HOW THE D.R.C (ex-ZAÏRE) COULD BECOME SELF-SUFFICIENT IN FISH PRODUCTION

PARTS I & II (44 pages)

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PART I: Historical background and the means of fish productions in the D.R.C. (ex-Zaïre)

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In the D.R.C. (ex-Zaire), fishculture and fishery management need more trained local technicians to encourage local private investment, to help in recovery of the collapsing fish stock and to become self sufficient in local fish demand. In 1952, belgian Congo had over 46,970 fish ponds (2148 ha), 100,503 (4171 ha) in 1955 (Gomez and De Kimpe, 1957) and 126,156 fish ponds in 1959 *(Huet, 1957). In 1988, an official inventory carried out* reported only 15,548 fishponds throughout the country. In 1955, local fish demand was estimated at about 300,000 tonnes/year *(Gomez et De Kimpe,1957). The same authors report that imported fish tonnage represented 60,000.* ***That means fish consumption was about 30 Kg/caput/year. In 1955, Congo-belge had over 10 millions people.*** *With respect to fishery management, very few has been done to protect the high value commercial fish stock.*

Recent study, analysing fish statistics, using the Herfindahl index confirm that there is a change in the taxonomic composition of the fishery of two periods (from 1973 to 1982 and from 1984 to 1988). Old practice using local toxic plants, as reported in other african countries (Walker, 1928 ; Malaisse, 1969 and 1970) is gaining more and more importance in this country.

Total fishery production yield at 150,200 tonnes per year *(FAO/PNUD), 1986)* ***while local demand is about 420,000 tons of fish per year.*** *Having that in mind, this investigation analysed the chance to success of the last FAO National Fish Planning Project to the D.R.C. (ex-Zaïre) (FAO /PNUD), 1986).*

To compensate the national deficit we outlined how much foreign currency the National Bank of the D.R.C. does spend each year. ***Local fish production being (150,200 tonnes/year which represent 6.6 g of fish/caput/day)****. Imported tonnage varrying between 82,000 and 120,000/year (OZAC,1985). Because the D.R.C. is still below the african average of 10.5 kg/caput/year (34 g/caput/day) (Huisman and Machiels, 1986) there is need to promote fish production in this country.*

Key words*: D.R.C. (ex-Zaïre), self-sufficient fish production, strategy.*

Headline*: Fish productions in the D.R.C. (ex-Zaïre).*

1 - INTRODUCTION

Very few subsaharian countries had mastered modern technology in fishculture productions. Most recent advances in aquaculture engineering, fishculture and fishery management require an expensive investment and specific management skills for highly trained graduated officers.

However, in order to understand the destiny of fishculture in this country, one should be aware of the historical agriculture background especially in this country where there is no fishculture tradition. Because the fishculture activity depends on agriculture sector, any main constraint to agriculture development affects most of the achievment of the fishery and fishculture objectives. With respect to the D.R.C. (ex-Zaïre)an experience, evidence suggests that fishculture practice is the most sensitive to regress in the country, where there is no fishculture tradition.

FAO (1981, anonymous) reported that fishing importance is continuously reflecting increase in catch. He showed that between 1950

and 1970 fish catch increased from 19 to 63 million tonnes per year.

However in 1981, FAO, (anonymous, 1981) data confirmed that fishery yields were stabilised to 70 million tonnes per year. Since, world fish catch continued to increase.

In World's animal production (1985) fish catch represented 90 million tonnes. Meanwhile,in 1994, the world aquaculture production has reached only 13,921,338 metric tons (FAO, 1994). Fishery resource experts thing that increase in fish catch does not keep peace with increased fishery effort. Furthermore, fishing practice, using toxic plants (CLAUS, 1930 ; WALKER, 1928; BENSAI , 1944; DIETERLEN, 1952; ALEXANDER, 1964 ; MALAISSE, 1969; 1970 & MUZIGWA and MUTAMBUE, 1993) , is gaining more and more importance .

In many african countries, uncontrolled and non regulated fishing practices had lead to collapsing and vanishing fish stocks (MOOR and BRUTON, 1988; O'KEFFE, 1989; O'KEEFFE *et al.*, 1989; MCGREGOR, 1990; OGUTU-OHWAYO, 1990a and 1990b; NEILAND *et al*., 1991; SKELTON, 1991 and PITCHER, 1994).

In D.R.C. (ex-Zaïre), two species *Lobochilotes labiatus* (Blgr.)*Cardipharhynx schoutedeni* (Poll), had collapsed from Ndjili stream and three others *Channallabes apus* (Günther), *Cyphotilapia frontosa* (Blgr.) and *Hemichromis fasciatus* (Peters) others species had vanished from Makelele stream in Kinshasa region (MUZIGWA, 1989). With respect to the D.R.C. (ex-Zaïre) river evidence suggest that the number of threatened and endangered fish stock had increased. This could be either the result of the construction of Inga, the hydroelectric dam on the Congo river either the use of the

ichtyotoxins in fishing practices, or the use of very small size fishing nets to catch larvi and fingerlings for european aquariophiles. Thereby, there is need for a new approach to fish production in subsaharian Africa and particularly to the D.R.C. (ex-Zaïre) which is considered to have one of the most important reserve (of 800 species) of the tropical fish species (LOWE-MCCONNELL, 1986).

With respect to fishculture, a more realistic strategy in fish production should be aware of that african fishculture was initiated (in subsaharian Africa) with a view to make up for animal protein deficiency occurred toward white colons during and after the second world war. Communication and exchange were cut between metropole and their colonies.

As a matter of course we should define the new motivation to restart fishculture activity in any one of these subsaharian countries. As matters stand many reasons do justify urgently the need for both extensive and intensive fishculture productions in the D.R.C. (ex-Zaïre). Most of the principal reasons could be summarized in five targets to achieve:

1- local fish production is not matching the national fish demand ;

2 - fishing pressure to native fish had lead to threatening of some fish stocks ;

3 - there is a need to keep going governmental fishculture reference centers for those isolated fish farmers with very low income who had, on their own initiative , start a small scale fishculture exploitation ;

4 - compared cost investment between fishculture and cattle breeding had proved that in developping countries the former could be available to everybody in the region with an important potential hydrology ;

5 - a small scale fishculture exploitation require less schemes

than poultry, sheep and cattle breeding exploitation ;

Furthermore, evidence suggests that fishculture activity is not a traditionnal one in subsaharian africa. Consequently, any extension service will be facing two kind of problems:

- first of all, the rural african way of life (this include the low adaptation to changes) as they will prefer proves to any changes and therefore, new technology for food production may not be accepted with the result that hunting and fishing activities still have adepts even towards vanishing species;
- secondly, the ignorance and pauvrety.

For instance, most of rural fish farmers do not agree that in culturing conditions fish should be fed. Furthermore fish' feedstuffs may not be expensive but their transport and stocking may require a short term expensive cost investment in a viable infrastructure.

Recent investigations (UNICEF, 1987-1988), sample surveys (MUZIGWA, 1993) and FAO reports (1986) confirm that animal protein deficiency in the D.R.C. had lead to a well known disease, the kwashiorkor in some regions (MUZIGWA, 1994). Nowdays, most kids suffering from this disease are unable to developpe their potential intelligence and they do have also a very low somatic growing performance. From white meat (fish) and red meat (i.e. beefs) the consummers do gain different essential amino acids (table 1). Both play an important role in human nutrition. With respect to mg/g protein of some essential amino acids, meat, wheat and fish can be compared.

Medical reports confirm that marin fish can help consummer suffering from deficiency in some amino-acids and fatty acids. Lovell, 1986 reported that the american catfish is rich in PUFA 3n

(polyunsaturated fatty acids) protecting consummers against heart attack disease.

2.- MOTIVATION

According to FAO data (1986) in the D.R.C. the available kcalories/day/caput in 1985 and 1986 were respectively 2,127 and 2,154. The *african average* in 1975-1977 was ***2,282 kcal/day/caput*** ; and ***2,448 kcal/day/caput*** in 1986 . However in developped countries it was ***3,375 kcal/day/caput*** and ***3,652 kcal/day/caput*** respectivelly.

It is clear that in this country the D.R.C. most people are ill-nourrished (tables 8 and 9) beside the natural potential for aquaculture.

Despite the existing dilemma some alternatives to production and to rehabilitation strategy can be discussed. One of these should consider the alternative of fishery and fishculture complementary.The strategy consist of repopulating some rivers with threatened endemic species. (N.B.Fingerlings hatched from a governmental pilote fishfarming should be free to fish farmers starting).

With respect to the repopulating strategy, feeding and management skills would not be required since fish will rely entirely, on the productivity of the natural environment. However, this suppose an existing hatchery throughout the country. Furthermore, local authorities should be helpfull in application of the protective legislation.

Another alternative is to increase the proportion of the present fish catch, reducing spoilage by improving the processing technology.

Very few african families can afford to pay a kg of fish produced with high technology (± 250 - 300 fb/kg of fish). Logically, where fishculture is still possible, extension services should benefit of Government special care (including,

financial support, taxe free on equipments purchased for fishculture project)

Yields as low as 5kg/are/year are still common. Recent improvment, thanks to american and belgian extension services resulted in the yields as much as 50-60 kg/are/year. Today, the Governement effort through american and belgian aids is to recuperate over 34 pilote fishculture Stations and to organize a confident national fishculture Extension Service.

Not only the D.R.C. is facing a chronic overall food shortages resulting in undernutrition,but more often, condition of malnutrition is obvious in some towns by a shortage of protein (Fig. 16). In 1987 (FAO, 1987; official declaration, in the annual year meeting) suggested ***25 kg of fish/pers./year*** (in developped countries) and ***15 kg/pers./year*** (in the third world). These figures represent **68.9** and **41.6 g** *of fish per day/person* respectivelly.

However, in the D.R.C.(ex-Zaïre), total fish production is ***150,200 tonnes pers year*** (FAO-PNUD, 1986; MUZIGWA, 1989). In terms of fish production, this represent ***4.3 g/caput/year***. Total fish import is about 172,000 tonnes/year (OZAC, 1985). Therefore, the total fish tonnage consummed in the D.R.C. (ex-Zaïre) is 322 000 tonnes/year. This represents an average of *9.2 kg / pers / year (25 kg/day/pers.)* for 35 millions of people. Meanwhile, Congolese (ex-zairean) ministry Council decided that each congolese should eat at least *12 kg of fish/year* (Conseil Executif du Congo (ex-Zaïre), 1987). Once again, the D.R.C. (ex-Zaïre) is below the african average.

Indeed, HUISMAN *et al.* (1986) reported an average of **10.5 kg/caput/year** (this aqual to **34 g per caput/year** of fish production).

Furthermore, the daily per capita protein consumption shows a world average of about 70 g, while in 12 equatorial african countries it was estimated at 48 g (BELL and CANTEBERRY, 1976). CUNNA (1982) reported that resulting protein utilization is 75-95 % for animal protein, while it ranges from 50-70 % for the common plant protein foods. In assesing the nutritional meaning of these protein intake levels, the digestibility and biological value of the various protein must be taken into account. BELL and CANTERBERRY (1976) showed that in 1970, only 25 % of the protein consummed in 12 equatorial african countries originated from animals, including 11 % from fish. Therefore the effective protein intake is even lower than the data indicated.

We do believe that there are needs for aquaculture and fishery management to improve fish yields and production in Africa, particularly in the D.R.C.

3.-HISTORICAL BACKGROUND

Fishculture in this country was initiated by the belgian colons who just after the 2nd world war had lost their sources of animal protein from Belgium, the metropole. Later, in 1949, this private initiative gained more and more governmental attention. This included governmental technical assistance and financial support which contributed to develop in each region, a fishculture extension service.

In 1958, more than 35 fishculture demonstration centers were active which role consisted on distribution of fingerlings to new rural fishfarmers (HUET, 1957). In 1949, belgian-Congo became a fishculture reference on warm water fish tilapia , in sub-Saharian Africa.

The first International Conference on african fishculture was organized by belgian and british in Congo-Brazzavillle. In 1959, belgian-Congo had 126,156 fish

ponds. However, an inventory carried out on behalf of the Ministry of Agriculture and Rural Development (by the National Service for Aquaculture) in 1988 found 15,548 fish ponds only throughout the country.

However, in 1960, the country became independant. As direct consequency of the political disorder due to the lack of prepared local officers to manage public goods, an inventory carried out on behalf of the Ministry of Agriculture and Rural Development, in 1988 recorded only 15,548 fish ponds (FRANSSEN and MUZIGWA, 1988) while in 1959 belgian-Congo had 126,156 fish ponds (HUET, 1957).

4.- EVALUATION OF THE LOCAL FISH DEMAND

Fishery resource experts thing that increase in fish catch does not keep peace with increased fishery effort.

Furthermore, since the craftsmen fisher had realised that their equipment was unappropriated to fish in some water bodies periodically full of fish, it's a great pity that fishing practice, using toxic plants and dynamite, as previoulsy denounced in some other african countries (CLAUS, 1930; WALKER, 1928; BEN SAI, 1944; DIETERLEN, 1952; ALEXANDRE, 1964; MALAISSE, 1969 and 1970 & DECEUNINCK, 1990) is gaining more and more importance in the Congo basin.This will lead very soon to total extinction of the most vulnerable and rare species.

Therefore, to satisfy the growing local fish demand evaluated at about 525,000 tonnes/year (FAO recommandations related to consumption rate of 25 and 15 Kg/caput/year in developped and developping countries respectivelly) three alternatives can be examined.

Compared to other type of fish production (lacustrian, riverine

and fishculture), marine fisheries represents only ± 10 % of the national production and 0.3 % of the local fish demand.

First of all, one of these could define how fishery and fishculture could be complementary with a view to attaining following objectives :

1-To compensate the local deficit (of 375,000 tons/year) in fish demand (table 2);

2-To use the regional fishculture infrastructure in order to acclimatate and to study the biology of the most endangered species ;

3-To control the breeding and the reproduction of these wild species what could lead to repopulating fish strategy in their native environments.

The second alternative could examine the possibility to provide to craftsmen fisher an adequate fishing equipment. That means for the 25,000 craftsmen fisher (half of these operating on the main Congo river and on its effluents) (MUZIGWA, 1991), each of them should land at least 15,000 tons/year.The actual average fishing rate being 0.9 tonne of fish/year/craftsman fisher on the lakes of the D.R.C. and 2 tonnes of fish/year/craftsman fisher on the river of the D.R.C. (CORSI, 1984). Obviously, this appear to be an impossible project to realise in the congolese geographical, economical and socio-political conditions. First of all, to equip all the fishermen (MUZIGWA, 1991).

In case this could be possible then we should get going a very active extension service to look after these craftsmen fisher. However, how could we encourage to such extend an exploitation of unknown size of any fish stock? What are the different MSY (maximum sustainable yield) to the most high price commercial fish, being the most fished? We believe that any fishery project intending to promote fish production in this country

should, previous to any intensive exploitation, define that fishery equipment to all fishermen could amount at about 750 millions BF. (Cost investment to fish farmer compared to craftsman fisher[1]) . Until now, nothing has been done in this tropical fish reservoir to ascertain how far has gone the destructive fishing practice as denounced above.

Furthermore, TAVARES DE PINHO (1985) estimated the potential fisheries production of the D.R.C. at a minimum and maximum of about 329,500 and 725,000 tons respectivelly, whereas the 1988 World bank study confirmed that this potential fisheries production could not exceed 394,000 tons/year. Obviously, we can not rely only on the local fishery potential to compensate the actual deficit in annual fish demand. Finally, the country could consider the importation of the deficit tonnage.This could amount at about 700 millions ($ USA dollars)[2] outgoings foreign currency.

Before going for any one of these suggestions one should be aware of the main causes of the failure in fish production in this country.

5.- MAIN CAUSES OF FAILURE IN FISH PRODUCTION

5.1- THE 1949-1959 FISHCULTURE CAMPAIN IN BELGIAN-CONGO AND RWANDA-URUNDI FAILED BECAUSE

5.1.1- There is no fishculture tradition in this country;

5.1.2- Arable soils were used for fishculture on recommandations of the colonizing administration request ;

5.1.3 - Fishculture practice was popularized an obligatory activity to rural farmers;

5.1.4 - Local waters (rivers and lakes) showed high potential in fishing activity;

5.1.5 - Fish breeding technology was less advanced;

5.1.6 - Infrastructure and veterinary extension service as an alternative meat production (cattle, sheep, pigs and poultry) were available and very efficient in each province;

5.1.7- Private and governmental funds to cattle and poultry farmers were available on request of the most performing farmers;

5.1.8 - Hunting was still allowed;

5.1.9 - Very few tribes privilege fish in their feeding habits;

5.1.10 - Poaching in fish ponds at night discouraged most concerned fish farmers;

5.1.10 - The existing of an unflexible traditional agriculture schedule which does not allow the rural farmer to attend to something else;

5.1.11- Tax on fish ponds and on annual fish incomes required by the local administration;

5.1.12- Increase of palludism and bilharziosis cases accompaning fishculture in some provinces;

5.1.13 - Very few were known on fish biology of the most cultured species, *tilapia* spp. and the african catfish, *Clarias* spp.;

5.1.14 -The rarety of local fish biologists and very few trained fishculture extension officers;

5.1.15- Neither agriculture, nor industrial and nor farming legislation could be applied to fishculture activity since it did not belong (at that time) to one of these three sectors.

But why fishery, which is a traditional practice in this country failed too? This activity encountered three types of difficults.

5.2.- COMPULSIONS TO PROMOTE FISHERY IN THE D.R.C. (EX-ZAÏRE)

5.2.1.- Natural headaches:

5.2.1.1. The D.R.C. is an enclosed country to access to sea (only 40 km opening to sea);

5.2.1.2.Most lakes are shared with other countries;

5.2.1.3.The existing of diversified fish species in the Congo basin (it may be difficult to manage the different fish stock);

5.2.1.4.The geo-morphological location of the Congo river (rapids area are not accessible whereas it is full of rheophile fish);

5.2.2 -Technical difficults:

5.2.2.1.The available total fishing area never been defined (landsat photographs needed to define the periodically inundated zones);

5.2.2.2. Non defined MSY implicating that fish stock size remain unknown;

5.2.2.3. Spawning grounds and hatching zones to migratory fish never been determined;

5.2.2.4. Processing and conservation facilities do not exist in most fisheries;

. 5.2.2.5. Apart from fish,there is no interest towards other aquatic living resources;

5.2.2.6.The inexisting lines between politico-administrative regions (fish get spoiled on their long way to market).

5.2.3 - Administratives obstacles

5.2.3.1. fishing juridiction is an old one and may not be applied, in some circumstances to motivate private investors. The first decree was signed in 1937 (Décret loi du 21 avril 1937, codes et lois du Congo-belge, 1954, Tome II, p.1185), modified in 1957 (Décret du 17 janvier 1957) completed in 1958 (Ordonnance législative n°52/273 du 24 juin 1958), then ratified in 1960 (Décret du 27 juin 1960).

5.2.3.2.The country does not organise any course on fishery management and nobody has been specialized in that field;

5.2.3.3.Uncontrolled taxes on fishing productions (FAKA PAUNI, 1984);

5.2.3.4. No available spare parts neither to industrial fishing smack nor to craftsman fisher;

5.2.3.5. Extension fishing service never exist in this country;

5.2.3.6. There is no credit granted to craftsman fisher ;

5.2.3.7. Most of time the government of the D.R.C. (ex-Zaire) was unable to honour bilateral conventions signed with neighbours countries to fish in their water bodies.

Having that in mind what could be a suitable strategy to promote fish production in this country ? Is there any chance to success of the PNUD-FAO 84/015/1986 W/S 1721 National Fishing Programme ?

Fisheries and fishculture belong to two different Ministries. This could be an handicap to coordination strategy to become complementary.

However, this does not seem to be the most determinant difficult to promote fish production in this country.

Not only governmental funds allocated to Agriculture (from which fishculture comes under) are enough but they are never available on time. Compared to other Ministries, although in this country, for the last 20 years Agriculture has been claimed the most important priority to any other national priority, funds allocated to this ministry do not confirm this official commitment (MUZIGWA, 1993).

Obviously, some ministries may get 80 % or more of their demand meanwhile in terms of ordinary budget (B.O) the ministry of Agriculture never get over 6.53 % of its annual demand budget. Between

1973 and 1981 agriculture budget represented only 1.88 % of the Governmental national budget whereas during the same period, energy sector received an average of 31.26% (Banque Nationale du Congo (ex-Zaïre),1970-1983).

This results in agriculture production increase of about 1.44 % whereas population growth rate is amounted at 2.84 % between 1971-1984 (Bureau d'Etudes du Département de l'Agriculture-Rapports synthèses 1980-1986; Rapport synthèse avril 1987).

Consequently, the agriculture yields in the D.R.C. remain below the african standard (MUZIGWA, 1994). Compared to two other african countries (Ivory Coast, and to Kenya) and to one developped country (U.S.A.), evidence suggest that although administrative and technical difficults could be overcome, more political willpower to fund agriculture is highly needed.

Compared to Agriculture, fisheries and fichculture suffer also from less means of production (table 3 ; figure 4) (including qualified trained officers/numbers of farmers, farm machinery, fertilizers, pesticids, genetically selected and performing seeds and broodstock, fishfeeds, biological studies on real fish stock assessment (M.S.Y: maximum sustainable yield) (F.A.O., 1986; DECEUNINCK, 1991 and MUZIGWA, 1994). In spite these difficults to satisfy the local demand fish had remained one of the most important sources of animal protids. The national average calculated on two years basis (1982 and 1991) had confirmed this apprehension.

- Figures with asterisk (*) indicate the number of trained officers in agriculture and the figures without asterisk (in the same space) represente the number of farmers.
- Ao, A1: Fully trained officers from university and from high school in agronomy;

- A2: Bachelors in general agronomy; A3: technician in general agronomy (after secondary school;
A3 and Mn are low level of training technician in general agronomy (very efficient in field works);
- Mn: Monagri: low level trained technician;
- NF/To: Number of farms per one technician.

Apart from this, main compulsion (the lack of funds), it is necessairy to outline also the lack of adequate road infrastructure which is macro-economic problem. This should not be considered in a short term project. Any (fisheries or fishculture) development project suffer also from the same compulsion.

The same author reports that a long term fishculture project captivating 500,000 farmers is possible in three regions (Kivu, Haut-Congo and Equateur) of this country.This will lead to fishculture total annual production estimated at about 30,000 T.

The same regional fishculture infrastructure fitted up, including hatcheries will become immediately complementary to fishery in studing biology of the most threatened species. Controlled reproduction of endangered species could lead to repopulation strategy of local rivers and lakes to promote fisheries yield.

Compared cost invest between fishculture and craftsman fishing exploitation in the congolese socio-economical conditions had proved that it is worth it to invest in fishculture than in the inland fisheries.

Both activities include some risks but in fishculture some of them may be avoided or calculated thanks to some management skills which could be acquired with time.

6. - CONCLUSIONS

The deficit is higher as outlined above. Private retailers import from various countries (Belgium, Canada, Maroc, Norway and Spain) either smoked or salt dried or fresh fish depending on regional feeding habit. In the west (Bas-Congo Province) part of the country, highly salted dried fish are prefered to smoked whereas in the North and North West (Equateur and Haut-Congo Provinces) consummers do like fresh or smoked fish.

However , in the east region (Kivu) people do consumme either simply dried (without salt), smoked or fresh fish. In the Shaba region, lowly salted and dried (locally called Bitoyi) or freshly fished species are prefered. Most freezed tonnage of fish (marine) *is distributed in the 450 Kinshasa town cold stores before 1/3 of this tonnage is transported to Kasaï , Bandundu and to Congo-Brazzaville* regions (MUZIGWA, 1991).

To compensate the local deficit of local production in fish, the national Bank grants enormous outgoings foreign currency and more wild meat from hunters had increased in the local market.

With respect to imported fish tonnage, *the D.R.C. government declared in 1984: 85,000 T. (O.Z.A.C.[4], 1985) , in 1989, 120,000 tonnes*. ***These represent respectivelly an outgoings of 340*** and ***480 millions dollars*** (at 2 $ USA dollars).

Nevertheless, **local investors should have in mind that it cost 6 to 8 $ USA dollars** (including transport and handling fees) **to import 1kg of fish. However it cost 1.7 $ USA dollars to produce one kg of fish at home**. Indeed, the PNUD-FAO Fishery Planning Project (N° 84/015/1986 W/S 1721) from which generated the most recent PNUD-FAO ZAI/88/002 requires **22.8 millions ($ USA) dollars to produce more 92,400 tonnes of fish.**

That means, local fishery is able ***to produce 1 Kg of fish at about 1.2 $*** (USA dollar). With respect to fishculture, prior studies demonstrated that fitting up of 24 fishculture demonstration Centers (CAP)[5] will cost **10 millions $** (USA dollars) (MUZIGWA, 1991).

The same amount of fund will allow operating Extension Services (on 5 years basis) to look after 40,000 family fish farmers producing 25 Kg of fish/are/year.Then, ***the ratio is 1 $ (USA dollar) produces 1 kg of fish*** in the D.R.C. fishculture conditions. Deceuninck (1990) thinks that this *yield can be improved at about 40 Kg/are/year*. However to overcome the national deficit of animal protein people do try other sources of proteins as represented on the tables 6 and 7 .

REFERENCES

(at the end of PART II)

PART II: Strategy to promote Fish production and to rehabilitate vanishing species

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Abstract

The strategy to improve fish production should first at all consider that in this country as well as in all the sub-saharian Africa people do prefer freshwater fish to marine ones. Control and rehabilitation of threatened and endangered species should be the main concern. Habitat restoration, regular control of the mesh size, closing periods of the spawning grounds should benefit from the most priority. Education programmes, keeping going an extension fishery and fishculture services are very important indeed.With respect to national local

deficit, any programme to its compensation should be aware of the home made infrastructure and the colonial fishculture production facilities. Potential production and yield (MSY: maximum sustainable yield) of the zaïrean rivers and lakes must be defined through a research programme funded by both FAO and EEU (European economic union) or by other developped countries.

1.- INTRODUCTION

Apart from political stability required in this country to gain more international overseas confident, some macro economics obstacles such as lines, should benefit from more governmental attention. Furthermore, in order to assure more security and more confident towards private investment, there is need to permanent education of people.

2- STRUCTURING STRATEGY TO PROMOTE FISH PRODUCTIONS

2.1. VALORIZATION OF THE COLONIAL FISHCULTURE INFRASTRUCTURE.

Prior to any fitting up of the 35 neglected fishculture demonstration Centers, the Ministry in charge of fishculture should consider chronologically the following steps:

2.1.1 To make sure that the national inventory of the local farmers interested in fishculture practice is being carried out. Each potential fishfarmer should indicate the available area for fish pond , his education background and his present agriculture status;

2.1.2 To elaborate a national aquaculture planning (NAP). This should define:

2.1.2.1. Its objectives;

2.1.2.2. The national targets to achieve in fishculture;

2.1.2.3. The sources of funds (private, governmental,

international or non governmental organisms-NGO);

2.1.2.4. The collaborative strategy with other international fishculture and fisheries research centers;

2.1.2.5. The fish species to be popularized in fishculture;

2.1.2.6. The size of the national fishculture extension service;

2.1.2.7. The local need to processing facilities;

2.1.2.8. The training schedule for both fishfarmers and graduated (biologist and agronomy and veterinary sciences) for local specialization in aquaculture;

2.1.2.9. The environmental norms to be respected in keeping with fish farmers wastes to down stream;

2.1.2.10. A protective legal text (in favour of fish farmers) to be submitted to local jurisdiction;

2.1.2.11. The conditions in which fishfarmer could benefit from credit ;

2.1.2.12. The stages to go through before any fish farmer organization could get a cooperative status;

2.1.2.13. How to associate to the national targets, the old operating private fishculture projects .

2.1.3.To lay down an operating regional and fishculture extension service organigramme and its popularizing strategy (this include the officer's bunch, the number of fish farmers an officer could look after, the number and the frequency of visits to each fish farrmer and the periodical fish farmers meetings to be held). Here below a model of a coordinated extension fishculture strategy in which such type of training programme could be achieved (Table 8).

2.2- STRATEGY TO PROMOTE FISHERIES PRODUCTION

2.2.1. FISH STOCK ASSESSMENT NEEDED PRIOR TO HIGH SCALE EXPLOITATION

LOWE-MCCONNELL (1986) reported that data on fish ecology used to come mainly from studies of commercially important food fish (the larger species). Recent informations on underwater observations of fish behaviour while scuba-diving and filming contributed to scientific knowledge in fish eco-physiology. Although man made lakes cause some problems to migrators fishes, behind hydroelectric dams (Inga electric dam on Congo river had modified the original fish distribution on that proportion of this river, MUZIGWA (1991) have provided large scale experiments for studying the changes from riverine to lacustrine fish communities. Congo river fish populations dynamics have never been studied. Problems associated with tropical multispecies management may be overcome by studing at different seasons one or two species on a short portion of the Congo river.

2.2.2. UNKNOWN MAXIMUM SUSTAINABLE YIELD (MSY)

Fisheries reseach should, first of all, determine the MSY(Maximum Sustainable Yield) of the most important commercial species in Congo river. However, for the inland african water bodies, very few has been done. Most methods to study fish population dynamics (including grow, reproduction strategy, age size for spawning, rate and the causes of mortality, specific genetic strains, hybridization occured, migration and their causes) is expensive and it requires highly trained fishbiologists BAGENAL (1978),

GULLAND (1978), 1983)., PAULY & MURPHY (1982) & PAULY (1983).

2.2.3. DIFFICULTS ENCOUNTERED WHEN STUDYING THE INLAND TROPICAL FRESH WATER FISH STOCKS ARE DUE TO :

2.2.3.1.the methods used in the determination of the age in tropical fish community by the squelets chronoly and other bony structure especially when the individuals do not live in rivers and streams with two regimes) (LECOMTE *et al.*, 1986, MERONA et *al.*, 1988 & MUTAMBUE, 1992) ;

2.2.3.2. The existence of mumerous species living together ; sampling of any specific species presents some difficults.;

2.2.3.3. That fish grow at different rate and breed at different places. With respect to Zaïre river system, this ecosystem has over 700 species. Congo basin has the richest fauna excluding Lake Tanganyika . 80% of these species are endemic. Although it is reported that fish fauna are continuously receiving or losing species from other, african fish fauna is dominated (in number) by the cichlids species (nearly 700 species) followed by Cyprinids (over 450 species) (LOWE-MCCONNELL, 1986).Worldwide there are over 20.000 species of teleosts, representing a wide range of physiological adaptations.

Reseach conducted on fish is confined to a relatively small number of species, often those groups that have some commercial value such as salmonids. However on a worldwide basis, Cyprinids include the majority of freshwater teleosts. BELL-CROSS (1965), quoted by LOWE-MCCONNELL, discribed the movements of six species of fish

(*Barbus,Clarias,Aplocheilichthy, Tilapia and Ctenopoma*) from the Congo tributary to Zambezi system. BEADLE (1976) and LOWE - MCCONNELL described the higher endemism of non Cichlids in Lakes Tanganyika and Malawi as the direct consequency of the probable greater ages of these deep lakes.

2.2.4. DIVERSITY OF THE ICHTYOFAUNA ON THE ZAÏRE BASIN

The greater diversity of Tanganyika's fauna must be related in part to the rich Congo river stock diversity. Indeed, seven of the ten families which constitute endemics to the Lake Tanganyika fauna are also represented by endemic fish to the rapids of lower Congo (Characidae, Cyprinidae, Bagridae, Claridae, Mochokidae, Cichlidae and Mastaridae). ROBERTS & STEWART (1976) reported that the Cichlids *Lamprologus* adaptation to the rocky littoral of Lakes Tanganyika received a preadaptation from the rocky habitats from the river Congo rapids. Accordingly Congo basin may be divided in six ichtyofauna regions (Poll, 1939 and 1959 quoted in LOWE-MCCONNELL, 1986) :

2.2.4.1.Ichtyofauna regions of the Congo basin

2.2.4.1.1. The Lover Congo, below Boma and entering a mangrove lined estuary (most eryhaline species; marine fish families: clupeids, gobies, tetraodonts, and freshwater species: cichlids , cyprinodonts , anabantids);

2.2.4.1.2. A stretch with 32 falls and rapids in 350 km between Matadi and Pool Malebo;

2.2.4.1.3. Pool Malebo, 500 km^2, enlargement of the river;

2.2.4.1.4. The great Center basin of the Congo, over

1.500 km upriver and almost on the Equator;

2.2.4.1.5. The upper Congo basin or Lualaba above Kisangani Fall;

2.2.4.1.6. The Upemba lakes on the Lualaba flood plain.

Most species move into the inundated forest at high water to breed and to feed, and back to the low water channels as the level falls. Young fishes stay behind in pools which become isolated as the level falls and fishes with special adaptations to withstand deoxygenated conditions may remain in swamps (LOWE-MCCONNELL, 1986). The shallow marginal waters along the banks and island, and over there when the river is high, carry more fishes than do the open waters.

So, the main biotopes include the rapids below Kinshasa, the swamps (either permanent), the main river (more numerous and diversified than swamps and streams), the marginal water (diversified series of biotopes and very important to the fishes), the inundation zones (which carry juvenile fishes of many species), the streams (shaded with very small variations in microclimate), the large lateral lakes.

Because of the importance of the Congo river fish fauna and its diversified ecosystems, particular protection should be maintained. It seems that those ecosystems with the richest faunas are likely to be those that are the most sensitive to perturbation. Furthermore, field works between Kinsuka and Maluku on Congo river confirmed that extensive among site variation in food-web parameters was associated with differences in species richness and environmental differences associated with rainfall patterns, physiography and gross primary production.Seasons generally influenced food-web parameters less

than did site differences (MUZIGWA,1989).

2.2.5. FISHING PRESSURE TO NATIVE FRESHWATER FISH

An investigation conducted on 50 high value commercial fish species (listed above) showed that there is a market change in the taxonomic composition of the fishery with reduction in diversity from 1973/1982 to 1984/1988 (Figure 7).

With respect to the Bagridae, Characidae,Cyprinidae,Distichodontidae, there is decrease in diversity calculated through Herfindahl index of diversity (H : $\sum_{i=1}^{n} S^2_i$). Obviously compared to 1973/1982, fishing effort increased to catch the equal weight in 1984/1988. The 1973/1982 Distichodontidae Herfindahl index is 0.46 whereas in 1982/1988 it decreased to 0.01 (Table 9) .

2.2.6. THREATENING SIGNS

2.2.6.1. Over-exploitation

The over-exploitation of the most accessible Zaïre river ecosystem is due to the abscence of a planned aquatic ecosystem management strategy. Indeed, as stated LOWE-MCCONNELL (1986), most species move into the forest at high water to breed and to feed. During this period poorly equiped craftsmen fisher is unable to fish. To overcome this difficult he uses ichthyotoxic plants (DECEUNINCK, 1990) and dynamite in order to optimize his annual yield. Later on, back to the low water channels as the low water level falls, the same fisherman can not face Zaïre river rapids, preferable biotop to well gauged fish. Once again he resorts to toxic plants or to dynamites for fishing.

Young fish stayed behind in pools which become isolated as the level falls and fish with special adaptations to withstand deoxygenation conditions remaining

in swamps become preys to any predator.

2.2.6.1.Introduction of non native species

The introduction of non native species had lead to some extent on competition and predation . One of the introduction which has caused to much damage on *Distichodus* spp. and Lates sp. has been done unvolontary in fishculture in Central Africa (Ubangui), when the scientists decided to use the Heterotis niloticus as a carnivorous fish to control over population in *Clarias spp.* and Tilapia spp. fish ponds. Unfortunately, some of this carnivorous escapped from these fish ponds and they are now competiting for food and now feeding on larvi of many species of the Congo river. Fishermen are now complaining, since catching effort had increased.

2.2.6.2. Fishculture and aquariological unwised action.

Some of the imported species (from South américa: Amazonie) for home aquarium has been caught around Kinshasa region. Tilapia spp. reared around Kinshasa region had populated Congo river and now competiting for food (MUZIGWA, 1994). Permanent education programme through media facility is required in these circumstances.

2.3.- STRATEGY TO REHABILITATION AND PROTECTION

Vanden Bossche (1986) reported that most markets (in Mbandaka) were inundated with fingerlings caught from marshes, shallow marginal waters along the banks and iland during subsiding period (LWL) (Figure 8).

These figures should be useful in management strategy to protect very young fish by periodical closing of the spawning grounds especially during high water level (Figure 10).

2.3.1. NON ALLOWED FISHING MESH SIZES

The following monofilament fishing gill nets with specific mesh sizes should be prohibited in margin waters in order to protect early stage fingerlings (Surface monofilament fishing nets: floatting rope : plastic weights with lead : 9 g/m. Bottom monofilament fishing nets: nylon weights with lead: 33 g/m)(Table 10).

2.3.2 .PERIODICAL CLOSING OF THE SPAWNING GROUNDS (at high water level: during the flooding of the Congo river)

Because most of fish do spawn few days before the rising of water levels (between October to 15 February in the high part of the Congo river and between 15 October to the end of December in the low section of the same Congo river), recommandations to extension officers in fishery management should foresee a closing fishing period in the margin waters.

2.3.3.PROHIBITED FISHING TECHNICS

Non ichtyotoxin neither dynamite fishing technics should be used during that period. Extension technician officers to contrôle the application of this regulation should be very mobile, controling by air and on water surface.

2.3.4. ORGANIZIING FISHERMEN IN REGIONAL COMMITEE

Fishermen can collaborate to this project. Most educated among them could be registered and being trained for that perspective. Gathering together in small committee, later on, in cooperative may be helpfull. Periodical meeting with regional officers in charge of extension service should be held at

the main fisheries during which targets to achieve in the strategy to protect threatened fish could be define.

2.3.5 . CONTROL, MANAGEMENT AND PROTECTION OF THE SPAWNING GROUNDS

Most critical months for eggs and newly hatched larvi may be identified in most tropical aquatic ecosystems with respect to spawning seasonalities process of cichlids fish in Lakes Malawi (Malawi in Africa) and Jiloa (Nicaragua in South America).

Ripe females do migrate in the spawning grounds with the rising of water in tropical Lakes and rivers. With respect to Congo river, around Kinshasa region, this phenomenon (in the middle of November) do coincide with improving catch by the fishermen of the most large species. Later on, (from December to January) the number of adults fish caught decreases with consequence that most fishermen do rely on fingerlings and very young specimen.

Accordingly, a coordinating programme to protect or to rehabilitate any fish population in these aquatic ecosystems should define the closing grounds and the control of the mesh size.

2.4.-DIFFICULT TO POTENTIAL MARINE INDUSTRIAL FISHERY

The D.R.C. (ex-Zaïre) is cosi'gnee of the United Nations (UN) Conventions for management , to protect and to access to sea water resources, in accordance with the article 70 . Therefore, it is recognized to Zaïre the use of the EEZ (Economic Exclusive Zone fixed at 12 miles). Unfortunately, Zaïre has a very narrow opening to sea (40 Km only). This natural handicap limits the type of fishing smacks. Most of time, apart from the compulsions to fish production described above, conditions required to in the

neighbours countries' waters (Angola, Namibie and Gabon), to congolese private fishing industries do not allow any blossom out to this sector. Consequently, there is only one sea fishing industry (Pêche industrielle de Moanda : P.I.M.[3]).

3.- CONCLUSIONS AND SUGGESTIONS

To become self sufficient food production Zaïre government should first of all to become more credible towards both local and foreign investors then it should allocate enough fund and honour his commitment towards agriculture projects on time. Furthermore, macro-economic infrastructure (lines to allow exchange between regions) should be the most important priority to others. Multidimentional agro-farming projects valorising the potential seats of integrated rural development should be obligatory encouraged. Existing colonial infrastracture in these regions allow to initiate integrated fishfarming and poultry or cattle breeding .

At least, more governmental effort should be required to educate permanently rural population through local media programme and to include , in the universities programmes, Aquacuture and Fishery management training courses. A country like Congo, with an enormous natural hydrobiological potential should prepare his officers to its management. Local busness men should encourage their countparts from overseas to undertake complementary activities, investing more and more in agriculture than in mining .

Local deficit is continously growing. In 1951 it represented 244,046 tons, while in 1985, it reached 614,025 tons. Therefore, the annual fish production increment is about 3,263 tons per year while zaïrean population grows at a rate of 565,801 habitants/year (Annual Population growth rate reported is

about 2.56% : Ministère de l'Agriculture, Service de Planification Agricole 1987). However, fish production has one of the lowest annual production increment (it represents 0.13%), calculated from the available official statistics. Obviously, this country seeks a more realistic and performing fishery and fish farming programmes.

The world number of threatened and endangered fish had increased. This is a response either to aquatic ecosystem alteration or to fishing pressure. A varied number of harmful external or internal factors to their habitat may be avoided through a practical habitat and fishery management. This should include publicity, politics, and law for conservation (WELCOMME, 1986; NEILAND *et al*., 1990 and McGREGOR, 1990). Few years ago, threatened words of fish increased and it seemed to be a specific problem to developed countries especially to Europe, North America and to Soviet Union Republic (URSS). (FITZ, 1968; CONROY, 1975; BURD 1978; ANON,1985; CADWALLADER , 1978; MACCALL, 1979; MACCALL *et al*. 1988; STEPHENS, 1983; WILLIAMS *et al*. 1985 and 1989; MOYLE *et al*., 1986; FAUSCH, 1988; MILLER *et al.* 1989; INGRAM *et al.,* 1990 ; and STEPHENSON *et al.* 1990).

However, with respect to Zaïre river, recent studies and reports funded by AGCD (ABOS) (VANDEN BOSSCHE, 1986; MUZIGWA, 1989, MUZIGWA & MUTAMBUE, 1993; MUTAMBUE, 1992; KANINGINI, 1994 confirm that the number of threatened, endangered and declining fish is likly to increase in the face of escalating problems of habitat destruction and degradation.

In the absence of protective legislation and basic research for

structuring recovery in Congo, fish pressure had lead to such severe depletion that some stocks could be unable to recover, if from now nothing could be done. OGUTU-OHWAYO (1990 a and b) and MCGREGOR (1990) working on the most collapsing african cichlid fish (*Haplochromis spp.*) stated that indications in Africa and elsewhere that the dramatic decline and demise of cichlid taxa in lake Victoria will not be an isolated phenomenon.

Evidence suggest that following human exploitation and introduction of non natives fishes has lead to reduction in fish species diversity in lake Victoria too (ACHIENG, 1990; GREENWOOD *et al.,* 1989 and OGUTUOHWAYO, 1990b). Earlier than that, authors such as ROBERTS (1975), BOTKIN (1984) O'KEFFE (1989) were hardly concerned with the ecosystem context of the management of endangered species of South African rivers. In Sudanian fauna, BUKAR et *al.* (1985),WELCOMME (1986) and NEILAND et *al.*1990) reported that the decline of the commercially important species is the direct consequences of damming, drought and overexploitation in lake Tchad, in river Niger and in river Benue respectively. Furthermore, in a crater lake, in Cameroun, the World Wide Fund (WWF) research team was alarmed by the decline of two cichlid species due to internal factors (agrochemicals, damming, deforestation, and overfishing) and to external ones (alien species, aerials pollution, socio-economic pressures and visitors pressure (BOUWMAN, *et al.*, 1990 & MCGREGOR, 1990). Predicted overpopulation in Africa will lead to increase in deforestation and in the advance of desert conditions, erosion and depletion of the soil (ENDA, 1980). Consequently, african widespread species from generalised habitats have to be threatened

(O'KEFFE 1989 & SKELTON,1990).

Most fish biologists do now agree that for a quick recovery of declining and collapsing fish stock, the biology of the species should be clearly defined (KAUFMAN, 1987 & LE CREN, 1990). This could include a captive husbandry of endangered species, identification of unique gene pools for special protection may be achieved (MEFFE,1990). However, prior to any field and laboratory works, as a part of strategy to help in recovery of any vanishing or threatened species , its present status throughout the world should be defined. Natural distribution being clarified.

As matter of fact, most biologists do not hesitate to link " Aquaculture and Development " (The Symposium on Aquaculture and Development. Nov. 1986. Univ. de Liège). On the one hand, for the simple reason that the standard of Aquaculture in a given country, can be regarded as the reflection of the potentials for technology transfer this country has; on the other hand; thanks to Aquaculture, man has proved he can control the production and thereby, guarantee his alimentary auto-sufficiency.

In short, this type of food production is an evidence of the enormous efforts that part of the humanity is outspreading to overstep the simple pic up, fishing and hunting. The African man, perpetuating this state, generally prefers fish from rivers, streams and rather than, Tilapia from ponds.

Therefore, it is not surprising that, on the African continent, where fishfarming has not been established for several thousands years like in Asia (HICKLING, 1950; BARD, 1962 and HUET 1968), it has not been properly vulgarised, and therefore failed.

The related experience of the belgian-Congo and Rwanda - Urundi is a good illustration of the problem, although the lac of knowledge in basic biology as well as reproduction and feeding behaviour (RUWET, et *al*.1983., PHILIPPART et al.1986), the indistinctness in the identification of the Tilapia species and the lack of home specialist, contributed to this failure.

Although these gaps have been fullfilled, and this thanks to the work of some Scientists (DE BONT, 1950; POLL and GOSSE, 1963; THYS VAN DEN AUDENAERDE 1971; RUWET and VOSS 1974) and, despite an improvement in the rearing techniques aiming at a maximum production per cubique meter of water, the Afican Fishfarming is still seeking itself!

Therefore, experienced men consider that it is time to contemplate a new approach of fishfarming extension service that would be more realistic. For the sub-Sahara african , in our point of view, two aspects of this new approach would be to introduce and farm some of the currently fished species (together with the intention of restocking the progressively deprived water bodies) and to adjust the rearing infrastructure to the farmer's income and needs.

To answer to the problem of food shortage in developping countries ,particularly in Africa specialist have suggested, among other possibilities, a more ratrional exploitation of the aquatic potential. Within the current economical contest, it is out of the question to think of improving the fishing gear and increasing their potential of action by using more " harrier " boat. It is a better option to encourage the lagoons and the estuaries (PAULY 1975; ERIC 1976; MOLL et al. 1972).

In subtropical Africa, in Congo in particular, a very diversified aquatic fauna can be found. Its valorisation as a source of protein should deserve a closer attention. In addition to this, the development and protection of the ecosystems previously mentioned, would insure an optimum production.Anxious about the future of this fauna in Congo, a survey has been conducted and has enabled to list fish species, crustaceans and floating plants with a high nutritional and an appreciable economical value.

The liking of Africans (those of Central Africa in particular) for freshwater fish, means that they are ready to pay more money for continental freshwater fish than for brackishwater or marin fish.

In Kinshasa, one kg. of mackerel (commonly called " Mpiodi ") cost, nowadays 550,00 zaïre (nearly 100 BF) whereas one kg of fish from the river Congo cost 980,000 (nearly 180 BF).

With respect to genetic approaches to conservation, since genetic data are now used to monitor hatchery population of several endangered fishes as stated by MEFFE (1990), more informations are needed in order to describe the quantity and geographic distribution of genetic variation in threatened species, to estimate historical levels of natural isolation and gene flow among populations, to identify an unique gene pools for special protection, thus contributing to taxonomic clarification, and to the choice of stocks to release into the wild.

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