Adaptation of floodplain fishing communities to hydro-climatic changes in the Niger basin: lessons learned

KEY MESSAGES

- The river floodplain ecosystems of the Sahelian region have recently undergone two major hydrological changes: (i) increased interannual variation in rainfall and (ii) a steep reduction of flood peaks and floodplain inundation following the construction of a number of dams and increased water abstraction.
- The Inner Niger Delta is home to 35,000 fish-dependent households, whose annual fish production can exceed 100,000 tons in the best years.
- Fishers have little freedom of movement within the delta to help them cope with environmental changes. The only new opportunities are those offered by new reservoirs.
- Most fisherfolk farm traditional rice as a secondary activity, but farming cannot replace fishing, which brings in steady, substantial cash income for much of the year. Fishing and rice farming are complementary, but fishers cannot shift completely from one to the other.
- Although migration and diversification are often presented as strategies to reduce vulnerability, recent data from the Inner Niger Delta demonstrates that these strategies alone are insufficient to cope with the worsening constraints that come with changes in hydro-climatic conditions.

1. BACKGROUND

The river floodplain ecosystems of the Sahelian region have recently undergone two major hydrological changes. The first is increased interannual variation in rainfall. Although climate modelers consider this to be only one of several possible climate change scenarios for the region, it must be recognized that the phenomenon has now been observed for 15 years. After 20 years of high rainfall from 1950 to 1969, and 23 years of low rainfall from 1970 to 1993, the period from 1994 to 2009 was characterized by alternation between years with medium–to-high rainfall and years with low rainfall (Figure 1). Variable rainfall causes interannual variations in river discharge, which depends primarily on rainfall on the upstream portion of the basin.

The second phenomenon is the construction in the second half of the 20th century of a number of dams and increasing water abstraction from the upstream catchments of most large West African rivers. The main consequence is a steep reduction of flood peaks in the downstream stretches of the rivers and reduced inundation of the floodplain. Dam construction continues apace, as it is a central pillar of African governments' current policies to adapt their

Figure 1. Annual rainfall in the Sahel region relative to the 1900-2008 mean, also showing the 5-year moving average (data from the Joint Institute for the Study of the Atmosphere and Ocean website, 2009).

economies, particularly the agriculture and energy sectors, to population growth and climate change.

Faced with such major changes in the hydrologic regime, the question is whether fishers are able to adapt. One way to answer this question is to examine the main characteristics of fishers' current livelihood strategies, on the assumption that looking at the past can generate lessons for the future.

The example of the Inner Niger Delta

The Inner Niger Delta (Figure 2) covers 40,000 square kilometers (km^2) in Mali, of which more than half (about 25,000 km^2) may be inundated at the annual flood peak. The delta is home to 35,000 fish-dependent households, or more than 250,000 individuals, whose annual fish production can exceed 100,000 tons in the best years.

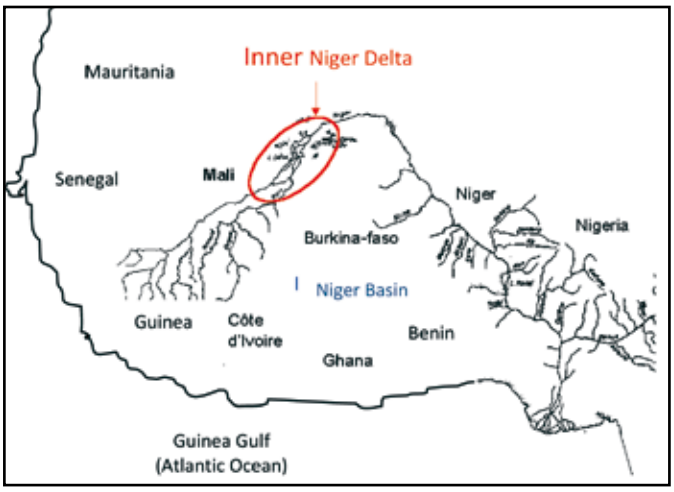

Figure 2. The Inner Niger Delta in the heart of the Sahelian region.

Fisheries and livestock are two fundamental pillars of the economy of the Inner Niger Delta

In the upper and middle basin of the Niger River, several large dams and reservoirs already exist. More are planned at Fomi, in Guinea; Taoussa, near the end of the river's course in Mali; and Kandadji, just upstream of Niamey in Niger.

Since the completion of the Markala dam in Mali in 1947 and the Selingue dam in 1981, the Inner Delta has been subject to the effects of human development. According to Laë (1992), these two older dams are responsible for the delta's loss of about 5,000 tons of fish annually. The new dam to be constructed at Fomi will certainly exacerbate this limiting of flood levels in the floodplain. In addition, the doubling of irrigated area in the irrigated perimeter managed by the Office of Niger is expected to increase the amount of water abstracted at the Markala dam.

Malian traps are a very common fishing gear used in inland fisheries in the region

Various studies (e.g., Zwarts et al. 2005, Marie et al. 2007) have found the Markala and Selingue dams to very significantly suppress the flood peak in the Inner Delta by 20-25 centimeters at present and expect further suppression to 60-65 centimeters when the Fomi dam is completed. As 1 centimeter of water height translates into an inundated area at flood peak of about 65-95 km^2, the loss of inundated area is estimated to range between 1,300 and 2,400 km^2 at present and between 3,900 and 6,200 km^2 in the future. Given a median maximum flooded area of about 15,000 km^2, it is clear that the cumulative impact of damming is already significant and will become even more dramatic when the Fomi dam is operational. In addition to these big dams, several new small dams and manmade sills are planned in the upstream reaches of the Niger Basin, mostly in Guinea and Mali. Individually these small dams have limited impacts, but they add up to effects similar to those of bigger dams.

Adaptation of fishers to hydrological conditions and fish availability

Do fishers increase or decrease fishing intensity in response to changes in the availability of fish?

Figure 3 shows the change over time for various combinations of indicators of fishing activity. The data show that the frequency of fishing trips varies very little from one campaign to the next and is constantly high, at about 10 trips per week, or 1.4 per day. The mean duration of fishing trips shows some weak and divergent trends. More than 50% of all trips are passive, to set one or more stationary gillnets and land the catch, and these trips' mean duration does not vary from year to year. The duration of trips with active nets with high catch capacity (large seine nets, familial seine nets and castnets) seems to increase over the

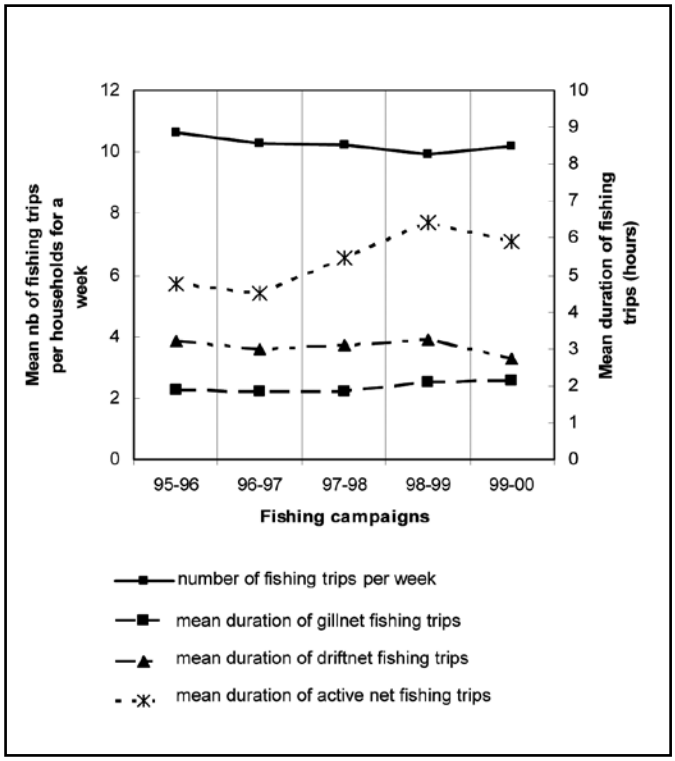

Figure 3. Trends of some indicators of fishing effort.

1995-2000 period considered, while driftnet trips become slightly shorter. These trends are monotonic and very slow, and, in the five fishing campaigns considered, they seem to correlate neither with sharp interannual variations in hydrological conditions nor with changes in mean fish availability. These results suggest that interannual fishing activity always involves a relatively constant amount of labor time, whatever the yield or the hydro-climatic conditions.

Adaptation of fishers' intensity of farming to hydro-climatic conditions

Traditional land-tenure systems in the Inner Niger Delta provide land access only to fishers living in their own villages or in settlements located on their village territory. Data collected from three fishing communities in the delta (Korientze, Diakka-aval and Batamani) reveal that fishing households who engage in farming (i.e. fisher-

One permanent settlement on the territory of Batamani (Inner Delta of Niger)

farmers) do so following a regular annual pattern (Figure 4). At the seasonal peak of farming activity from August to October, the percentage of indigenous fisher-farmer households involved in farming is up to 45% in Korientze, 70% in Diakka-aval and 95% in Batamani, for an aggregate percentage of 78%. At this time of the year, between fishing campaigns, most fishers stay in their villages or areas of origin. These results indicate that a high proportion of Inner Delta fishers engage in farming.

Interannual variation in the percentage of fishing households involved in farming are important, but some interesting observations emerge. During the crop season of August-October 2000, just after the highly productive fishing campaign of 1999-2000, the proportion of fishers working in the fields fell slightly. This may be attributable to the decision of some households to extend their 1999-2000 fishing campaign by several weeks. According to Fay (in Baumann et al. 1994), households that migrate seasonally have a tactical choice to make concerning the end of their

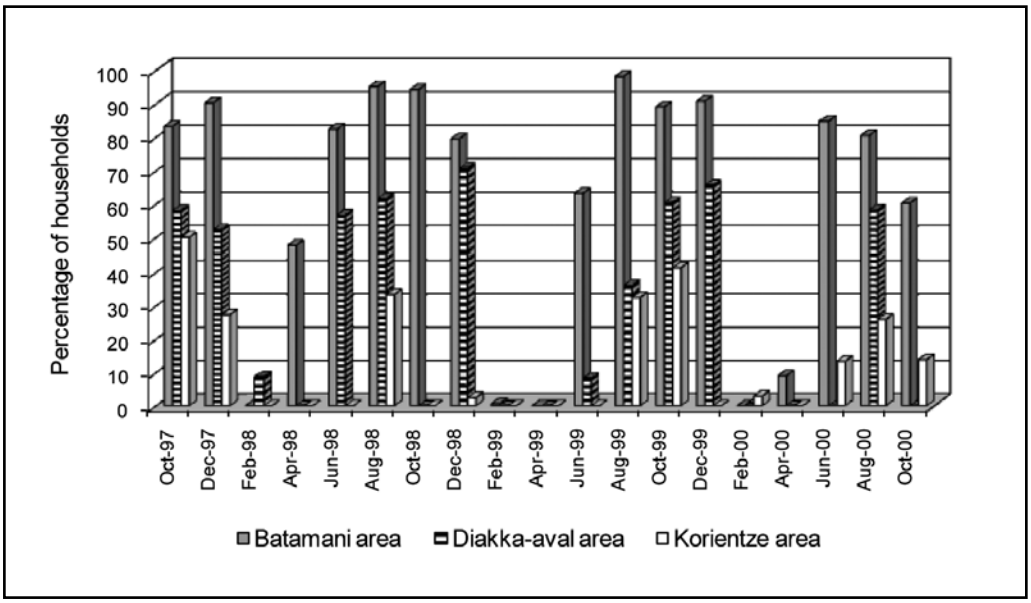

Figure 4. Variation of fisher households' involvement in farming in the three areas surveyed.

fishing campaign and the return to their village of origin. To some extent, this choice determines the balance between fishing and farming, as there is much work to do in the fields beginning in June or July.

These interannual variations in farming involvement are small, however, involving only 5-20% of fisher households present in their home village in August and October. When longer-term trends are considered, the data indicate a certain stability, since the proportion of households engaging in farming in the three areas is very similar to the rate of 81% observed in 1987 by Baumann et al. (1994) during a severe drought.

The persistence with which most fishers try to raise crops each year is remarkable in view of the wide interannual variations in hydro-climatic conditions — both rainfall and river flow — that strongly affect crop yields. For example, yields of rainfed rice and flood-fed floating rice, the main traditional crops, can be almost nil in some years at some locations. Annual rice production in the Inner Niger Delta floodplain ranges from 20,000 to 110,000 tons (Zwarts et al. 2005).

It is thus observed that (i) most fisher households use farming as a secondary activity and (ii) this strategy is practiced every year even though results are highly uncertain and variable from year to year.

Low flexibility of traditional fisher activities

To understand why fishers' follow their traditional fishing and extensive rice farming with little interannual flexibility, it is useful to consider in detail the characteristics of rice farming, as well as its interaction with fishing.

Fishers in the Inner Delta of Niger traditionally grow mainly rain- and flood-fed rice and, in deeply flooded areas, long-stemmed floating rice. The main advantage of this crop system is that it depends on natural flooding and so requires no infrastructure. But yields are highly sensitive to rainfall and hydrological conditions because the yield of each plot depends on when the rains begin locally and the subsequent flood (with some risk of mismatch) and, more broadly, because the potentially productive surface area depends on the flood level of the delta.

Flood-fed rice farming requires less labor than fishing, and the period of intensive labor in the fields, mainly from May or June to early December, overlaps only slightly with the fishing campaign, from the end of November to July. Deciding how to divide labor between the two activities is therefore not a major problem. In late May or early June, when the fishing campaign is drawing to a close and fish are becoming scarce, some fishers leave the camps early for their villages to plow their fields before the rains begin.

From the economic standpoint, the two activities are very different. Whereas fishing requires large investments and may earn steady and substantial cash income for much of the year, rice farming is primarily a subsistence activity. It cannot replace fishing. Fishing and traditional rice farming are complementary activities, which means that fishers cannot adopt a strategy of shifting completely from one to the other.

Flood-fed rice is the main traditional farming activity in which fishing households also invest

Life is very basic in the temporary seasonal camps

Moreover, there is no reason why poor fishing years should be good years for rain- and flood-fed rice farming. The relationship between climate and rice yields is admittedly not as simple and close as that between hydrology and fish catch, but a relationship does exist (Zwarts et al. 2005). When the Sahel undergoes a series of years with low rainfall, as it did during the prolonged drought of 1973-1993, the output of both rice farming and fishing is severely reduced.

Migration strategies

Another adaptive strategy for fishers is to engage in seasonal migration. In the Inner Niger Delta, a substantial proportion of the fishers migrate seasonally to be close to the places where fish congregate in a particular period of the flood season but return to their villages for farming and the harvest. Some other migrant fishers choose to become sedentary, however, spending the entire year in what are considered permanent camps.

Data indicate that, in many seasonal camps, the pattern of occupation is very similar from one year to the next. In particular, peak occupancy occurs almost systematically at the same time each year. Although there may be a high interannual variation in the number of fishing households present during the occupancy peaks, such quantitative year-to-year variations do not entail marked changes in fishers' migratory paths. Indeed, individual interviews indicate that most of the households "had come to the same site last year" or "had come here in the past." So the seasonal migratory paths of fishing households are highly stable but not followed in exactly the same way every year.

In addition, the data indicate that most permanent camps were founded more than 40 years ago. Many temporary seasonal camps are also on long-established sites. This shows that the number of settlements has stabilized, which seems to indicate that the Inner Niger Delta is saturated, with most favorable sites already occupied.

The relative stability of settlements and migratory patterns in the delta probably reflects mainly that this area has long been occupied. As the delta is a floodplain area, much of it is unsuitable for permanent human settlement. It is rare today for new permanent settlements to be founded. While there is considerable seasonal migration, it follows rather strict patterns, as the camps are occupied each year at the same period by more or less the same households. As a result of the longstanding human occupation of the delta and its high population density today — with 20 rural inhabitants per square kilometer, one-fourth of whom are fishers — any attempt to find a new place to settle has high transaction costs. Fishers thus have a choice between

remaining in their home village or else undertaking seasonal migration to fishing camps following the same path as in previous years. These migratory paths were marked out by their predecessors, who negotiated and obtained the rights to settle and fish in favorable spots.

Fishers thus have little freedom of movement within the delta to help them cope with environmental changes. The only new opportunities are those offered by new reservoirs. Indeed, it appears that manmade reservoirs, notably those in Mali, are possible migration destinations for fishers from the Inner Niger Delta.

Possible scenario

In theory, multiple activities and migration can help fishers cope with environmental changes. However, the observed low interannual variability in productive activities and the rigidity of spatial mobility within the delta indicate that, in fact, fishers there are highly vulnerable to the modifications in flow caused by new dams or climate change. Under these conditions, several scenarios are possible.

First, increased competition can be expected among fishers over fishery resources. This seems to be under way already, as highly efficient fishing practices are increasingly observed. In the past 10 years, prohibited practices have emerged, such as completely blocking large channels with nets during the rising flood stage. The increased use of unsustainable fishing techniques cannot be attributed solely to climate change. Population growth and the weakening of customary fishing rules probably play roles as well. Regardless of which factor is the main cause, this phenomenon clearly brings no long-term benefit in terms of average catch per household and will probably exacerbate social conflict over the sharing of fishery resources.

Second, with the downward trend in the area inundated, it can be expected that the productive area for growing traditional rainfed and floating rice will gradually decline.

For these reasons, the economic well-being and food security of fisher households may deteriorate in the coming years, worsening their poverty and vulnerability (Mills et al. 2009) and risking the kind of catastrophes that occur in years with severe drought (Baumann et al. 1994).

The result will probably be the same as in the 1980s, when young fishers departed for other regions of West and Central Africa with estuaries and reservoirs to exercise their occupational skills. Fishers from the Inner Niger Delta do well in these fishing areas in terms of skills, but as outsiders they are vulnerable to lack of access to land, services and infrastructure, as well as exclusion or marginalization regarding civil and political rights.

Smoking is a common way to preserve fish in these regions where there is no electricity

In sum, although migration and diversification are often presented as strategies to adopt to reduce vulnerability, this analysis demonstrates that the fish-dependent communities in the Inner Niger Delta cannot expect these strategies alone to be sufficient to cope with the worsening constraints that come with changes in hydro-climatic conditions.

The way forward

Increased dam construction and some uncertainty about the future rainfall regime resulting from global climate change are threats to the livelihood of the fishing communities of the Inner Niger Delta. Conjointly, overexploitation of the fishery resource may occur with increasing fishing pressure. With the downward trend in the area inundated, the productive areas for growing traditional rainfed and floating rice can be expected to gradually decline.

If fish-dependent families have to migrate to other (and often newly created) fishing grounds, such as manmade reservoirs, because of dam construction and water abstraction, policies should be implemented to help them in their new environment. As outsiders they may be vulnerable to lack of access to land, services and infrastructure, as well as marginalization regarding civil and political rights.

To ensure that the arrival of fisher migrants from the Inner Niger Delta does not echo the problems encountered in other places, policies should support their establishment and thereby mitigate the impact on their environment and livelihood. Only the adoption of supporting policies will ensure that the migration of river floodplain fishers to manmade reservoirs becomes a successful adaptation strategy, rather than a descent into greater vulnerability.

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