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Overcapitalization,  
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management**

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# **Fishing and Farming at Lake Chad: Overcapitalization, Opportunities and Fisheries Management**

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## **Abstract**

Overcapitalization is one way in which fishing is said to exert a negative externality on the wider economy. Resources invested in fishing could be invested more productively in other sectors of the economy. The logical solution is the shift of resources, in particular scarce capital, from fishing to more profitable sectors. This paper examines the rural economy at Lake Chad and the implications from the results of a socio-economic survey of fishing households, for potential fisheries management measures, in particular those which would limit or reduce the level of resources invested in the Lake's fishery. Survey results demonstrate a close link between the farming and fishing activities of many households and suggest that the integration of fishing and farming necessitate consideration of the inter-sectoral impacts of potential fisheries management measures.

key words: Fisheries Management, Overcapitalization, Lake Chad, Nigeria

## **Introduction**

A recent review of world fisheries estimated that the annual operating costs of the World's fishing fleets exceeded the value of their catch by US\$23,000 million in 1989, even before any consideration of their capital costs (FAO, 1993). This phenomenon has been described as overcapitalization and is said to be symptomatic of the market failure inherent in fisheries where an economic rent is not charged for their use and as a consequence, marginal production costs exceed the marginal value of the fishery. This apparent inconsistency is often attributed to the absence of property rights.

Overcapitalization is one way in which fishing is said to exert a negative externality on the wider economy. Resources invested in fishing could be invested more productively in other sectors of the economy (Clark, 1977; Johnston, 1992). The logical solution is the shift of resources, in particular scarce capital, from fishing to more profitable sectors. A related approach concerned with reduction of resources invested in fishing, is being utilized in an increasingly wide range of fisheries, falling under both local and state management systems, with a variety of associated property rights. Acheson (1975) documents how groups of lobstermen in Maine agreed to limit the number of traps set in their territorial waters. Individual transferable quotas have been allocated to Icelandic fishing vessels with a history of fishing in an attempt to prevent the entrance of further capital to the Icelandic fishery (Arnason, 1994). In both these situations the productivity of the capital or equipment invested in the fisheries has improved dramatically. However, the impacts of deliberate shifts of capital on the wider economy have received scant attention, despite the benefits heralded.

This paper does not address this issue in any comprehensive sense, rather it examines the rural economy at Lake Chad and the implications from the results of a socio-economic survey of fishing households, for potential fisheries management measures, in particular those which would limit or reduce the level of resources invested in the Lake's fishery. Survey results demonstrate a close link between the farming and fishing activities of many households and suggest that the integration of fishing and farming necessitate consideration of the inter-sectoral impacts of potential fisheries management measures.

## **Fisheries Management, Externalities and Overcapitalisation**

The management of natural resources has received increasing attention since Scott-Gordon's 'Theory of a Common Property Resource' which he published in 1954. Two concerns have dominated thinking on natural resources, sustainability and property rights. Causal links are thought to exist between the two. Following Hardin's essay on the 'Tragedy of the Commons', a clear framework for analysing property rights developed which distinguished open access resources (*res nullius*) from common property (*res communis*) and the alternatives of state property (*res publica*) and private property which Hardin advocated (Hardin, 1969; Bromley and Cernea, 1989). Further theories have been developed which have been used to explain the development of various property regimes. Demsetz (1967) linked the development of increasingly exclusive property regimes with the costs of policing the resource in question while Runge (1987) and Jodha (1992) associate common ownership with survival strategies of the poorest, whereas Quiggin relates common property to equality amongst resource users. While these theories have been applied to a range of natural resources including rangelands, forests and fisheries, this paper considers one aspect of economic theory, overcapitalization, and its application to fishing resources.

Johnston (1992) examines fisheries management strategies within the economies of developing countries at a conceptual level. He considers the externalities associated with fishing. An externality is specified as the direct effect of an economic decision on another economic agent, which was not considered in the decision process. He identifies two kinds of externality which determine the nature of fisheries development. The first occurs within the fishery where the harvest activity of each fisherman "represents a cost imposed by each fisherman on all the other fishermen affecting their current and/or future harvesting success" (p4). The second type of externality is that "which operates between the fishery and other sectors of the economy" (p viii). Johnston further subdivides externalities, whether intra-fishery or inter-sectoral, into real externalities or pecuniary externalities. Pecuniary externalities concern the impact of individual decisions on market prices, whereas real externalities directly effect the production or satisfaction levels of other producers or consumers. This paper primarily considers the real inter-sectoral externalities of potential fisheries management measures.

An example of an intra-fishery externality is where each fisherman's catch reduces the fish population and as a result decreases the chances of other fishermen. Johnston calls this a 'stock externality' (p4). Underlying this externality is said to be a lack of property rights which limit the ability of individual fishermen to determine how the fishery is exploited.

A further and related example of an externality is a 'crowding externality', where there are many fishing boats operating in a fishing ground, as each new fishing vessel enters the fishery, the catch efficiency of each falls and the costs associated with each catch increase. This process is known as overcapitalization and involves both the intra-fishery 'stock' externality described above, and an inter-sectoral externality. The inter-sectoral aspect of overcapitalization concerns the opportunity cost of the resources invested in the fishery and the is the conceptual focus of this paper.

The inter-sectoral externality associated with overcapitalization arises through the opportunity cost of the capital and/or labour invested in the inefficient fishing boats. If the money (and time) invested in the inefficient fishing boats were spent (employed) in another activity, returns could be higher (Johnston, 1992: p28) and "overall employment might be increased, leading to a general rise in social welfare" (Clark, 1977: 3). Underlying this situation is a market failure, as each new boat does not have to pay to enter the fishery, the financial costs it incurs while fishing (the fishermen's time and the cost of the boat) do not represent the economic costs of the fishing boat, which also includes the value of the fish which are caught by that boat and are then unavailable to others (see Scott-Gordon, 1954).

Management strategies have focused on limiting the resources invested in fishing, while maintaining a sustainable level of output, thus increasing the returns to resources invested in fishing. The anticipated benefits of such strategies include not only improved returns to fishing, both in a financial and economic sense, they also include the reduction in the exploitation of the fishery to levels which are more likely sustainable and the expected benefit that such a strategy will result in the shift of resources from the fishery to more productive employment elsewhere and bring about a general improvement in the wider economy. This last potential benefit of such management strategies is the focus of the paper's discussion of Lake Chad.

Attempts have been made to limit the resources invested in various fisheries, both in fisheries into which entry was more or less free, for example the fisheries within the Iceland Economic Exclusion Zone and the British Columbia Salmon fishery where the fisheries were state property (*res publica*), and in situations where the fishery was the property of local communities (*res communis*), although in theory (*de jure*), state property (*res publica*). An example of the latter are the lobster 'fiefdoms' of Maine where Lobster 'fief's excluded outsiders from the Lobster fishery (Acheson, 1975; Schlager and Ostrom,

1992). Both in Iceland and Canada, state regulations have allocated catch quotas to a limited number of fishing vessels (Arnason, 1994; Fraser, 1979). The allocation of a quota and its size were decided on the basis of the vessels past experiences in the fishery. In Maine, fishing communities themselves have agreed to limit the number of lobster pots set. In Iceland and Maine, this strategy has been successful in increasing the catch per unit effort and thus efficiency of investments in fishing. However, in other situations, for example the British Columbia Salmon Fishery, success was not so forthcoming.

As Johnston notes, efforts to manage fisheries have been dominated by a concern to resolve intra-fishery externalities. Studies of the various schemes and management plans reflect this and scant attention has been directed towards their impacts on the wider economies in the regions where they have been implemented (Acheson, 1975; Arnason, 1994; Flam & Storoy, 1982; Fraser, 1979; Matthews & Phyne, 1988;). Many of these studies focus on the management efforts of developed nations. Studies of Alaskan entry limits on fishing do consider their wider social impacts and have found that the dominance of fishing in the Alaskan socio-economy has made it particularly sensitive to fisheries management issues (Adasiak, 1979). Given, the vulnerability of the economies in developing nations, such as those that surround Lake Chad, the impacts of fishery management measures on the wider local economies deserve particular attention.

The status of the Lake Chad fishery is not clear and whether the activities of the Lake's fishermen are exerting 'stock' or 'crowding' externalities on each other has not been established. However, it is certain that the fishery plays a major role in the economy of the Lake Chad Basin. This paper utilizes the results of an initial year of socio-economic research in the Nigerian sector of the Lake Chad basin to speculate on the impacts of potential fisheries management measures on local livelihoods. The paper utilizes one part of the wide body of theory available to examine natural resource management. It is anticipated that as research with the communities of the Lake Basin continues, it will be possible to place the fisheries of Lake Chad within a wider conceptual context.

## **Research at Lake Chad**

The savanna latitudes contain some of the most productive inland fisheries in Sub-Saharan Africa. Alongside farming, fisheries are an important component of the regional economy, they provide employment, income, trading opportunities and a

valuable source of protein. The perception that heavy exploitation of inland fishery resources threatens a loss of socio-economic benefits to local communities and their governments, has prompted the Traditional Management of Artisanal Fisheries research project (TMAF). The project's ultimate objective is to investigate the possibilities for designing more effective management systems for the fisheries of the northern savanna zones of Sub-Saharan Africa using a community based approach.

This paper reports results from the initial phase of TMAF research in 1993 which investigated the socio-economies of fishing communities in three study regions in Northern Nigeria<sup>i</sup>. This paper is based on the first year's study of the Lake Chad study region. This was conducted in three stages: firstly, exploratory appraisals of fishing villages in each study region were conducted with key fishing personalities and community leaders in each study region; secondly, the research team met with village leaders and discussed a range of issues including village structure, occupations, sources of income, work patterns and recent changes in the community; and thirdly, a multi-stage random sample survey of household heads was conducted.

The 1993 sample survey interviewed 484 households based in 9 randomly selected fishing villages at Lake Chad. The sample was estimated to represent 1.8% of a total population of 25000 sedentary households in the study region. At this initial stage of the research, the seasonal influx of migrant fishermen was not represented. Households were sampled from the whole village in order to gauge the importance of fishing as a source of household income. Very few (5%) households relied entirely on fishing income and the majority (59%) earned no income from fishing. However, a significant proportion (36%) earned income from fishing and farming and it is the links between the fishing and farming activities of these households which has prompted this paper.<sup>ii</sup>

## **Lake Chad**

Lake Chad lies within the Sahel Savanna Zone of Sub-saharan Africa. The Lake Chad study region is located between latitudes 11° and 13° N and falls along the Nigerian, western shore of the Lake. The Nigerian section of the Lake Chad Basin is located at the country's north-east extreme. This zone is the most northerly in Nigeria and is characterized by a hot dry climate with a marked rainy season of 3 to 5 months from June to October. Rainfall is extremely variable, mean annual rainfall is less than 500mm,



with a monthly peak of 100-300mm in September. The Lake is characterized by its shallow depth and fluctuating surface area. The shallow depth accounts for large fluctuations in surface area in response to small increases or decreases of flow into the Lake. Lemoalle (1991) reports a difference in surface area of 5000km<sup>2</sup> between 1975 and 1989 with a corresponding difference in water level of only 2 meters. Since 1973, rainfall in the Sahel Savanna Zone has been reduced and the surface area of the Lake has been reduced sharply (Lemoalle, 1991).

There is great ethnic diversity amongst the people of the Lake Chad. In the past the area was farmed by the *Kanuri*, while the *Yedina* dominated the fishery and the *Shuwa Arabs* and *Fulanis* herded cattle and camels. Since the 1970s, the Lake has attracted people from all over Northern Nigeria, Mali, Chad and Niger, in particular the *Hausa*. This migration was influenced by the fishing opportunities provided by the introduction of nylon lines and nets (Sikes, 1973; Van Meeren, 1980). There is also a seasonal influx of migrant fishermen during the peak fishing period in December, January and February. The population of certain villages will double during this three month period. The recession of Lake Chad since 1973, while restricting the fishing opportunities of immigrants to the area, has revealed extra land, much of which is seasonally flooded and exhibits beneficial soil-moisture characteristics.

The cropping systems of the fishing and farming communities of the Lake shore are based on the seasonally revealed lake bed. Cropping follows the receding Lake, which fluctuates between its maximum extent in November/December and its minimum at the onset of the rains in June. As the Lake recedes, moist vertisols and later sandy loams are revealed. This land is farmed intensively with a relay of crops which are dominated by maize and beans. Towards the end of the dry season, pumpkins and melons are grown utilizing the remaining soil moisture. The arrival of the rains in June is an added bonus which farmers use to grow an early maturing bean crop before the land is submerged by the expanding lake. Less than half the households interviewed in 1993 kept livestock. Those that did kept poultry and small ruminants. (see Figure 1)

The majority of fishing is done as the lake rises following the end of the agricultural season in November. The peak fishing period occurs during December, January and February. Fishing activity decreases as the Lake recedes in March, when farmers take advantage of the moist lake bed. Traps and gill nets are the most frequently used gears and together account for 63% of the gears that are used.

The fluctuating and multinational nature of the Lake make accurate estimates of fish production difficult to assess. Extrapolating from figures for the fish sold in the two key, lake-side markets, Sagua (1991) estimates an average annual production of 56000 tons (fresh weight equivalent) between 1986 and 1989. Figures calculated by Durand (1980) for the 1970 to 1977 period allow a comparable estimates for average annual production during this period of 243000 tons, which at the least, suggest the considerable fluctuations in the lacustrine environment and could indicate a serious decline in fish production.

#### ACCESS TO LAND AND WATER

Under Nigerian law, the land and the lake are both state property, although there is provision for individuals to register their occupation of specific parcels of land. However, throughout Northern Nigeria, farmers have exercised usufructuary rights to the land that they farmed and in the more densely populated areas there is an active market for land (Hill, 1972). The situation concerning inland water-bodies is less clear and whether state and/or traditional or local jurisdiction operates at a particular water-body or fishing ground depends both on the season and the local circumstances.

Since the drought of the early 1970s, the maximum extent of the Lake has decreased considerably. There is now several kilometres between the mean 1972 shoreline and the current shore. The overall recession of the Lake has meant that much of the land under crops in the recent agricultural seasons is in effect, new land with no history of ownership or land use rights. However, those who have accessed this 'new' land have done so at the discretion of the traditional community leaders, whose area of jurisdiction has been extended into the Lake bed from the old shoreline.

The recession of the Lake has also meant that there are no long-standing fishing rights associated with specific fishing grounds. When the Lake is at its maximum flood, entry into the fishery is open to anyone with the ability, time and gear (see Table 1). However, as the flood recedes, residual pools and channels are left behind for up to 3 months before they too dry up. Access to the fishing in these water-bodies is often restricted.

#### **Results**

The results in this section are discussed in three parts. The first presents a socio-economic profile of the sedentary households in the study region. This illustrates the importance of fishing and farming in the local economy and reveals the two groups of households which are the focus of this paper: 'fishing-farming households' and 'mainly farming households'. The second part considers the links between fishing and farming in fishing-farming households and the third part examines the differences between the two groups of households.

#### A SOCIO-ECONOMIC PROFILE OF HOUSEHOLDS AT LAKE CHAD

Farming and fishing are important activities in the economy of the Nigerian sector of the Lake Chad Basin. Fishing and farming were the two main income earning activities of the sampled households (see Tables 2 and 3). Nearly every household interviewed had an income from farming and approximately a half of these also earned an income from fishing. This paper has used two groups of households to examine the interactions between fishing and farming: households which earned an income from both farming and fishing - 'fishing-farming households'; and farming households which do not earn an income from fishing - 'mainly farming households'. Together these groups included 95% of the households included in the survey.

Tables 2 and 3 demonstrate the importance of fishing and farming to the regional economy. Other activities, in particular trading and labouring, are engaged in, however these account for 16% or less of mean household income.

The survey did not reveal great differences in household structures between either group at Lake Chad (Table 4). However, households were smaller and younger than those investigated in other survey regions. This is partly explained by recent contractions of Lake Chad which have exposed large areas of lake bed. Communities have moved into this area both to take advantage of the farming opportunities provided by the moist soils of the Lake bed and in order to be closer to the Lake itself for fishing.

#### FISHING AND FARMING IN FISHING-FARMING HOUSEHOLDS

A combination of exploratory appraisals and group discussions revealed much about how households allocated their resources. When asked about their different sources of income, many discussion groups explained that farming or fishing were interlinked, harvest sales would be used finance fishing and cash from catch sales would be used to purchase inputs for farming. Any income earned from fishing was associated with income from farming which had been invested in fishing, similarly agricultural output was in part attributed to the ability to invest in hiring labour, purchasing fertilizer and insecticides provided by sales of fish. These discussions built up a picture of capital being cycled through fishing and farming enterprises through the course of the year.

The survey revealed that the majority of fishing households in each study region fish during specific seasons. At Lake Chad, 90% of [fishing] households fished during the rising and/or receding flood. Only 2% of sedentary households fished throughout the year. Seasonal calendars constructed with village leaders and household heads during group discussions, confirmed that the seasonal nature of fishing. The peak fishing season comes at the end of the rainy season as the flood rises and recedes and farm harvesting is over (see Figure 1). Further discussions revealed that household members participated in both fishing and farming, switching from one to the other on a seasonal basis. This enables fishing-farming households to 'cycle' both cash and household labour from fishing to farming and vice-versa.

#### FISHING-FARMING AND MAINLY FARMING HOUSEHOLDS COMPARED

The survey recorded important differences between the two household groupings, households which fished and farmed, 'fishing-farming households', and households which farmed but did not fish, 'mainly farming households'. The extent of differences between the groups varied according to the variable recorded. Differences in household structure were minimal as were differences in the type of land cultivated whereas there were large differences in levels of agricultural output between fishing-farming and mainly farming households. Households which fished as well as farmed produced more agricultural output, hired more labour and were more likely to own livestock. Although mainly farming households depended on farming for a larger proportion of their income, they produced less farm output than fishing and farming households.

Table 5 shows the average output achieved by fishing-farming and mainly farming households. For the majority of crop types grown, mainly farming households produced

less than fishing-farming households. There was a small exception to this where mainly farming households grew more fruit and tree crops (usually watermelons), than farming and fishing households.

Table 6 shows the proportion of crops undertaken by interviewed households, which used each land type. The difference between mainly farming and fishing-farming households was small.

Table 7 illustrates differences in the proportion of crops grown by interviewed households which utilized hired labour. Fishing and farming households at Lake Chad employed hired labour on a greater proportion of the crops they grew than mainly farming households. Disaggregation of overall figures into the proportion of crops in each crop-type category that utilized hired labour illustrates important differences in the level of labour utilization between fishing-farming and mainly farming households. Fishing-farming households hired more labour than their mainly farming neighbours in nearly all crop types categories and this corresponds with their higher production levels of each crop type.

Table 8 shows that a greater number of fishing-farming households kept livestock than their mainly farming neighbours. An overall impression from Tables 5 to 8 is that mainly farming households tended to produce farm output than fishing-farming households.

#### MIGRANT FISHERMEN

Discussions with community leaders and the process of constructing a sampling frame revealed that during the fishing season, the population of certain villages was swollen to double its non-fishing season size. The sampling procedure was adjusted to accommodate for this and the results of random sample selection included one such village. However, the research on which these results are based was undertaken in April, May and June 1993. As can be seen from the seasonal calendar in Figure 1, the survey period fell after the end of the fishing season. This has an important implication for the survey results, notably the unavailability of migrant fishermen for interview. The seasonal fluctuations of the Lake combined with the lack of transport infrastructure mean that full-time fishing necessitates a migratory livelihood strategy. Thus in representing the sedentary population of the Lake Basin, the survey results under-represent the number of households which rely on fishing for the majority of their income. The impact of this

for the survey results is almost certainly to underestimate the importance of fishing to the local economy and thus underestimate the potential consequences of fisheries management measures on the economy which are discussed in the following section.

Future research is planned to learn about the role of migrants in the fishery of Lake Chad and any policy recommendations will be made in the light of this

## **Discussion**

These results suggest three main findings. Firstly, that fishing and farming dominate the economy at Lake Chad, at least in the Nigerian sector of the lake. Other economic activities are important, for example labouring and trading and livestock rearing, however these make a small contribution to the incomes of most households. The second finding is that a large majority of the sedentary fishing households interviewed also derive an income from farming. There are important links between the fishing and farming activities of these households, both in terms of the seasonality of the environment which determines the viability of either activity and in terms of household resource allocation decisions which are made between them. These links have important implications for the opportunity costs of resources invested in fishing. Finally, there appear to be important differences in agricultural output between farming households which fish and those which do not fish. Households which farm and fish produce more, this may be attributed to their ability to cycle fishing profits into farming and farming profits into fishing. This has important inter-sectoral and inter-regional implications for fisheries management measures which seek to restrict the capital invested in fishing.

The first part of the discussion considers the links between farming and fishing in fishing households and examines their implications for the opportunity costs of the resources invested in fishing. Fishing and farming are linked in two ways. The results show that fishing-farming households allocate their resources between the two activities. At a certain stages in the year households will decide to switch labour from farm activities to fishing (see Table 1).

When such decisions are made is influenced by the second important link between fishing and farming, the seasonality of the environment. Many of the villages that participated in the survey were surrounded by water during the peak flood. The results show that the

vast majority (circa 90%) of cropping was undertaken on seasonally flooded land surrounding each village and conversely, very little cropping was undertaken on land that was not flooded at some stage. As the annual flood rises at the end of the rains, households are left with little choice, areas which do not flood are either residential or too dry - a tiny proportion of cropped land was irrigated and it is unlikely that any available upland with residual soil moisture would not have been cropped during the rains. Households can invest resources in fishing their flooded environment or not. The survey results show that an important number of farming households do not invest in fishing and rely mainly on farming. Although these households do have other sources of income, these provide a small part of their income (16%) and suggest that during the flood, opportunities other than fishing are severely limited (see Table 2). This implies that the opportunity cost of resources invested in fishing are low.

When the flood recedes, the choice of livelihood is rather better. Farming can be resumed on the moist soils revealed by the receding lake or fishing continued by following the Lake. While mainly farming households will resume farming and full-time fishing households will migrate with the lake, how fishing-farming households allocate their resources is not as clear. At this stage in the year, however, the opportunity cost of fishing begins to rise.

So far these scenarios have not considered the market failure described at the beginning of this paper. The failure is the externalizing of the value of the fishery from individual decisions about how and when to fish. This externality has two aspects, firstly that it encourages overcapitalization because it underestimates the costs involved fishing. Where a maximum sustainable yield is exceeded, this can lead to overfishing and a decrease in catches. The returns from the capital invested in fishing, which may cover the fisherman's costs, are not high enough to cover the real cost of his fishing which also includes the value of the fish. The second, inter-sectoral aspect of the externality is that if that capital were invested elsewhere, in other sectors of the economy, returns would be higher. This assumes that there are other opportunities for investment, in effect that there is an opportunity cost.

The results discussed here illustrate how at certain times of the year at Lake Chad, there are few other alternatives for investment, which implies the opportunity cost of capital and labour invested in the fishery is minimal. Furthermore, very limited access to banks which offer low interest rates coupled with rapid rates of inflation could mean that

opportunity costs were nil. Similarly, high rates of pest infestation of stored produce also serve to reduce the opportunity costs of capital invested in fishing.

Previous management efforts which have sought to rectify overfishing have focused on limiting the capital invested in certain fisheries. These have had success in increasing the returns to the capital invested in fishing and to some extent have addressed the first aspect of overcapitalization (Acheson, 1975; Arnason, 1994). However, few management measures have addressed the issue of charging a rent for access to the fishery which represents its economic value, and fewer still have examined the impact of management measures on the wider economy. While it can be argued that calculating the correct level of such a rent to charge would be uneconomic in itself, it is possible to examine the inter-sectoral impacts of fisheries management measures. How desirable this latter consideration is will depend on the economy in question. In certain developed industrial economies, it can be argued that the contribution of fishing is small relative to other industries and the effects of fisheries management measures on the wider economy would be limited and difficult to measure. However, where fishing plays an important role in the local economy, limited entry measures can have a significant impact on local livelihoods as they have in Newfoundland (Proulx, 1994). Here it is argued that fishing plays a major role in the regional economy at Lake Chad and that the inter-sectoral impacts of potential fisheries management measures are a valid consideration.

The absence of other income earning opportunities in the Lake Chad region during the peak flood suggest that any measures to restrict the resources invested in fishing would have at best, a minimal, positive effect on the wider economy. As the flood recedes and farming opportunities open up, the opportunity cost of fishing does increase, however, at this stage a rent is charged for access to the fishing in the residual ponds left behind and to some extent 'the market failure' is reduced if not overcome.

The next stage of the discussion considers the results which show how fishing-farming households fare better agriculturally than households which do not fish and the additional implications of these results for potential fisheries management measures.

The survey results show that households which do not fish or devote any resources to fishing, and rely mainly on farming are not more productive than households which fish and farm and further, the results indicate that mainly farming households may be less productive agriculturally than their fishing-farming neighbours. There are two possible explanations for this, firstly that mainly farming households may have an absolute lack of



capital which prevents them from investing the necessary cash in either fishing or production enhancing agricultural inputs (eg hired labour).

Group discussions with village leaders and household heads helped to understand rural livelihoods at Lake Chad. These revealed that there are essentially five necessities for entry into the fisheries of Northern Nigeria. These include: fishing gear, taxes and bait, fishing rights, skill and labour (see Table 1). Although cash is not essential to meet any of these requirements, fishermen do need to input resources on a seasonal, weekly and daily basis. Cash can be used to purchase all the necessary fishing prerequisites. Without cash, entry into the fishery is difficult, would-be entrants need to collect the materials, make their own gear and rely on either open access fisheries, which are more likely to require water transport. In general, fixed and working capital is an important determinant of access to the fishery.

Comparable household structures between fishing-farming and mainly farming households suggest that similar levels of household labour are available to fishing-farming as to mainly farming households. This implies that the reason that mainly farming households do not fish, is not explained through a relative lack of household labour.

Whether or not mainly farming households have, hypothetically, the same fishing rights as fishing-farming households is less clear. At Lake Chad, the survey observed that fishing-farming households were most frequently *Hausa* and mainly farming households were most frequently *Kanuri*. The long history of *Kanuri* settlement around the Lake in comparison to the recent *Hausa* immigration suggests that it is not a historical lack of fishing rights which explains why *Kanuris* are less likely to fish as well as farm. Thus although the relative fishing rights status of fishing-farming households and the potential rights status of mainly farming households is far from clear, at this stage there is no evidence to suggest that differentials between the two groups households explains why mainly farming households do not fish.

As mainly farming households do not fish, it is highly probable that they do not possess the appropriate skills to enter the fishery. How difficult it is to learn has not been elucidated by the TMAF research. However, it is possible to 'buy' these skills through buying gear for those who do and sharing the catch or profits from their fishing (see Table 1).

A second explanation, why mainly fishing households produce less, is that as they do not or cannot invest in fishing during the flood, they miss the opportunity to increase their capital and can experience a dwindling in the value of their capital assets through a combination of processes. The first of these involves the high rates of inflation and minimal access to banks which offer low or negative real rates of interest. A second drain on capital resources is the need to consume rather than store farm output or invest the proceeds of farm sales.

The implication for potential fisheries management measures from this second explanation is that rather than having a positive effect on the wider economy, an enforced reduction in the resources invested in fishing may bring about a situation where households have productive resources but during certain seasons, are unable to utilize them within their environment. Households which previously fished may then either leave their potential fishing resources idle and risk a dwindling in their value or invest those resources in enterprises in another location. As the peak flood comes at the end of the rainy season, it is unlikely that farming opportunities will be available even in other parts of Northern Nigeria - if other farming land were available it would be hard to understand why mainly farming households relied so heavily on seasonally flooded land. Other options would involve migration to other fisheries or migration to towns in cities in search of trading or casual work opportunities. Both these options have important impacts both within the Lake Chad Basin and inter-regionally.

Within the Lake Chad Basin, there are two potential impacts of a reduction of the resources invested in fishing. Firstly, it is possible that households or household members which migrate in search of other income earning opportunities may not return for the farming season, resulting in a loss of the households and the resources which were most agriculturally productive. Secondly, it is possible that households which did not migrate would experience the loss, whether relative to what they could have achieved or absolute, in the value of their productive resources, both of which would have a negative impact on their agricultural production.

Inter-regionally, a migration of Lake Chad fishing households to either the ranks of migrant fishers or to specific other fisheries may simply relocate any overfishing problem that did exist to other fisheries. Given current government strategy which aims to increase agricultural production and rural employment, it would seem that both the loss of agricultural output and/or any urban migration would also be undesirable (FGN, 1988)

This discussion has examined the results of research conducted with the sedentary fishing and farming communities of Lake Chad and considered on the impacts of fisheries management measures which would restrict the resources invested in the fishery. It is suggested that an entry limit to the fishery could have an important impact on the wider economy and particularly on agriculture in the Lake Chad Basin. The discussion is based on an initial year of socio-economic research which focused on sedentary households. The impact of entry limits on migrant fishermen have not been considered. However, it is speculated that the impacts of limited-entry measures on migrant, full-time fishermen would augment the inter-regional impacts discussed above as those fishermen sought out other fishing opportunities. There are other possible scenarios which will be investigated in the ongoing programme of research.

## **Conclusions**

This paper has considered one part of economic theory, overcapitalization, which has provided a conceptual framework for management systems designed to solve problems of overfishing. Management measures devised using this framework have frequently involved a restriction of the capital resources applied to a fishery. The paper has used the results of the first year of research into traditional management of artisanal fisheries in Northern Nigeria to consider the potential impacts of such management measures on the economy of Lake Chad. At this stage, the Lake Chad fishery has not been examined within the range theoretical frameworks available from other approaches to natural resource management. As more information becomes available, it will be possible both to assess the accuracy of the suppositions forwarded in here and to consider the validity of other approaches to natural resource management.

In linking higher agricultural output levels with fishing and the ability to cycle cash through each enterprise to the other, exact causality is difficult to establish. It is not certain if better access to resources and higher levels of farm produce provided better-off farming households with the cash to invest in fishing or whether cash from selling fish catches provided the resources to invest in more productive agriculture. Whether or not fishing-farming households produce more crop output because they fish or because they are better off any way cannot be determined with any certainty here. However, it is suggested that there is a complementarity between fishing and farming which provides a

large proportion of farming households with two alternative production activities which enhance the flexibility of household resource management.

Whether or not a symbiosis exists between fishing and farming, they are linked through household resource allocation decisions and this has important implications for any future management interventions. At Lake Chad, where fishing and farming are closely connected, an enforced reduction in fishing effort could have knock on effects on agricultural activities. The nature and extent of these effects need further investigation before policy is determined. A crucial lesson from the first phase of the TMAF research work is that fishing and farming are interwoven and that future management recommendations will need to acknowledge this.

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## **Notes**

1. The other two study regions included in the Traditional Management of Artisanal Fisheries, Northern Nigeria (TMAF) project are the Upper River Benue, in Adamawa State and the Nguru-Gashua Wetlands in Yobe State.
2. Although some women participate in fishing activities at Lake Chad, they make and mend gear, they buy and sell fish, very few actually catch fish. Interviews and discussions were held with household heads who were predominantly male. The paper refers to fishing households and occasionally fishermen.

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**Table 1 Access to fishing at Lake Chad: prerequisites to entry**

Requirement	Nature of requirement	Timing and type of resources required
Fishing gear	A wide variety of gears are used. The majority of gears consist of nylon nets and can be bought ready made, commissioned or made using a combination of bought nylon line or net and locally collected materials such as wood, grass or palm fronds. A small number of gears are made entirely from locally collected materials.	One-off investment of capital and/or labour to buy materials (eg nylon netting) or collect and make up gear.  Seasonal and frequent purchases of nylon line and/or labour inputs to mend and maintain nets.
Bait and taxes	Fishermen need a supply of working capital in order to pay various taxes imposed at the lake and to acquire bait for fish traps.	Daily expenditure of cash or catch proceeds.
Fishing rights	Access to fishing varies. During the peak flood and year-round on open stretches of Lake Chad, access to fishing is free. In the smaller, residual water bodies created by flooding, access to fishing is discretionary and may be charged for. The level of charges levied for fishing will often depend on the fishers' links with community or individual in control of the fishing area.	Seasonal purchase of fishing rights. These may be purchased with cash or traded with other 'liquid' assets (eg grain stores etc)  Seasonal and frequent transport costs both in terms of capital (cash) and labour (time).
Skill	This refers to experience with and ability to use fishing gears successfully. Fishing requires dexterity as well as talent. Retired fishermen may provide gear for their sons and/or share workers.	Long-term investment of labour in acquiring fishing skills.  Seasonal transactions with fish workers. Fishing gear, capital, may be 'leased' to share workers who provide the owner with a portion of the catch.
Labour	This refers to the time available to fish in. Fishing households may rely entirely on family labour or hire labour to operate fishing gear. Hired fishing labour is often paid for with a share of the catch.	Seasonal and frequent investment of household labour.  Seasonal and frequent of hired labour either with cash or part of the catch

**Table 2: Proportion of sedentary households engaging in fishing and/or farming at Lake Chad (%)**

Mainly fishing	Fishing and Farming	Mainly farming	Neither fishing or farming	Total (N=484)
5%	36%	59%	<1%	100%

(Source: TMAF survey data, dry season 1993)



**Table 3: Sources of income, fishing-farming households compared with farming households.**

Source	Fishing-farming households	Mainly farming households
Fishing	54%	0%
Farming	39%	84%
Other <sup>1</sup>	7%	16%
TOTAL	100%	100%

<sup>1</sup> Other frequent sources of income included: farm labouring, fish labouring and petty trading.

(Source: TMAF survey data, dry season 1993)

**Table 4: Household Structure (household means)**

Household activity type:	Lake Chad		Upper River Benue	Nguru-Gashua Wetlands
	<i>Fishing and farming</i>	<i>Mainly farming</i>	<i>All households</i>	<i>All households</i>
Total number in household	5	4	9	7
Number of adults	2	2	5	4
Ratio of men to women	0.7	0.6	0.8	1.2
Length of residence in village of interview (years)	8	7	41	53
Most frequent ethnic group	<i>Hausa</i>	<i>Kanuri</i>	<i>Bwatiye</i>	<i>Bade</i>

(Source TMAF survey data, dry season 1993)

**Table 5 Average farm output from fishing and farming and mainly farming households at Lake Chad, 1993 (kg/household).**

Crop Type Category	<i>Fishing &amp; farming households</i>	<i>Mainly farming households</i>
Cereals	2051	1716
Grain Legumes	802	697
Roots and Tubers	410	189
Vegetables	290	31
Fruits and Tree Crops	1	4
Non Food Crops	10	0
Other	330	161
Total	3894	2798

(Source: TMAF survey data, dry season 1993)

**Table 6** Proportion of crops grown on each land type by fishing and farming and mainly farming households at Lake Chad, 1993

	<i>Fishing &amp; farming households</i>	<i>Mainly farming households</i>
Upland	5%	6%
Lowland	2%	2%
Seasonally Flooded Land	90%	91%
Irrigated Gardens	0%	0%
Combinations	1%	1%
Other	3%	0%
TOTAL	100%	100%

(Source: TMAF survey data, dry season 1993.)

**Table 7** Hired Labour Utilization at Lake Chad, 1992/3: Proportion of crops undertaken by fishing-farming and mainly farming households, which used hired labour.

	<i>Fishing &amp; farming households</i>	<i>Mainly farming households</i>
Cereals	68%	54%
Grain Legumes	67%	61%
Roots and Tubers	67%	67%
Vegetables	73%	57%
OVERALL	66%	59%

Note: The less important crop types, ie fruit & tree, non-food and other crops, have not been included in this table as they account for 8% or less of crop output in each study site region.

(Source: TMAF survey data, dry season 1993.)

**Table 8** Livestock Ownership at Lake Chad, 1993: Proportion of fishing-farming and mainly farming households which kept livestock.

	<i>Fishing &amp; farming households</i>	<i>Mainly farming households</i>
Kept livestock	52%	43%
Did not keep livestock	48%	57%
TOTAL	100%	100%

(Source: TMAF survey data, dry season 1993.)

**Figure 1: Seasonal Calendar of Fishing and Farming Activities at Lake Chad, Daba Shatta Kwatta Village 1992/1993.**

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rain							Peak	Peak				
Flood	Rece	ding								Rising		
Fishing	Peak	Peak										Peak
Beans I		Sow				Harv						
Beans II				Sow			Harv					
Maize		Sow				Harv						
Sorghum						Sow			Harv			
Millet						Sow			Harv			