich, Kilby and Johnston, 1995).

In the choice of methodology for assessing the status of tropical fisheries (e.g. Sparre & Venema, 1992) including those in Africa's inland waters, and setting targets for sustainable production and development, there has been an underlying ecological assumption that fisheries are equilibrial systems. This is despite long-standing recognition that constant catch or constant effort approaches to management, based on the paradigm of an achievable optimum sustainable yield, are inappropriate in fisheries that fluctuate extensively as a consequence of abiotic (primarily climate) factors (Beddington & May, 1977; Sharp, 1995).

The sustainable livelihoods research framework (Ellis, 2000) provides a means of moving beyond these narrowly sectoral, production orientated and equilibrial views of small-scale

fisheries, to base design of fishery management institutions on a firmer understanding of complexity and interdependency of fishing and other livelihood sources (Geheb & Binns, 1997; Sarch, 1999; Allison & Ellis, forthcoming). The Sustainable Livelihoods approach addresses competing notions of "sustainability" – the ubiquitous aim of development investment. Chambers and Conway (1992) highlight the conflicts between the conservation goals of 'environmental sustainability' which subsume production limits and the welfare aims of 'social sustainability' which often include production targets. The livelihoods approach attempts to capture both aspects of sustainability and incorporates them through its focus on the vulnerability of livelihoods. Ellis (2000: 137) draws a parallel between livelihood systems and the agroecological systems on which rural households depend:

"...a sustainable livelihood [is] one that can cope with stress and shocks, and displays resilience when faced with adverse events."

1.2 Africa's Inland Fisheries

Fish protein has made up approximately one fifth of the animal protein consumed in Africa since 1961 (FAO, 1996). However, the contribution from inland waters has risen from less than 25 per cent in 1951 to 41 per cent of domestic fish production in 1994. In absolute terms, inland fisheries production has soared from 250 000 tonnes in 1950 to almost 1 500 000 (*Ibid*.).

In recent years, Africa's inland fisheries have produced the majority of fish consumed in many African countries and almost all of that consumed in Mali, Chad and East Africa (see Figure 1). Africa's inland fisheries are important not only as a source of food, but as a source of employment and income for resource poor families. They are exploited almost entirely by artisanal fishing communities in predominantly rural areas. In 1996 FAO estimated that the number of canoes operated by artisanal fishers in Africa's inland waters had increased by 40 per cent in the preceding decade and that most freshwater fisheries were intensively exploited.

" As fishing effort continues to respond to the growing demand for fish, proper inland fisheries management is becoming more and more urgent." (FAO, 1996: 10-36)

'Proper fisheries management' in this context has usually meant management for equilibrium production targets such as maximum sustainable yield, with measures to achieve these targets enforced by the State (e.g., for Lake Malawi, Tweddle & Magasa, 1989; FAO, 1993; GOM, 1999).

While fisheries management in Africa shows an increasing interest in community and co-management strategies (e.g. Normann, Nielsen & Sverdrup-Jensen, 1998), these approaches too, are often based on unjustified assumptions about static equilibria and livelihoods based entirely on fishing. These assumptions lead to uncritical promotion of territorial use rights in undifferentiated and idealized constructs of a 'community' united by fishing interests (Allison & Ellis, forthcoming). The assumption in both cases is that fish yields can be both optimized and stabilized by better management. This does not allow for the possibility that optimal strategies may be opportunistic and 'unstable' in the conventional sense.

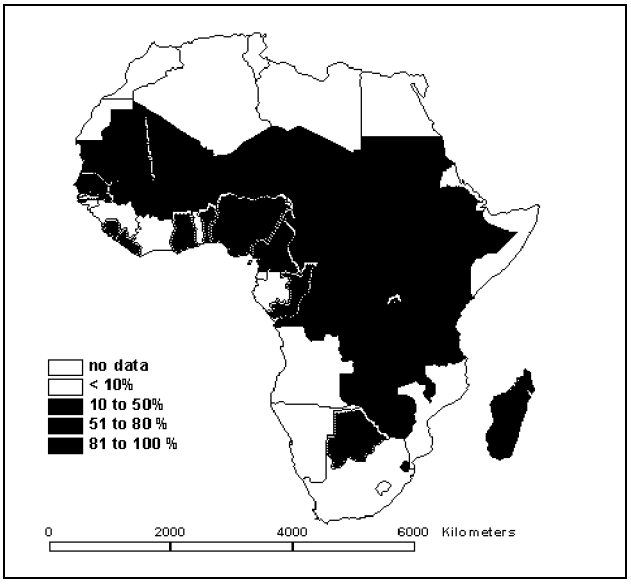

Figure 1: Inland fish production as a proportion of fish supply available per caput in sub-Saharan Africa, 1994 (Adapted from FAO, 1996)

This paper evaluates evidence that fish stocks in many of Africa's inland waters fluctuate extensively, and that these fluctuations are climate-driven and cannot be stabilized by conventional fisheries management measures. We draw on published material and our own recent and on-going research in Lake Chad and the East African Great Lakes to propose that fisherfolk's livelihood strategies are well adapted to both seasonal and inter-annual climate-induced fluctuations. We argue that current state-led fisheries management fails to recognize the significance of these climate-induced fluctuations, and the nature and rationality of fisherfolks' responses to them. We conclude with a discussion of how management could adapt to support, rather than hinder, fisherfolk's adaptations to the fluctuating resource base, and how such management needs to be based on a fuller understanding of fisherfolk's livelihood systems.

2. LIVELIHOOD RESPONSES TO FISHERY FLUCTUATIONS IN THE CONTEXT OF MANAGEMENT

We examine livelihood responses to climate-induced fishery fluctuations and the attempts to manage fisheries for sustainable yield in three of the most important types of ecological production systems in inland Africa: shallow lakes, river floodplains, and the pelagic zones of large lakes. It is the fisheries of these systems that undergo the most pronounced climate-induced fluctuations (Kalk, McLachlan & Howard-Williams, 1979; Lae, 1992; Plisnier, 1997; Sarch & Birkett, 2000). By contrast, fisheries based on longer-lived, larger sized fish in demersal ecosystems in many of the larger and deeper African lakes seem more likely to fit with prevailing notions of equilibrium dynamics and the conventional fish stock management approaches based on them. There is a reasonable body of evidence suggesting that fisheries are significantly impacting productivity in these latter systems (reviewed in Pitcher & Hart, 1995), which is not the case for the more variable fisheries we consider in this paper.

2.1 Responding to fluctuations in shallow lakes

Africa's shallow lakes are among the most productive fishery ecosystems in the tropics (Talling & Lemoalle, 1998). They are also prone to periodic lake level fluctuation, even to complete drying out in low-rainfall years. Most inland water ecosystems (with the exception of the African Great Lakes) are young, in geological and evolutionary terms, with an adaptable, resilient flora and fauna. They are, in a sense, pre-adapted to cope with a degree of human-induced change (Moss, 1992). This resilience is a feature not often emphasised in fisheries analyses, typically pre-occupied with stability as a management objective (Shepherd, 1991). Here we analyse the nature of climate and fishery variability, livelihood strategies of people living around the lakes, and attempts to manage fisheries, in two shallow lakes- Chad and Chilwa.

The Chari/Logone river system, which drains into Lake Chad from the highlands to the south, is the lake's major affluent. Although the lake lies at the south-east of the Sahara Desert, local rainfall has little impact on its volume. Water from the Chari/Logone rivers flows into the lake at its southern extreme (see Figure 2). This inflow peaks in October/November following the end of the rains in the southern catchment area and reaches a minimum in May/June at the start of the next year's rains (Olivry *et al*., 1996). The shallowness of the lake means that water level fluctuations are associated with considerable variation in the extent and occasionally the timing of the annual flood. These flood waters take between one and two months to reach the south-west shore where seasonal flooding plays a vital role in the renewal of the natural resource base.

Although seasonal fluctuations in the lake level lead to considerable flooding of the lakeshore zone, and this has important renewal effects for the lake's aquatic environment, inter-annual fluctuations, specifically the overall contraction of the lake during the last 25 years, have had a predominantly negative impact on fish production (Figure 3). While the initial impact of the lake's contraction on fisheries production and the profitability of fishing was masked by high catches from concentrated fish stocks in shrinking waters (Neiland and Verinumbe, 1990) - and by decreased competition from fish imports (World Bank, 1989; IMF, 1997) - decline in fish production from Lake Chad is undoubtedly linked to the contraction of the lake.

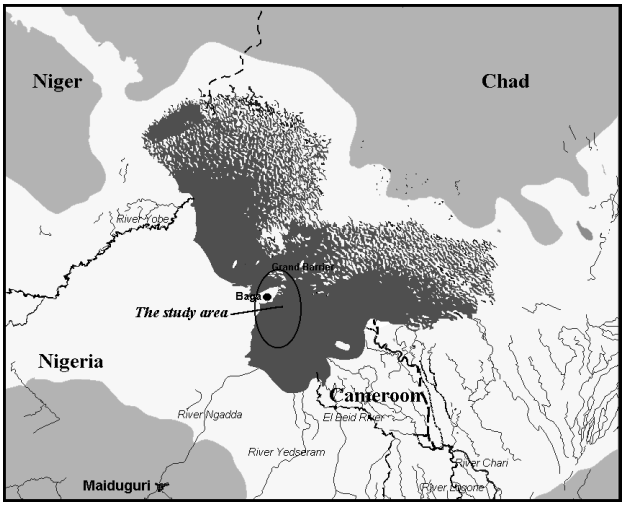

Figure 2: The Lake Chad Basin

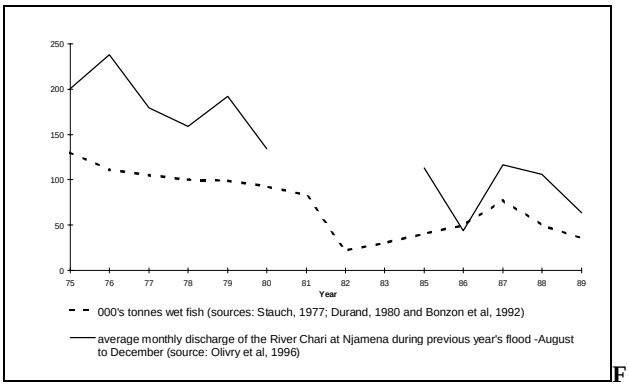

Figure 3: Flood Levels and Fish production from Lake Chad

In 1992 the Federal Government of Nigeria promulgated the inland fisheries decree which charged the Commissioner for Agriculture in each state with the responsibility for licensing

and regulating inland fishing. (Inland Fisheries Decree 1992, Supplement to the Official Gazette Extraordinary No 75, vol. 79, 31st December 1992). The aim of the decree was to "give maximum protection to our precious inland fisheries resources ... [and] enhance the optimum productivity and utilization of the inland fisheries resources..." (Ita, 1993: 169). A key implication of the decree for fishing at Lake Chad was the ban on fishing techniques that obstructed the free movement of fish. In effect, this has prohibited the use of barrages of fish traps set across channels of receding lake water, which had become an extremely popular fishing method during the 1990s. Although both Federal and Local Government have attempted to manage fishing at Lake Chad, compliance with measures such as this is limited by the inability of fisheries staff to reach the most productive fishing areas on the lake and enforce them. Although broadly benevolent and similar in their aims to sustain fish stocks, the efforts of the Federal Fisheries Department and Local Government have conflicted and have resulted in failure. Illegal fishing persists and Local Government has little direct control over it (Krings, 1998; Sarch 2000). Fisheries management cannot operate effectively because there is confusion over which agencies have jurisdiction over which areas, the formulation of regulations cannot to keep up with of dynamics of the lake, and the organizations charged with enforcement are so poorly resourced that their staff are rarely in a position to enforce a regulation.

Sarch and Birkett (2000) have compared livelihood responses on the south western shore with the lake level fluctuations recorded by ground gauges, satellite imagery and radar altimetry. This shows that since 1972, the communities of the western lake shore have made important responses to the contraction and recent expansion of the lake. Two responses were mentioned frequently: resettlement and switching livelihood strategies. Each of the village communities involved in the participatory research explained that they had moved to their current village from a location further west. As the lake levels dropped during the 1970s and 1980s, the maximum extent reached by the lake each year receded eastwards towards the center of the lake basin. Village elders in each village explained how they had followed the lake shore and in some cases, had moved eastwards more than once. The second response that had been made in each of the case-study villages to the contraction of the lake was to diversify from relying entirely on fishing to farming the lake floor as the flood water receded. In the years 1978, 1984 and 1985 when there has been a significant, year-on-year, drop in the level of the lake, previously fishing villages have responded immediately by farming the emerging lake floor. Although each of the village communities described how they had initially been set up as fishing settlements during the 1970s and early 1980s, in 1993 the majority (54 per cent of households) of households relied on farming as their main source of income (Sarch, 1996). Many of the Hausa communities who had been attracted by the fishing opportunities of the 1970s explained how they had switched to farming as the lake shore contracted and revealed the moist soils of the lake floor around their fishing settlements. Of the 80 per cent of Hausa households who had fished Lake Chad in the past, the majority (58 per cent) now relied on farming for more than a quarter of their annual income (Sarch, 1999).

Lake Chilwa, Malawi has many ecological similarities to Lake Chad, but, being smaller and shallower (recently fluctuating around 1850 km^2 including both open-water and wetland areas, and less than 3 m deep), is subject to even more extreme fluctuations, including complete desiccation (Lancaster, 1979). In good years, fish catches can be as high as 25 000 tonnes (fishery statistics are rather uncertain and vary between sources) and more than 10 000 people are engaged in fishing activities. There was a major increase in fishing effort around the early 1970s, as the region became better integrated into the market economy. Minor recessions in lake level, sufficient to reduce fishing for one or two years, can be expected every six years or so (see Figure 4) and major recessions which will interfere with fishing in the open lake for 3-5 years can be expected every 60-70 years, with a possibility of an intermediate recession in 30-40 years (Lancaster, 1979). The last drying episode covered the period from late 1994 to 1996, when fishing ceased altogether. Fishing operations started again in April 1997 (GOM, 1999)

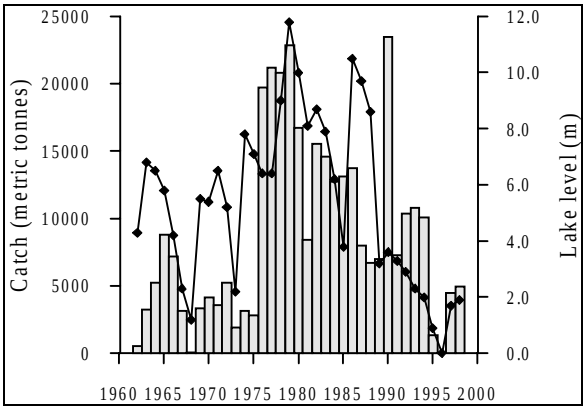

Figure 4: Catch fluctuations (shaded bars) and lake level variations in Lake Chilwa, Malawi 1962-1998. Note also that the lake gauging system was changed in 1989, and the lake level measurements from this period onwards may not be directly comparable with those in previous years (lower apparent amplitude of fluctuation) Fisheries data from Department of Fisheries, GOM (1999); Lake Level Data from Environmental Affairs Department (2000).

Kalk *et al.* (1979) offer an interesting insight into livelihood responses to fishery fluctuation during the 1960s and 1970s at a time of gradual transition from quasi-subsistence to a partial cash economy in this area of Malawi. This insight does not appear to have been transferred to current fishery management initiatives. The fisheries of Lake Chilwa offer an economically unstable environment, determined by the seasonal and long-term fluctuations in lake level. Yet, at high production periods, the fisheries permitted readily earned cash, with "a substantial number of men gained an income five or more times greater than that prevailing for unskilled or agricultural labour" (Chipeta, 1972). In good years, Lake Chilwa supplies almost half the total fish production in Malawi, where fish is said to supply around 70% of animal protein in the diets of 12 million people (GOM, 1999).

Fishing in Malawi is largely a business, not a subsistence activity (Ferguson, Derman & Makandawire, 1993). Management that constrains access to fish in productive periods constrains income-generating opportunities, denies people access to much-needed protein and serves no conservation purpose in a lake where the sustainable yield concept is obviously untenable. And yet, despite wide-spread acceptance that fisheries management, in its traditional guise of stock conservation measures, is inappropriate, there have been recent measures to introduce fishery closures to allow recovery after drying periods (even though recovery in the past has been rapid). Various gear and mesh-size restrictions have also been introduced, apparently at the behest of fishing communities around the lake, who participate in an evolving co-management scheme with the Fisheries Department (Sholtz *et al.*, 1998).

Work reviewed by Agnew (1979) & Agnew & Chipeta (1979) provide a useful baseline from which to review the likely choices available to people in the latest drying episode, and how these might have been impacted by new management initiatives. These authors summarise the short-term choices of fishermen during the lake-drying period of 1967-68 as: 1) fishing on a very much reduced scale in the remaining swamps, streams and lagoons in the Chilwa catchment, 2) transfer to nearby Lakes Malombe, Malawi or Chiuta, 3) increasing the cultivation of rice, cotton cassava and vegetables 4) a switch over to commercial handicrafts such as plaiting carpets, 5) spending considerable time trapping birds and digging for rodents or 6) seeking employment elsewhere. These responses varied according to income status, asset profiles, ethnicity and time of residence in the area.

In the drying episode of 1968, around 200 fishermen migrated to nearby Lake Malombe, and others moved to Lake Malawi. These were among the richest fishermen, whose investment in fishing-related assets meant that they could not simply cease fishing, as could those with less stake in this source of livelihood. Since the introduction of community-based management in Lake Malombe and Southern Lake Malawi (Sholtz *et al*, 1998, Chirwa, 1998), the option to move fishing operations between lakes is constrained. That this may also prevent Malombe's fishermen from migrating to Chilwa in productive years, thereby relieving pressure on this intensely exploited lake, does not appear to have been explicitly considered.

The repercussions of recession in Lake Chilwa waters and consequent decline of fishing are much wider than on fishing alone. The whole of the Chilwa plains and lake must be seen as an economic network. Not only are there links between fishing and various ancillary services, but also complementary flows of income between fishing and farming. The successful fishermen had larger gardens and produced more cash crops than other fishermen (Phipps 1973). Recognition that there is an "integrated small-scale economy of farming, fishing and cattle-rearing" (Kalk, 1979; p15) does not seem to have led to any specific policy support for these diversified livelihoods. Instead, sectoral concerns for the sustainability of individual natural resource systems have prevailed, even when it is known that notions of resource sustainability are questionable. "The Chilwa fishes are clearly well fitted to persist in the unpredictable Chilwa ecosystem, provided the refugium of swamps and streams is maintained", according to Moss, (1979, p411), with Kalk (p431) adding: "Man must remain as generalized in activity as the lake fauna in order to succeed in the Chilwa area".

Moss (1979) also cautions that more dangerous than overfishing in this resilient system were threats to the swamps through 'reclamation' for agriculture or perhaps as irrigation reservoirs, siltation through changes in catchment land-management, and pesticides. It is these threats that have led to recent interest in environmental management in the Chilwa wetland, and its designation as a Ramsar site. (Environmental Affairs Department, 2000).

The EAD report reiterates the perceived resilience of the system. However, in an analysis of fisheries issues (EAD, 2000, Table 5.2), the report highlights "Ignorance, Poverty, Corruption, Migratory fishermen and Lack of Resources" as barriers to sustainable utilization of fishery resources, and recommends the implementation of "community-based natural resource management for the benefit of the local people". There is clearly some difficulty in accepting that migration may be a legitimate and sustainable strategy to maximize benefits from a fluctuating resource, a factor that

needs to be taken into account in the design of any community-based management scheme.

The mobility and livelihood flexibility of the fishing families making their living on the shores of Lake Chilwa in the 1970s and Lake Chad in the 1990s has enabled them to respond to the extreme fluctuations observed. These are not mere 'coping strategies', but represent active opportunism – adaptations aimed at maximizing the contribution of fishing to household incomes. It is not particularly useful to talk of the fish stocks as sustainable in the context of this level of 'natural' fluctuation. Around Lake Chad, people have adapted their livelihoods and are able to exploit the same areas of the lake basin in a range of environmental conditions, through fishing during the flood and farming after the flood has receded. Around Lake Chilwa, there are large-scale shifts from fishing to farming, pastoralism and other occupations when the lake dries out (and back to fishing when it refills). Such strategies highlight the importance of enhancing or maintaining the flexibility of lake-shore livelihoods rather than constraining it with fixed fisheries production quotas, seasons or areas.

2.2 Responding to Fluctuations in a River Floodplain

Figure 5: Mali and the River Niger

The inland delta of the River Niger is situated between Ségou and Timbouctou in central Mali. This floodplain covers an area which fluctuates between 30000 and 40000 km^2 (Drijver and Marchand, 1985; Moorehead, 1989; Bonzon and Breuil, 1992) (see Figure 5). The delta traverses the Sudano Sahelian climatic zone to the south and the Sahelian zone to the north and, like Lake Chad, is an important source of water in the semi-arid Sahel. The flood plain is also characterized by considerable seasonal and interannual fluctuations in water levels. Levels in the main watercourses rise between June/July and September/October as rainfall in the rivers' mountainous catchment area to the west and southwest reaches the delta. Flooding peaks between October and December and at this stage the floodplains will be submerged. The floodwaters recede between January and March and between April and June, water flows only in the deepest river beds. The delta has one short rainy season between June/July and September/October. Both the water levels and the timing of each of these events vary considerably within and between years and either can make the difference between a good or bad year for floodplain livelihoods (Moorehead, 1991).

A range of livelihood systems are based on the natural resources of the delta. These include semi-settled cultivators, agro-pastoralists, agro-fishers, transhumant fishers and herders. Moorehead (1989) estimated that approximately a third of those living in the delta in 1987 were fishers. In the 1970s and 1980a both local rainfall and flood levels were much reduced and this put considerable pressure the livelihood systems of the region. Fish catches also fluctuated (see Figure 6). FAO catch statistics for Mali (90 per cent of which is from the inland Niger Delta) show an improvement in the early 1990s and factors such as increased rainfall, flood levels and fishing effort are most likely to account for this. Fisheries management measures put in place during this era have been largely ineffective in regulating fishing effort or achieving optimal catch rates (Quensiere *et al*, 1994).

Unlike at Lake Chad, there is a long history of fisheries management systems in operation in the delta (Moorehead, 1991). These have experienced important changes firstly in response the Fulani conquest of the region in the eighteenth century and more recently in response to the nationalization of fisheries resources in post-independence Mali. Access to fisheries and other floodplain resources were traditionally managed at a local level by community elders. Water masters managed the range of fishing resources in the vicinity of their community through determining dates when particular water bodies could be fished, the gears that could be used and who was permitted to fish. Fishers from outside the community would be taxed and this revenue would be spent by the water master within the community. These resource management systems were subjucated to the Fulani during their conquest of the region and the management of

farmland, grazing and fisheries was codified in the *Dina*. Water masters remained in control of fisheries management although the Fulani exerted authority over their appointment and revenues.

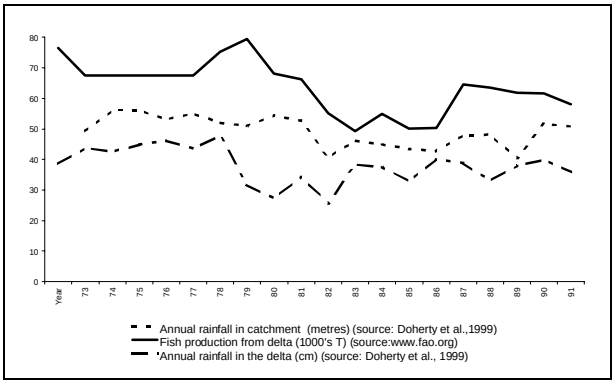

Figure 6: Rainfall and Fish Production in the Inland Niger Delta in Mali

Kone (1985) charts the evolution of fisheries management measures through the colonization and post-independence eras in Mali. He describes how the 1959 colonial ordinance switched the focus of fisheries revenue collection from the fisherman's region of origin to the size of his boat. It was, however, institution of fisheries permits in 1975 which ultimately dissipated the control which the water masters were able to exert over the fisheries of the floodplain (Quensière *et al.,* 1994). State issued fisheries permits enabled outsiders to fish on the same terms as traditional fishing communities and the ability of water masters to use their community based influence to control access to fishing was lost. Although fisheries permits were part of a wider system designed to sustain fisheries yields for the benefit of the nation, there is agreement that this system has not only failed to meet its objectives, it has led to increasing conflict and the breakdown of the traditional systems of fisheries management (Kone, 1985; Moorehead, 1991; Quensiere *et al.,* 1994). Quensiere *et al* (1994) explain how the concept of "*gestion rationelle*" i.e. adjusting fisheries effort to stock characteristics in order to attain an optimal offtake rate, cannot be applied to the inland Niger delta because species diversity is high, fishermen are numerous and diverse, and large variations in the relationship between catch and effort is the norm. They call for fisheries management which is based both on technical and political choices.

Davies (1996) has examined the responses of those employing different livelihood strategies in the delta to the low and fluctuating flood levels over the course of the decade from 1982 to 1991. She found that while most of those living in the delta region have had to make adaptations which have had a detrimental impact on their future livelihood security, the severity of this impact differed between those employing different livelihood strategies.

Agro-fishers in the Inland Niger Delta have traditionally relied on cultivation to meet their subsistence needs and fishing for the accumulation of capital and as a safety net. Since the droughts of the 1970s and 1980s, decreasing harvests have forced them to rely on fish sales to make up a food deficit. As with their agro-pastoralist counterparts they are particularly vulnerable to the terms of trade for such sales. After especially poor harvests, the amount of fish which must be traded to buy a fixed quantity of grain increases and agro-fishers are forced to intensify their fishing activities. More family labor is diverted to fishing earlier in the season and at further distances. This has led to conflict among agro-fishers and transhumant fishers as competition has increased for fish stocks depleted by the contraction of the flood season during drought years. Nevertheless, unlike those employing other livelihood strategies, rather than having to find new activities, fishers have been able to intensify their fishing efforts. Davies (1996: 163) observes that "Fishing remains one of the more secure sources of productive entitlements as evidenced by the increasing numbers of people fishing".

The ability of these families to intensify their fishing effort illustrates the failure of management measures designed to restrict this. However more importantly, this intensification of fishing effort demonstrates the role fishing has served in the ameliorating food insecurity of those who now rely on it to meet their subsistence needs. This has several implications for future fisheries management policy. Firstly, as Quensière et al. (1994) have observed in the Inland Delta and others (e.g. Bailey and Jentoft, 1990) elsewhere, fisheries management involves political choices. The granting of licenses in 1975 to fishers irrespective of their region of origins increased both competition and conflict within the fishery. These have been exacerbated by the droughts of the 1970s and 1980s. The enforcement of either effort or catch quotas could have done so further.

2.3 Responding to fluctuations in pelagic fisheries in African Great Lakes.

The fisheries for small pelagic fish in Africa's Great Lakes are among the most important on the continent, supplying dried fish (variously known as *kapenta, usipa, dagaa or omena* according to species and region) to markets throughout much of East and central/southern Africa. Anecdotal evidence, oral histories, ecosystem and environment studies and government fishery statistics all support the notion that of these small clupeids and cyprinids fluctuates extensively from year to yea, in response to

climate-driven variations in primary and secondary biological productivity (Tweddle & Lewis, 1990; Allison *et al.*, 1995; Plisnier, 1997 - see Figure 7).

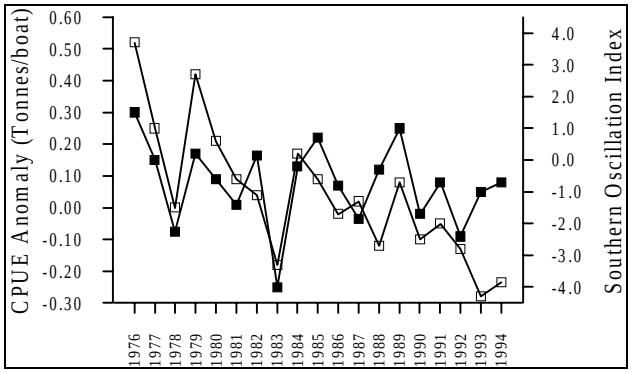

Figure 7: The relationship between stock abundance anomalies of small pelagic fish (clupeids) in Northern Lake Tanganyika (□), measured as the differences from the long-term average in Catch per unit of fishing effort by the Bujumbura-based industrial purse-seine fishery in Nov-Jan, and the Southern Oscillation Index or 'El Niño effect' (■) in the previous Feb-March. The correlation coefficient of 0.62 is highly significant. (Redrawn from Plisnier, 1997.)

While there has been significant recent interest in understanding the causes of variability in these fisheries, there has been little published work on the conseqeunces of that variability for those involved in catching, processing, distribution, sale and consumption, although descriptive accounts of fish marketing are numerous in the grey literature. One exception is a detailed study of the Lake Victoria *dagaa* marketing chain in Tanzania (Gibbon, 1997), which highlights traders' strategies for overcoming what would otherwise be seasonal over-supply in the rainy season by sale to markets for poultry feed, and of export to Congo. Even this study does not explore the implications of short-term and inter-annual fluctuations in supply. A recent study of fisheries management on the Kenyan shore of Lake Victoria illustrates how neither fisheries managers nor fishing communities perceive the *dagaa* fishery to be over-exploited (SEDAWOG, 2000).

Bias by development agencies and government fishery managers towards the interests of 'industrialized' fishing (Ferguson *et al.*, 1993) may explain why small-scale fisheries have more typically been seen as an impediment to sustainable fisheries development, by fisheries managers in these lakes. In particular, beach-seine and small-mesh nets targeting inshore life-history stages of small pelagic fish are frequently implicated in causing 'overfishing'. This is largely a knee-jerk reaction to seeing small fish being caught in what appear to be significant numbers. There are no studies quantifying the contribution of fishing to mortality of juvenile small pelagic fish in these lakes. Biodiversity conservation agendas also play their part in the vilification of beach seines – they catch nesting cichlids, including juveniles of more valuable tilapiines (Turner, Tweddle & Makwinja, 1995). This impact is seasonal and may be site-specific. The bans on beach seining recently imposed in Lakes Malawi and Tanganyika may deprive villages of an important opportunistically deployed component of a livelihood portfolio. And all on the basis on untested assumptions about detrimental fishery impacts, and over-generalization about impacts on biodiversity.

One of us (EHA) and co-workers in Malawi are currently engaged in studies to understand strategies pursued by fishers targeting small pelagic fish in Lake Malawi (mainly *usipa* and *utaka*). Mobility and livelihood diversification are emerging as key factors enabling fishers to 'track' resource fluctuations in time and space. These strategies are well established and accepted around the Lake shore villages, where migrant fishers are seldom regarded as problematic, but are rather seen to bring benefits in the form of increased trade and economic activity in lake shore villages. Reciprocal access to fishing 'beaches' for landing catch and mending nets etc., may be more important to fishing-dependent communities than claims for territorial exclusivity of the type encouraged by efforts to promote community-based management (e.g. Sholtz *et al*, 1998). Such studies are urgently required around the other African Great Lakes, if the laudable move towards co-management is to develop models for fishery management that reinforce sustainable livelihood strategies. There is a danger that the idealized concepts of village-owned fishing grounds currently being promoted don't fit with the ecology of the fish or the livelihoods of the fishers.

3. DISCUSSION

The livelihoods analyses at Lake Chad and in the Inland Niger Delta both illustrate how their fisheries cannot be regulated in isolation from the socio-economy which fishers are part of. Although the transition of labor and capital from fishing to other sectors of the economy may be feasible in large industrialized economies where fisheries managers have attempted to remedy overcapitalization in the fishing sector, Sarch (1996) and Davies (1996) have shown that this is not the case in two of Africa's most important inland fisheries. In the Inland Niger Delta persistent drought has impoverished all livelihood groups and fishing has provided an important safety net for a significant minority of the population. Although fishing families at Lake Chad have been able to respond to lake level fluctuations by diversifying into farming, fishing continues to play a crucial

role in providing household income outside the agricultural season. Families which fish either on the Nigerian shore of Lake Chad, the shores of Lake Chilwa or in the inland Niger Delta are relatively better off than those who do not. The Lake Chilwa and Niger Delta cases demonstrate that such coping and optimization strategies existed prior to introduction of both State-led and co- management systems. Recent information on the impact of fisheries management measures on livelihoods is lacking. Finally, the evidence for climate-induced fluctuations in the fisheries for small pelagic fish in the African Great Lakes indicate that the management of these stocks also needs to be informed by an understanding of how fishers, distribution chains and markets cope with fluctuating supplies.

Fisheries management strategies which focus on optimal catch rates ignore both the role which inland fisheries play in the livelihoods of many Africans and the inherent stock fluctuations which have shaped such livelihood strategies. Proposals to manage these fisheries need to be based on a better understanding of these livelihood strategies. In fisheries where exploitation has little demonstrable impact on fish stocks, and productivity is closely linked with climate, it is not useful to talk about sustainable yields, or limited access to limit fishing effort. Neither are community-based or co-managed territorial use rights, in the form of geographically fixed territories, useful for fisheries management in areas where lake or floodplain levels are highly variable, or where fishers have to track mobile pelagic resources to sustain their catch rates.

It is relatively straightforward to outline what management approaches should not be taken, less easy to identify appropriate management support for fluctuating fisheries. While removing unnecessary impediments to sustainable opportunistic exploitation strategies is one important step, it may not be enough, given the increasing pressures on resources and livelihoods in Africa. Common property institutions that have evolved mechanisms, such as reciprocal access agreements between migrants, should be considered more appropriate than territory-based approaches as a way of implementing any effort-limitations deemed necessary. Formal recognition, in national policy and legislation, of the legitimacy of opportunistic livelihood strategies, coupled with active removal of barriers to mobility and livelihood diversification would seem to be appropriate policy responses at national or district level. Active support for livelihood diversification (not the same as providing incentives for people to diversify out of fishing altogether) is another management option.

The apparently greater importance of climate, relative to fishing, in driving the dynamics of fish stocks in many of Africa's inland waters also suggests that effort should be redirected at protecting wetland functions and broader ecosystem integrity and away from trying to manage fish stocks for sustainability. Management needs to lose its preoccupation with stability and gain an increased appreciation of resilience.

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5. REFERENCES

Agnew, S. (1979) 'The People and the Land' pp 309-342 in: Kalk, M., A.J. McLachlan and C. Howard-Williams, editors *Lake Chilwa: Studies of Change in a Tropical Ecosystem.* Dr. W. Junk, The Netherlands.

Agnew, S. & C. Chipeta (1979) 'Fishing and Fish-trading: Socio-economic Studies' pp 343-368 in *Ibid*.

Allison, E.H. & F. Ellis (forthcoming) 'The Sustainable Livelihoods Approach and Management of Small Scale Fisheries'

Allison, E. H., G. Patterson, K. Irvine, A. B. Thompson and A. Menz (1995). The pelagic ecosystem. pp 351-377. In: A. Menz (ed.), *The Fisheries potential and productivity of the pelagic zone of Lake Malawi/Niassa*. Natural Resources Institute, Chatham,

Bailey C; D Cycon and M Morris (1986) 'Fisheries Development in the Third World: The Role of International Agencies' *World Development* 14(10/11): 1269-1275, 1986

Bailey C and S Jentoft (1990) `Hard choices in fisheries development' *Marine Policy* **14**(4): 333-344

Beddington, J. and R.M. May (1977) 'Harvesting natural populations in a randomly fluctuating environment.' *Science* 197: 463-465.

Bonzon A and C Breuil (1992) 'Priorites pour l'Amenagement et la Planification du developpement des peches continentales dans la region du Sahel.' FAO Fisheries Report No 481 FIPP/R481. FAO: Rome

Chambers R and G Conway (1992) 'Sustainable rural livelihoods: practical concepts for the 21st century' *IDS Discussion Paper 296* Brighton, UK: Institute for Development Studies

Chipeta, C. (1972) A note on Lake Chilwa Cyclic Changes. *Journal of Interdisciplinary Cyclic Research* 3: 87-90.

Chirwa, W.C. (1998) The Lake Malombe and Upper Shire River fisheries co-management programme: An assessment. Pp 61-77 in: Normann, A.K., J.R. Nielsen & S. Sverdrup-Jensen (1998) *Fisheries Co-management in Africa*. Institute for Fisheries Management & Coastal Community Development.

Cycon D (1986) 'Managing Fisheries in Developing Nations: A Plea for Appropriate Development' *Natural Resources Journal* 26(1): 1-14

Davies S (1996) *Adaptable Livelihoods. Coping with Food Insecurity in the Malian Sahel* London: Macmillan

Doherty RM; M Hulme and C G Jones (1999) A gridded reconstruction of land and ocean precipitation for the extended tropics from 1974 to 1994. *International Journal of Climatology* 19: 119-142

Drijver C A and M Marchand (1985*) Taming the Floods. Environmental Aspects of Floodplain Development in Africa.* Center for Environmental Studies, University of Leiden: Leiden

Duran J R (1980) 'Evolution des captures totales (1962-1977) et devenir des pecheries de la region du lac Tchad' *Cahiers ORSTOM series Hydrobiologie* **13**: 93-111

Ellis F (2000) *Rural Livelihoods and Diversity in Developing Countries.* Oxford University Press.

Environmental Affairs Department (2000) Lake Chilwa Wetland – State of the Environment. Environmental Affairs Department, Malawi Government, June 2000.

FAO (1993) 'Fisheries Management in the south-east arm of Lake Malawi, the Upper Shire River and Lake Malombe, with particular reference to the fisheries on chambo *(Oreochromis spp*)'. CIFA Technical Paper No. 21. FAO, Rome.

FAO (1996) 'Fisheries and Aquaculture in Sub-Saharan Africa: Situation and Outlook in 1996' *FAO Fisheries Circular No. 922 FIPP/C922*. FAO: Rome

Geheb, K. & T. Binns (1997) 'Fishing Farmers or 'Farming Fishermen'? The quest for household income and nutritional security on the Kenyan shores of Lake Victoria' *African Affairs* 96: 73-93.

Gibbon, P. (1997) 'The Poor Relation: A Political Economy of the Marketing Chain for Dagaa in Tanzania'. *CDR Working Paper* 97.2, Copenhagen, Denmark.

GOM (1999) Resource Report, 1999. Fisheries Department, Government of Malawi.

IMF (1997) 'Nigeria -Statistical Appendix' In *IMF Staff Country Report No 97/1* Washington D C: International Monetary Fund

Ita (1993) *Transactions of the Inland Fisheries Laws and Regulations Drafting Committee, 25th April 1985* New Bussa, Nigeria: National Institute for Freshwater Fisheries Research

Kalk, M., A.J. McLachlan and C. Howard-Williams, editors (1979) *Lake Chilwa: Studies of Change in a Tropical Ecosystem.* Dr. W. Junk, The Netherlands.

Kalk, M. (1979) 'Focus on Social Problems' pp 417-432 in *ibid.*

Kone A (1985) 'Traditional Fishing Rights in the Central Delta of the Niger and the Lake Region: Conflicts and Recommendations with a view to Equitable and Rational Management of Fishery Resources' Pages 95-103 in *FAO Fisheries Report No 360* Rome: FAO

Krings M (1998) 'Migrant Hausa Communities in the Lake: Preliminary Research Notes from Lake Chad.' *Borno Museum Society Newsletter* 34 &35: 31-41

Lae, R. (1992) 'Influence de L'hyrdobiologie sur l'evolution des pecheries du delta Centrale du Niger, de 1966 a 1989'. *Aquatic living Resources* 5: 115-126.

Lancaster, N. (1979) 'The Changes in the Lake Level' pp 41-58 in: Kalk, M., A.J. McLachlan and C. Howard-Williams, editors *Lake Chilwa: Studies of Change in a Tropical Ecosystem.* Dr. W. Junk, The Netherlands.

Lele (1991) 'Sustainable Development: A Critical Review' *World Development* 19(6): 607-621

Mahon R (1997) 'Does fisheries science serve the needs of managers of small stocks in developing countries?' *Canadian Journal of Fisheries and Aquatic Sciences* **54**: 2207-2213

Moorehead R (1989) 'Changes taking place in Common Property Resource Management in the Inland Niger Delta in Mali' Ch 15 in F Berkes (Ed) *Common Property Resources: Ecology and Community-Based Sustainable Development* London: Bellhaven

Moss, B. (1979) 'The Lake Chilwa Ecosystem – A limnological overview' pp 399-416 in: Kalk, M., A.J. McLachlan and C. Howard-Williams, editors *Lake Chilwa: Studies of Change in a Tropical Ecosystem.* Dr. W. Junk, The Netherlands.

Moss, B. (1992) Uses, abuses and management of lakes and rivers. *Hydrobiologia* 243/244: 31-45.

Neiland A E and I Verinumbe (1990) 'Fisheries Development and Resource-Usage Conflict: A case-study of deforestation associated with the Lake Chad Fishery in Nigeria' *Environmental Conservation* **18**(2): 111-117

Normann, A.K., J.R. Nielsen & S. Sverdrup-Jensen (1998) *Fisheries Co-management in Africa*. Institute for

Fisheries Management & Coastal Community Development.

Olivry J-C; A Chouret; G Vuillaume; J Lemoalle and J-P Bricquet (1996) *Hydrologie du lac Tchad* ORSTOM editions: Paris

Phipps, P. (1973) 'The 'Big' Fishermen of Lake Chilwa. A preliminary study in entrepreneurism in rural Malawi. In: M.E. Page, *Land and Labour in Rural Malawi*. *Rural Africana* 21: 39-48.

Pitcher, T.J. & Hart, P.J.B, editors (1995). *The Impact of Species Changes in African Lakes.* Chapman & Hall, London.

Plisnier, P.-D. (1997) Climate, Limnology and Fisheries Changes in Lake Tanganyika. FAO/FINNIDA: Research for the Management of the Fisheries on Lake Tanganyika. GCP/RAF/271/FIN-TD/72 (available from ftp://ftp.fao.org/fi/ltr/TD72.PDF).

Quensière J (Ed) (1994) *La Pêche dans le Delta Central du Niger: approche pluridisciplinaire d'un système de production halieutique* Paris: Editions ORSTOM

Sarch M-T (1996) 'Fishing and Farming at Lake Chad: Overcapitalization, Opportunities and Fisheries Management' *Journal of Environmental Management* 48: 305-320

Sarch M-T (1999) *Fishing and Farming at Lake Chad: A Livelihood Analysis.* PhD Thesis, School of Development Studies, University of East Anglia, UK

Sarch M-T and CM Birkett (2000) 'Fishing and Farming at Lake Chad: Responses to Lake Level Fluctuations' *The Geographical Journal* 166(2)

Sarch M-T (2000) Institutional Evolution at Lake Chad: Traditional Administration and Flexible Fisheries Management' Paper to be presented to the Tenth Conference of the International Institute for Fisheries Economics and Trade, Corvallis, Oregon, 10 - 14 July, 2000

Sharp, G.D. (1995) . It's about time: new beginnings and old good ideas in fisheries science. *Fisheries Oceanography* 4: 324-341.

Shepherd, J.G. (1991) Stability and the objectives of fishery management. MAFF Laboratory Leaflet No. 64. Directorate of Fisheries Research, Lowestoft, U.K.

Sholtz, U., Njaya, F.J., Chimatiro, S, Hummel, M., Donda, S. & Mkoko, B.J. (1998) Status and Prospects of Participatory Fisheries Management Programs in Malawi. Pp 407 – 425 in T. Petr (editor), *Inland Fishery Enhancements.* Fisheries Technical Paper 374, FAO, Rome.

Sparre, P. & Venema, S.C. (1992). Introduction to tropical fish stock assessment. FAO Fisheries Technical Paper 306/1, Rome.

Stauch A (1977) 'Fish Statistics in the Lake Chad Basin during the Drought (1969-1976)' Cahiers *ORSTOM série Hydrobiologie* **X1**(3): 201-215

Talling, J.F. & Lemoalle, J. (1998*). Ecological Dynamics of Tropical Inland Waters*. Cambridge University Press.

Tomich T P; P Kilby and B F Johnston (1995) *Transforming Agrarian Economies: Opportunities Seized, Opportunities Missed* Ithaca, New York: Cornell University Press

Turner, G.F., D. Tweddle and R. Makwinja (1995) 'Changes in demersal cichlid communities as a result of trawling in southern Lake Malawi. In: T.J. Pitcher & P.J.B. Hart (eds). *The Impact of Species Changes in the African Lakes.* Chapman & Hall, London.

Tweddle, D. and D.S.C. Lewis (1990) ' The biology of usipa (*Engraulicypris sardella*) in relation to fluctuations in productivity of Lake Malawi and species introductions' pp 67-72 In: T.J. Pitcher & C.E. Hollingworth, editors, *Collected Reports on Fisheries Research in Malawi.* Occasional Papers Vol. 1., Overseas Development Administration, London.

Tweddle, D. & J.H. Magasa (1989) 'Assessment of multispecies cichlid fisheries of the Southeast Arm of Lake Malawi, Africa.' *Journal du Conseil International pour l'Exploration de la Mer* 45: 209-222.

World Bank (1989) *Nigeria. Strategy for Agricultural Growth* Western Africa Agriculture Operations Division Main Report No 7988-UNI Washington D C: World Bank

Legislation

1992 Federal Government of Nigeria Inland Fisheries Decree Supplement to the Official Gazette Extraordinary No 75, vol. 79, 31st December 1992