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AD HOC TECHNICAL MEETING ON ARTISANAL FISHERIES CRAFT, PROPULSION, GEAR AND SECURITY IN THE IDAF REGION

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25 - 28 September, 1989

Cotonou

Programme de Développement Intégré des Peches Artisanales en Afrique de l'Ouest - DIPA

Programme for Integrated Development of Artisanal Fisheries in West Africa - IDAF

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With financial assistance from Denmark and Norway, and in collaboration with the Peoples Republic of Benin, the Fisheries Department of FAO is implementing in West Africa a programme of small scale fisheries development, commonly called the IDAF Project. This programme is based upon an integrated approach, involving production, processing and marketing of fish, and related activities ; it also involves an active participation of the target fishing communities.

This report is a working paper and the conclusions and recommendations are those considered appropriate at the time of preparation. The working papers have not necessarily been cleared for publication by the government (s) concerned nor by FAO. They may be modified in the light of further knowledge gained at subsequent stages of the Project and issued later in other series.

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A previous meeting on this subject was organised by the IDAF Project at Freetown, Sierra Leone, on 15-18 November 1986. The report was issued as IDAF/WP/17.

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The meeting was opened by Mr Gilbert Mensah, Director of Fisheries in the Ministry of Rural Development and Cooperative Action of the Peoples Republic of Benin. He welcomed participants to Cotonou, and appreciated the importance that was being given to the matters under discussion.

It was agreed that Dr Gordon Sheves be the chairman, as he had chaired an earlier meeting of a similar nature in Freetown in November 1986. This ad hoc meeting was a followup to the Freetown meeting.

The names of the participants are presented in Appendix I and the agenda is given in Appendix 2.

Part I - Vessel and Motorisation Developments

Vessel and improvements in Sierra Leone

This session was begun by Mr Taylor Co-Manager of the Project for Integrated Development of Rural Fishing Villages, Shenge Region, Sierra Leone. It was explained that the fleet operating in Sierra Leone could be categorized as:

- Kru canoes, usually 1 man operated, 3-6 m long with 0.6 m beam, dug-out powered by paddle and sail ;main fishing methods are lines and gill nets.

- Standard 1-3 man canoes 6-7 m long with 1.3 m beam paddle and/or sail powered ; main fishing methods lines and gill nets.

- Standard 3-5 man canoes, 7-8 m long with 1.5 m beam propelled by sail with some motorised; main gear drift nets.

- Ghana boats up to 18 m long with 3 m beam powered by 25 hp-40hp outboards (mostly Yamaha) ; main fishing gear, ring net.

Standard canoes and Ghana boats are planked as no large trees are available as in Ghana. The Kru canoes are dug out made from a single log. Work at Shenge has concentrated on improving stability of the present canoes and reducing their operating costs.

Experimentation was begun with a crab claw sail and although this performed slightly better than traditional sails, particularly when sailing to windward, local fishermen did not find sufficient advantage to accept this rig. Similarly a trial with a 9.9hp, 4 stroke outboard engine was inconclusive mainly due to a lack of spare parts.

Improvements in stability found greater success. At the moment the smaller vessels cannot venture far from land because of the risk of capsize. To overcome this the project introduced simple outriggers. The prototypes were constructed from P.V.C. pipes. These were successful but needed a greater degree of crew agility in operating the canoe. A next stage was to use 'V' shaped pontoons constructed from planks. These were more successful but their length decreased manoeuvreability and posed problems when beaching.

The next stage in this development was to use a locally obtainable soft wood akin to balsa. This gave good buoyancy and was readily available.

The outriggers are fixed with cleats and are lashed with rope to the canoe stringers and outriggers poles. The necessity of stringers on which to lash the outrigger also provides longitidunal strength to the canoe. So far 15 vessels have been fitted with outriggers and ten lives have been saved due to greater stability. A stimulant to their adoption was the fact that during the last rainy season two canoes fitted with outriggers were able to operate when others did not venture out. This convinced other fishermen of their efficacity.

Vessel Improvements in the Gambia

Mr Mbye of the Gambia Fisheries Department described work going on in that country. Traditionally the vessels used are Senegalese built to the normal design. These are :

- 7-9 m with a 3-4 man crew, main gear gill nets, powered by 25 hp outboards

- 10-12 m with a 6-9 man crew, main gear surrounding net, powered by 25 hp outboards.

- 11-15 m with an 11 man crew, main gear purse seine, powered by 40 hp outboards.

All are motorised except the smallest 4 m vessels. Recently G.R.P. vessels have been tried. The Italian government had provided 150 of these vessels and 100 were given through Japanese government assistance. However five years previously the government had received two G.R.P. vessels with inboard engines. Of these one was kept by the fisheries department and the other given to a local fish smoking cooperative which mistreated it. It has now been repaired by Japanese technicians working with the fisheries department and these two vessels now form the basis of a training programme for unemployed youth. Each vessel carries 3-4 school leavers and the period of training lasts for two years with continual assessment by the project's master fishermen. Training has been given in gill netting, long lining, and octopus pots have been tried. Presently the fisheries department are constructing a 250 m purse seine. A small trawl given by the Japanese Government has also been tried but it was found that the 23 hp engine in the project's vessel was not powerful enough for towing.

Supply of timber

The first presentation of the Tuesday was by Mr J.Prado of FIIT Rome, who discussed FAO Fisheries Department's anxiety concerning the sustainability of large logs for dug out canoe manufacture. The problem centred round the constant depletion of the forest reserves of wawa Triplochiton sclerexylon particularly in Ghana but also in other West African countries, and the time needed for these trees to grow to a sufficient size to provide logs capable of being carved into a large canoe. The minimum size of tree for a large canoe was 165 cm diameter and these could take over 100 years to grow. Not only was this timber in demand for canoe building but there existed a high demand for its use in other industries such as construction and manufacture. At the moment the annual demand for large canoes was estimated at around 600. This figure should be viewed against a standing stock of 30,000 large trees all of which would not be available for canoe carvers. Also the tendancy in Ghana was for greater emphasis to be put on the harvesting of smaller trees which were more economic. Eventually therefore all the larger trees would be harvested and would not be replaced under the present forest management regime. This situation needed careful study as in the past several replacement vessels had been tried but none had met with the approval of the fishermen or had had the characteristics necessary to operate from open beaches.

In view of the gravity of the situation and the need to act immediately to avoid a decline in the artisanal fishing industry due to increasing prices of vessels and / or a reduction in the fleet, FAO was proposing a two phase project. The first phase would consist of in depth studies, to permit a detailed analysis of the situation and to prevent duplication of research. The main themes of the studies would be :

- Survey/inventory of the timber resources available for canoes either dug out or of more traditional construction.
- Socio-economic aspects of the fishing and canoe building sectors
- Boat building feasibility studies
- Survey of landing sites to determine how many canoes actually operate from open beaches.

The second phase would consist of :

- Establishing a task force of representatives of interested parties from the fishing and boat building sectors.
- The preparation of several alternative designs.
- Construction, testing and commercial operations of promising models.
- Preparation of guide lines for series construction.

The programme would be closely associated with IDAF and would be developed within the Regular Programme activities of FAO; the main divisions involved being FII and FOR.

Introduction of new craft

Mr Prado was followed by Mr Y. Pinard who discussed the difficulties of introducing replacement craft to existing fisheries. He drew examples from three countries - Sao Tomé & Principe, Maldives and Senegal - in which he had worked.

A crucial feature in a vessel replacement programme was to have a clear objective, and that should be to introduce a vessel which would be acceptable to fishermen and not merely a well designed craft pleasing to the eye.

Four criteria had to be examined and satisfied before proceeding with a replacement programme. These were :

Tradition : -

> This concerns the conservatism of fishermen and their reluctance to accept innovation too far removed from their experience. Often it is governments who are enthusiastic to introduce "modern" designs and materials, for exemple G.R.P., which may be opposed by fishermen. Also it was much easier to introduce innovation when dealing with non traditional fishermen as was found in the Casamance in Sénégal where the project was working mainly with agriculturalists who have no preconceived ideas based on tradition.

Economic performance

> Often a replacement vessel while being superior to those already existing may be uneconomic in terms of the fishery being pursued. Vessel designs and construction methods most therefore be examined to ensure that local fishermen can operate any replacement craft economically.

Local Skills :-

> Attention should be given to the level of local boat-building skills so that any replacement vessel introduced is capable of local replication.

Prototypes :-

> It is insufficient merely to present a new vessel without extensive trials under commercial conditions whereby the prototype model can be modified to suit the needs of local conditions and fishing practices.

Often reluctance or inability to replace traditional vessels lead to conflicts with other resource users. In the Maldives for example the traditional vessel is constructed from coconut planks. These vessels are 12 m x 3 m and draw only 50cm of water, they have developed over the last 600 years and are ideally suited for the local shallow water conditions. To replace these craft using other, almost certainly heavier, materials would change their characteristics, therefore they continue to be built of coconut wood. The difficulty arises in that suitable trees are now in short supply and felling is strictly controlled by the Government, and to prevent wastage, trees are only now allowed to be cut by experienced carpenters who choose trees naturally shaped.

In Sao Tome and Principe 7 m yamaha G.R.P. vessels were introduced and were immediately accepted by fishermen. Traditional beaching techniques were not however adapted to conform with the new materials. After only 4 years therefore only 7 vessels out of an original 30 were still operable, the rest having been damaged on beaching (the beaches being volcanic in origin). Now with Japanese assistance these vessels are being repaired at a cost of around $ 7000 each - the same cost as the original new vessels.

In Sénégal also vessels have developed to their present state over the last 200 years. Some innovations have been seen, for example the present practice of cutting four keel pieces from one log whereas in the past only one piece would be cut. This is however a reaction to diminishing timber supplies. Basically the vessel has not changed except to have become larger. In fact the vessels in use in Senegal are so well adapted to the condition that it may be impossible to have an adequate replacement.

The main problems with the Sénégalese vessels are instability and leaking. The former is overcome by shipping an extra 10-12 men, simply to sit on the gunwale opposite the hauling side to provide ballast when hauling a purse seine. This seeming under- employment could be avoided through structural changes to the vessels but this is opposed by vessel owners on social/familial grounds who insist that it is necessary to provide a livelihood for these supernumeries.

Leaking in these vessels is caused by their flexibility and construction methods, but particularly the latter. The garboard strake and second plank are butt jointed and drift nailed to each other and the keel with fastings made from ungalvanised reinforcing bar. The two top planks are similarly butt joined to each other and the third plank is clench fastened to the second plank. Apart from leaks occuring at the butt joints which are not perfectly matched, leaks also occur as the fastings progressively rust. Longitudinal patches are nailed along the inside of the plank fastenings but here also the nails rust and weaken the timber again causing leakage.

It is calculated that a new 14-16 m vessel costs 1.3 m F CFA ; the two top planks are replaced after 2 years at a cost of 200.000 F CFA and the two bottom planks after 5 years at a cost of 500.000. Thus in five years a vessel costs in total 2 FCFA million. With improved building practices a vessel would cost 3 FCFA million and last five years. In contrast a replacement vessel in G.R.P. with an unpredicted life span would cost 7 million F CFA. No fisherman is however willing to invest a further 1 million in improved construction for a vessel which will last 5 years when under present practices he can have a vessel for 2 million over 5 years; neither will fishermen invest 7 million F CFA for a vessel with an unknown duration.

Introduction of diesel motors in Sierra Leone

Mr Rod Beare Project Manager of the Shenge Project in Sierra Leone introduced his outline of the Shenge project's experiences with diesel outboard motors with the statement that, often imported technological innovations were innappropriate for local conditions and amounted in many cases to a solution seeking a preconceived problem. He cited the case of the diesel inboard motorisation programme in Sierra Leone in which two projects had been involved, each attempting to install diesel engines in existing and new canoes as a fuel and cost saving measure. Although this approach would appear sound and logical, in reality neither of the projects had successfully overcome inherent but unforseen difficulties encountered as their programme progressed. From the experiences obtained, several criteria could be identified as prerequisites for a successful inboard diesel installation programme.

- Speed of the vessel should be the same or greater than existing craft to ensure continuation of local fishing practices. As an example of this the Tombo project introduced diesel engines to the local ring net fleet which fish Bonga which commanded a high price on the market. By changing over to diesel inboards it was found that the vessels were no longer fast enough to encircle the adult fish which dispersed from an epicentre, but could only catch the young which tended to escape in a predictable fashion by zig-zagging down tide. Diesel powered vessels therefore in Tombo now have to concentrate on this younger stock which make a lower price on marketing, thus forcing the vessel owner to fish larger quantities than when the previous target was adult bonga. Now many of these vessels are being withdrawn from the fishing fleet and are being used as transport boats.

- Diesel motors should respond immediately on starting as often engines are stopped when a shoal is found and the vessel paddled arround to identify the movement of the shoal ; when the direction is identified the engine is restarted to surround quickly the fish with the purse seine. If an engine refuses to start immediately then the risk of losing the shoal is increased.

- Diesel installation programmes should be accompanied by intensive training to ensure adequate maintenance procedures of a the new technology. Simple problems such as air locks which do not occur with petrol outboards can seriously immobilise a vessel if local mechanics/ motormen are not aware of the problem. In fact at Yellibuya Island Bukh motors were installed but no training was given in their operation and when airlocks occurred it was beyond the competence of local mechanics to clear them with the result that owners removed the inboard diesel and returned to the petrol outboard which was understood by the fishermen and could be repaired locally. This simple occurrence set back the Yellibuya Island diesel installation programme by two years. Equally important is the need for training in maintenance of engine alignment which does not occur with outboards. In Sierra Leone when the vessels are lightly built and flexible this is especially important as a misalignment of the shaft and engine transmits wear directly to the gear box.

- Existing vessels should be capable of receiving internal propulsion units. At present the Sierra Leone vessels are lightly built and cannot be motorised without strengthening of the keel, skeg and stringers. This makes the boat heavier. But also in Sierra Léone vessels are virtually disposable with planking being renewed every two years. Even if vessels are constructed more strongly and with better construction methods they will still have to be replanked regularly because of marine borers. Engine installation therefore increases the cost of the basic vessel through increased scantlings but does not improve its longevity.

- Propulsion units should be easily removed from a vessel. In Sierra Léone vessels are often left at anchor and will sink if heavy rain occurs when the vessel is unattended. Also the vessels leak badly if they touch the bottom when at moorings. With an outboard motor this does not represent a problem as the motor is usually unshipped and stowed at the fishermen's homes. With an inboard engine however on refloating the vessel, the engine must be removed, stripped down, cleaned and reassembled before reuse.

- Alternative installation should be comparative in cost with existing means of propulsion or show benefits over time. They should show fuel cost savings immediately and over time.

- When introducing diesel motors, back up services for the technology should also be provided in the form of availability of fuel and spare parts. Part of the problem is that installation programmes are often instigated by projects which are not supported by in-country agencies and efficient to ensure a sustainable supply of spare parts and repair facilities.

Mr Beare went on to describe the Sierra Léone experiences with outboard diesel engines.

Ruggerini 8 hp and 14 hp diesel outboards were tested at Yellibuya Island but were not successful due to problems with lubrication, difficulty with starting, slow speeds and high vibration. The latter caused caulking aft and 15' forward of the engine mounts to shake loose. The economy of these engines was good but did not meet many of the criteria necessary for acceptability.

At Shenge a Yanmar 27 hp diesel outboard has now been tested for one year and this engine meets virtually all the necessary criteria. The fuel saving is 60%, speed is in excess of a 40 hp petrol outboard vessel and vibration is low. An added advantage over inboards is that installation is simple and requires the minimum of modification to convert from petrol outboard propulsion. The main but minimal disadvantage is that the engine is about 20 kg heavier than a petrol outboard. No serious mechanical problems have been experienced in one year's operation except air locks occurring in choppy seas due to the small fuel tank and wear on the starting ropes. However it was found that the plastic starter wheel, round which the starting rope is wound, had broken after one year's use.

Calculation of costs and returns made by the project show that the Yanmar diesel outboard is economically superior to all other alternaive propulsion units and installations.

Vessel improvement in Benin

Mr Pascal Tanimomo described the improvements carried out by the Benin national project. It was emphasized that the strategy was to improve existing vessels by making them more versatile without changing deck lay out. The main improvement was to insulate the existing underdeck space so that the vessels could carry ice allowing them to go longer distances and stay at sea for longer periods. The unchanged deck lay out however allows the vessels to continue to utilise their traditional purse seines.

Insulation consisted of installing three water-tight bulk heads to divide the fish hold. Between the bulk head panels and the underdeck flooring 60 m/m polysterene was fitted. In order to allow bilge water to flow from forward to aft a plastic pipe was fitted in the lowest part of the hull. This was sealed at the point of traverse of the bulkhead to avoid bilge water contaminating the ice. Insulated hatches were also fitted. With this system ice could be stored for 4-5 days. Although normally project and other vessels made up to 3 day trips.

Apart from these improvements the Benin project had also installed three diesel engines in traditional Ghanaian dugout canoes. These installations consisted of two vessels with fixed shafts and their propellers in tunnels built into the hulls. The other had a fixed motor with a pivoting shaft assembly, which allowed the propeller shaft and rudder to be retracted into the hull on beaching. The pivoting shaft version and one tunnel version are powered by a Volvo watercooled 2003 23 hp motor and the other tunnel vessel has a Lombardini air cooled 8 LD - 655 23 hp engine. All engines demonstrated substantial savings in fuel consumption over 40 hp petrol outboards also used by the project. These savings were in the order of 60%. The costs of a normal two day trip with an outboard cost around 23,000 F CFA in fuel while with a diesel the trip cost around 9,000 F CFA.

Part II - Improvement in Fishing Gear

Twine deterioration

This section was opened by Mr Udolisa of the Nigerian Institute for Oceanography and Marine Research who presented a paper prepared by his colleagues and himself on the effect of sun light on polyamide twine deterioration.

This study was prompted by the fact that artisanal fishermen in Nigeria (and elswhere in Africa) habitually left their synthetic nets and ropes exposed to sunlight, the effects of which had not been quantified.

The study was in two parts :

a) The relative wet knot strength of the twisted polyamide netting twines used in the fabrication of artisanal fishing nets in Nigeria

b) The weathering (sunlight) effects on artisanal polyamide netting twines.

A summary of the results showed that the relative wet knot strength of the various twines tested ranged from 64.55% - 75.37%. The sunlight exposure tests were conducted on the roof of the institute and were affected by stretching knotted twines of different thickness in a position exposed to the sun. After 400 hours exposure to sunlight the breaking strengths were tested. The loss in strength ranged from 13.5% - 24.8% with netting twine of R 77 tex being least affected and R 51 Tex showing the greatest deterioration. Under shaded sunlight, again with 400 hours exposure, deterioration was reduced to 10.0% - 18.9% of their initial breaking strength.

Offshore fishing - experiences of the recent past

Mr Prado introduced his talk with the observation that recent tendencies were for fishing to be carried out at greater distances from shore which has introduced the necessity to modify gear and vessels to equip them for different working conditions. In the main, offshore fishing has meant exploiting resources in deeper water. Hand lining in 400-600 m needs greater attention to details of rigging lines and also the use of reels for retrieving the lines and catch. The latter have gradually become more sophisticated as deeper waters have been exploited. Vessel improvements have also developed in the manoeuverability and mooring systems so that they can change grounds rapidly with a minimum of loss in fishing time. Bottom long lining which is often over rough ground had previously the disadvantage of being costly in lost hooks when the line was set on the bottom. Also the setting time encouraged shark depredation. To overcome this, vertically set long lines were developed which keep the hooks suspended above the ground and allows the same number of hook to be worked in a shorter time, minimising setting time and avoiding, or at least reducing shark interference. Bottom set gill nets and the vessels which use them must also be improved when working further offshore.

Traditionally fish traps have been used in widely varying geographic regions, though until recently mainly in shallow water and on coastal reefs. Now these are being used in much deeper water. In Porto Rico for example deep water traps in 270-360 m of water yield 2-15 times higher catches than similar gear in the traditional shallow water fishing areas. In addition deep water fish have a higher value and are of better quality. Similar experiences have been noted from other areas.

Improvements to pelagic fishing are also evident, again with the tendency to fish further offshore. Although offshore trolling for example is traditional in some areas, in others the method has recently been introduced either as a specific fishery or as an additional activity to normal fishing practices. In Indonesia an offshore trolling industry has recently developed 120 miles off the West coast of Sumatra with surface trolling for small tuna, and at deeper depths for larger fish. In India in combination with offshore drifting gillnets, trolling was tried during the 14-18 hours trip to offshore grounds. In 2 months (36 trips) the lines caught over 450 kg of fish weighing between 6 and 12 kg each, which represented a market value double the cost of fuel used in the same period.

The evolution and increasing use of drifting gillnets for large pelagics has also necessitated improvements to materils and vessels. In particular, care must be exercised in choosing the correct mesh size for the target species in a particular area. Also, attention must be paid to correct fishing depths and appropriate rigging of the nets.

An offshore resource often under-exploited is shark. Exploitation of the fishery often demands the introduction of new methods and equipment, for example floating longlines. To change over to this fishery, which often involves the handling and processing on board of large fish, may require modification to vessels. Several exploratory and trial fisheries have demonstrated the commercial viability of shark fishing (in the Red Sea and Mozambique). In the Caribbean around Tobago, an 8.5 m vessel with two 48 Hp outboards and using 300 hooks per day can catch around 200 kg of fish (two thirds of which are shark).

Research is still ongoing on new deep water and offshore resources. Flying fish which are common universally in the tropical zone are now being fished experimentally with gill nets off the East Coast of India with encouraging results. In other areas in water depths up to 700 m experimental pot fishing for crustaceans has been tried, for example, off Bermuda and the Seychelles, and off Namibia the Geryan crab is already fully exploited by a Japanese fleet.

Despite the increase in offshore and deepwater fishing, exploitation is not without constraints. In the main these can be economical - lack of fuel, spare parts, ice, bait and insufficient vessel capacity. Other biological and ecological features also intervene however, with limited fishing areas, abrupt continental slopes, slow growing species and dispersed populations being the main limiting factors.

Survey of fishing gear on Volta Lake

A very detailed and well studied paper was presented on the fishing gear in the Yeji area of Lake Volta by Mr Braimah the National Director of GHA/88/004 "Integrated Development of Artisanal Fisheries in Yeji". In his presentation Mr Braimah described all the fishing methods used on the Lake in the vicinity of the project site with description of variations in the use of gear according to water conditions.

The presentation was reinforced by Mr Braimah's demonstration of a model baech seine net as used on the lake and his exhibition of a sample card for twine identification which he designed for use in the villagee so that confusion as to twine size and materials would not occur.

Recent gear development in the Gambia

A short talk was given by Mr Mbye on the experiences of the Gambia Fisheries Department in the introduction of and experimentation with new gears in recent years. The main innovation had been octopus pots and a pelagic purse seine.

The octopus pots used were made from segments of motor tyres, each tyre yielding three or four pots depending on circumference. The inner walls were wired together at the bead and one end was closed by a round wooden plug with a drilled hole in the centre. The overall approximate dimensions were 220 mm long by 100 mm diametre. Usually 14 pots were set in a string across the current on hard ground. The pots yielded 2-3 octopus each three days. The trials were however only newly started and the pots had been set only three times. The use of pots had been decided upon because of the high catch (350 t p.a.) of octopus by trawlers in the Gambia. At present the price was around US $.70 per kg.

Mr Mbye also described his department's work with a purse seine of Japanese design. This net was 230 m long and approximatly 19.6 m deep, with the main body of the net in 210d/15 x 60 m/m. Using a planked dug out of 15-16.5 m with a crew of 7-14 men the catch per day was 0.8 t - 2.5 t with the main species Sardinella maderensis, S. aurita, and mullet.

<u>The experience from Guinea Bissau and Cape Verde</u>

Mr Ansel (FAO) described his work on two recent but very different artisanal projects in Guinea Bissau and Cape Verde.

In Guinea Bissau the project was based at Biombo on the Biyagos archipelago with the objective of improving the artisanal fisheries of the area. Project work was carried out with a specially built 9 m x 1.8 m vessel powered with an 18 hp Volvo engine which was regulated to deliver 12 hp. The main fishing method was bottom set gill netting. Nets were mounted at 49 meshes deep (later reduced to 25 mesh deep) x 150 mm stretched mesh, with floats of 83 g and leads of 166 g. Only a limited quantity of netting was employed at any one time which amounted to around 500-700m. Daily catch rates were 265 kg with higher catches during spring tides. Even when the nets were reduced to 25 mesh deep this catch rate was maintained. The project employed six fishermen initially and then a further six. These were divided into two crews which alternated between fishing and mending on shore.

Sixty five percent of the fish caught were of the highest value category, as classified for the local market. Four women employed by the project prepared the fish for sale. What was not sold fresh was split and salted and dried. The local method of salting was to use dry salt but equally acceptable results were obtained by brining for 2-4 days prior to sun drying.

Although the price is fixed by the government and prices at Biombo are 10% lower than in Bissau salted dried fish finds a ready market in the capital.

Mr Ansel's work in Cape Verde was completely different from that in Guinea Bissau and included the fabrication and placing of fish aggregation devices (FAD) around the coast. In all, twelve FADs were positioned. Of these, three were sophisticated and of Japanese make while the others were locally fabricated.

The Japanese FADs of fibre glass construction consisted of a marking buoy on which were fixed, horizontally, solar panels for powering a warning location beacon on top of the 18.8 m upright, while below the surface, ropes were stretched between the perimeter of the flotation platform and the lower extension of the upright. It was claimed by the manufacturers that the vibrations set up by these ropes added to the attracting power of the FAD. The moorings consisted of a 250 kg block anchor on the sea bed attached to 70 m of chain followed by 18 m of 12 mm polypropylene. This was attached to the FAD by 200 m of 10 mm steel cable.

The locally made FADs were constructed from steel panels which formed the flotation platform and steel strip and bar for the superstructure and mooring attachments respectively. In height, overall, these FADs were 4.65 m and had a bouyancy of 600 kg and a weight of 180 kg. Old netting and polythene sacks were fixed on the mooring attachments and cables. Moorings consisted of two discarded engine blocks of 200-400 kg and 60-100kg linked together by 20 m x 5mm chain. Above this was another 3 m of chain and then 16 m of P.A. or P.P. 22m diameter rope. This was attached to 20 m of 8 mm or 10 mm steel cable to which was fixed a 10-15m panel of old netting. The cable was attached to the FAD by 3 m of 5 mm chain. Each locally made FAD cost about US $ 800 including moorings while the Japanese FADs cost in the region of US $ 30,000.

The FADs were placed in various positions around the island group, and after two weeks fish were observed to be congregating in their vicinity. A diurnal migration of fish away from the FADs to a distance of around 1.3 miles with a return migration at dusk was also noted. Apart from congregating fish the FADs also acted as a point of reference for vessels which, with the absence of navigation equipment could locate fishing grounds more easily by steering for the FADs.

Although placed in positions near to fishing communities for the use of local fishermen, the fishermen were not informed beforehand and in most cases were not aware of their use. A further problem arose when three FADs disappeared in one night. This was thought to have been sabotage but this was not proven. One clear lesson from the exercise was that the fishermen must be fully informed from the beginning of the use of FADs and must be involved in their placing so that they will accept responsability for their protection.

The evolution and dangers in the use of small mesh netting in Ghana

This topic was presented by Mr Ben Anum-Doyi, master fisherman at the Fisheries Research and Utilisation Branch of the Ghanaian Department of Fisheries. The most damaging gears using small mesh netting are the watsa and poli net, both of these are now almost identical. Originally the watsa was a simple ring net with a 50 mm mesh used for large pelagics such as tuna and caranx but in the 1960s fishermen from Ada fitted pursing rings, after seeing sardine purse seines being used on 40' motorised vessels at Tema. Fishermen also noticed that beach seines which were constructed with small mesh caught anchovies, this lead to the development of the poli net with 1/2" mesh in the bunt. The poli could also however catch tuna and caranx which were the target species. This in turn forced fishermen to diminish the size of the watsa mesh ; until now there is little difference between the two nets.

Fishermen and the fisheries authorities are aware that fishing with small mesh nets damage stocks because of the catch of juveniles, and in fact the Ghanaian fisheries laws stipulate a minimum mesh size of 1"(25 mm). Despite several meetings between fishermen and fishery department staff no action has been taken to firmly enforce the minimum mesh size of 1" as this would cause hardship to fishermen, who fish adult anchovy with 1/2" mesh. Unfortunately the anchovy shoals are often mixed with juvenile sardines.

Relatively recently the purse seine was introduced to lake Volta by fishermen from the coast. Apart from the social friction caused by this innovation, purse seining (winch net) was banned because of fears of overfishing, but actually it still goes on.

Extension work - the Benin experience

The Benin integrated project has put considerable emphasis on experimental fishing and training in new methodologies. Extension training has been done in Benin itself and in Togo and Ghana. Mr P. Tanimomo and Mr P. Holler who have been closely involved with this work described their experiences.

Mr Holler discussed the project's work in Beninese fishing villages where the traditionally used bottom set gillnet was modified and replaced by multimonofilament netting. In addition to diversify fishing effort bottom set long lines were also introduced. Training was in two parts, for fishermen and for government field agents.

The fisherman's training was based on the following principles :

- The site of mounting the gear had to be in an actual fishing village
- The project would supply all material needed for mounting the gear
- The fishermen would supply a canoe for the trials
- The 5 fishermen selected for the practical experiment had to be well experienced and belong to one family unit
- During the net mounting period a per diem of 200 FCFA would be paid to each fisherman to defray loss of earnings
- The catch from the training trips would go to the fishermen

During the training period the technologist paid particular attention to discussing the advantages and disadvantages of new gear, not only with the fishermen working with the project but also with other village fishermen and particularly the elders. This was seen as an essential element in involving the greatest number of people in the training programme and a basic factor for stimulating interest in the new technology. It was considered very important that the fishermen themselves mounted the net as this familiarised them with the gear and introduced a responsibility for its upkeep.

The training was considered successful, with the fishermen regularly mounting their gear and even making their own improvement to it to suit local conditions.

For the field agents the training was at a more basic level, and had the objective of upgrading the agents'knowledge so that they could improve their relationship with fishermen in their daily work. Based on their present knowledge the training programme included :

- Counting and measuring meshes
- Cutting meshes
- Hanging ratio
- Mending, knots and splices

- Mounting nets and measurement of flotation
- Theoretical explanation of echosounder and reading of scales.

Mr P. Tanimomo fisheries technologist on the Benin project then went on to describe training of fishermen in the use of echosounders. Again the objective was to diversify fishing efforts, and echosounders were used in conjunction with bottom set gillnet and handlining on hard ground.

Training commenced by using the traditional lead line for detection of rocks. This was to demonstrate the advantages of the echosounder for this purpose. This phase of training also included onshore courses in motor maintenance, seamanship, navigation and theoretical instruction in the echosounder. At this state the fishermen realised that.

- Hand lining did not require a heavy investment
- Catches could be increased and costs reduced by spending two or three days at sea, per trip.
- The echosounder helped increase catches because of the rapid detection of suitable fishing grounds.

The third stage of training involved sending the fishermen trainees to sea on commercial trips on the project canoes. On their trip they were accompanied by experienced project personnel who continued training during fishing operations. The trainers received as a salary 50% of the proceeds of the catch after deduction of expenses. Using this methodology the project has trained :

- 13 experienced trainers in echosounding, gillnetting and hand lining
- Over 80 fishermen experienced in bottom set gill-netting and hand lining
- 12 vessel owners who have adopted the new techniques

Another aspect of the Benin project's training programme as described by Mr Tanimomo was the diffusion of gill netting using echosounders and compasses to Togo and Ghana. In each case the procedure was to have a period of demonstration fishing whereby local fishermen were exposed to the new techniques.

In both Togo and Ghana the demonstrations were successful and in Togo led to a small FAO T.C.P. funded project, whereby fifteen fisherman were trained. In Ghana it was found that the bottom conditions were completely different than those found in Benin and Togo. In both the latter countries the fishing grounds were characterised by the presence of a continuous fossil reef which lay in 50 m of water about 12 to 15 miles off the coast. This was easily detected by the echosounder. In Ghana the reef was absent, at least in the water fished during the demonstration. Here the bottom was flat with only small outcrops of rock slabs. Nevertheless using the echosounder it was possible to detect these with precision and the catches obtained convinced the fishermen of the efficiency of the equipment.

Recent development in the Beninese inland fisheries

Mme Hounkpe and M. Akambi of the G.T.Z. funded Project Peches Lagunaire presented a resume of fishing methods and recent innovations in the Beninese reverine and lacustine fisheries.

As explained by Mme Hounkpe the most recently introduced gear in lac Nokoué in fact arrived by accident when a fisherman who was about to fish his acadja fell ill after he had placed his net prior to fishing operations. On his return to work he was surprised to find that his gear in close proximity to the acadja had fished extremely well. From this experience evolved the "Medokpokonou" (literally translated, "one man alone is happy" which refers to the fact that traditionally several fishermen were engaged in fishing an acadja).

The Medokpokonou consist of a wall of sheet netting of about 50 m, at each end of which circular pockets are formed. In all usually five bundles of netting of 25 yards are used with a mesh size of around 15 mm (stretched). The netting is held in place and upright by stakes stuck in the lake bottom. The bottom rope which is leaded is embedded in the mud to prevent the escape of fish. The head line is not rigged with floats but kept above the surface by the stakes.

From the appearance of the first "Médokpokonou" in March 1983 it is estimated that by July 1988 at least 512 were in use in lac Nokoué. Ethmalose represents the greatest proportion of the catch. Of 92 installations observed, this species contributed 47.9% and shrimp 16.95%.

Mr Akambi then went on to describe the flood plain fishery, using various forms of traps. This fishery was limited in extent due to land ownership and the existance of the necessary geomorphological conditions which demanded a periodically submerged flood plain adjacent to a permanent water body. These conditions occurred to the west of lac Ahémé and in the area of the coastal lagoon.

The main types of traps were described :

. Side channel with trap
. Side channel with a capture chamber
. Side channel with trap and an associated barrage also with trap.

In each case the system of operation followed a similar pattern, and consisted of digging a sloping channel at right angles from the bank of the permanent water body. As the water level rose during the floods these channels were filled and fish passed into them but were captured in the various traps and chambers placed at their entraces.

In the coastal lagoon area, 186 channels were in use in 1989 giving a total area of 2.9 ha. The production from which was .79t/ha. On the banks of lac Ahémé 1178 channels were counted with a total area of 9.95 ha. This produced 1.43t/ha.

Part III Security at Sea

General safety conditions of the artisanal fleets in developing countries

In recent years numerous marine accidents have lead to a greater awareness and more open discussions of the safety problems facing the world's but more particularly developing countries artisanal fleets. Several accidents involving loss of equipment and life had been recorded in the West African region and it was now the policy of FAO to become more involved in this aspect of vessel operation. In this regard it was considered that this seminar was an appropriate forum within which this topic could be fruitfully discussed.

Mr Prado of FAO Rome presented a paper prepared by FAO which gave an overview of the problems, highlighting the circumstances found in developing countries which differed from those in more developed areas . One major contrast was the fact that in developed countries safety at sea was a prime concern of authorities, and regulations and training for accident prevention and life preservation had evolved over a considerable time. In developing countries often the condition did not exist whereby effective security measures could be introduced. These included :

- Poor workmanship or maintenance leading to breakdowns

- Low levels of literacy, preventing rigorous training in safety or diffusion of knowledge through written texts.

- Scarcity of foreign exchange preventing rapid replacement or repair of defective equipment

- Dispersion of fishing communities and low activity rates of fishermen many of whom may be part time.

- State security regulations in some countries which prevent the use of radios or pyrotechnics.

- Superabundance of labour and that ill-organised, leading to poor working conditions.

In addition in developing countries vessels in use are generally smaller than in the industrial countries and in smaller vessels the available reaction time is much less when an accident occurs.

Mr Prado then went on to categorize and discuss the types of life endangering situation which occur aboard fishing vessels :

- Injury to personnel
- Fire
- Foundering
- Collision
- Stranding
- Machinery breakdown or disabled
- Capsizing
- Survival at sea after an accident

The conclusions offered by Mr Prado were that in the smallest class of fishing vessel, undertaking relatively short trips, the awarness of the need for safety precautions was not so fully appreciated as in large vessels fishing for larger periods offshore. Similarly legislation which does exist often applies only (even in developed countries) to larger vessels. Also, the types of legislation in force tend to discriminate against safety training for small vessel operators.

A major question which safety at sea legislation raises is the cost. In developed countries it is accepted as an unquestioned policy that the moral obligation to save or protect life overides the cost considerations. In developing countries however where the biological resource may be limited and fishermen are living on the economic margin the cost factor is a major constraint to having effective security regulations. The question is posed if the developing countries can afford safety regulations for their fishermen. Each country must examine its own particular circumstances, but what is apparent is that in most developing countries no adequate data upon which to base a rational decision are available.

The experience of Cape Verde

As a result of recent marine accidents around the archipelago of Cape Verde Mr Ansell of project CVI/86/006 was extremely concerned about the situation. He explained that small vessels often of only 4 m fished over 25 miles from land despite the regulations which confined them to 2 miles. Inevitably several were lost each year. In one recent lamentable case a large vessel which had broken down had radioed for help but nothing was done for several days despite the fact that the message had been received onshore. Eventually a military aircraft was sent from Dakar to make a search but found no trace of the vessel which was lost with eleven crew members.

As a means of assisting detection Mr Ansell proposed a wider use of automatic locating devices which had been proven technically and which are relatively cheap. In addition specific security proposals had been drawn up by his project, categorizing vessels with fixed motors and these either powered by outboards or sail. For the former it was proposed that each vessel should carry :

- A V.H.F. radio with an independent power source
- A sail
- Automatic locating device
- Regular inspection of security equipment by the responsible authorities
- An automatically inflatable life raft
- Sufficient life jacket for all crew members plus 20 % in addition, with the name of vessel on each to prevent transhipment to other vessels during inspection.
- Radar reflector

For smaller vessels which are by law restricted to fishing within 2 miles of the coast but which nevertheless venture in some cases more than 20 miles, the safety measures should include :

- A life jacket for each fishermen
- A buoyancy compartment installed fore and aft filled with either cork or plastic floats
- A mast and sail
- A spare steering oar
- Recommendation that smaller vessels fish in a group.

It was recognized that equipping vessels especially with electronic aids would be expensive, but when compared to the total cost of a new vessel the cost represented only a small proportion of the total outgoings. Nevertheless for the owners of older vessels already at sea the investment could be prohibitive. It was suggested therefore that the V.H.F. radio which would cost around $ 1000 should be financed by the owner as this was an aid to fishing as well as a safety item. Sails which would have a minimum cost should also be provided by the owner.

The more expensive items such as automatic location devices and inflatable life rafts costing $ 4000 respectively would probably be outwith the capabilities of several owners. In this case it was suggested that external aid be sought from the several bilateral aid organisations already involved in fishing development in Cape Verde. These included Japan, Holland, West Germany, Italy and France.

In addition to the safety equipment to be carried aboard vessels it was further proposed that an organized system of rescue assistance be introduced by the provision of three fibre glass life boats. Each would be equipped with two motors giving a speed of 13-18 knots, radar, radio equipment, automatic positioning device and a high powered search light.

These vessels which would cost between $ 200,000 - $ 250,000 each would be based at Sao Vicente, Boa Vista and Santiago, which would give each a maximum interaction range of 70 miles in case of an accident. The crews would be volunteers and be drawn from the port authorities and fishermen.

<u>The Benin experience</u>

Mr Pascal Tanimomo related the circumstances of an incident which occurred with the Benin Project glass fibre Cygnus vessel.

A routine trip was made to set longlines in the late afternoon with the intention of returning to port about six thirty pm., in all a trip of about 2 hours. After setting the long lines the vessel proceeded to port but after about 1/2 hours the main motor stopped and could not be restarted. A second outboard carried for such emergencies was mounted and the vessel proceeded but after a short while the motor vibrated loose and was submerged, and could not be repaired at sea. A sail was then rigged and the vessel again was got underweigh and proceeded to within three miles of Cotonou when the wind dropped. It was decided to anchor overnight. Fortunately the crew had plenty of food and water aboard as this was carried as standard practice. At dawn the wind had changed and the vessel could not proceed directly to Cotonou but drifted to the east where it was finally picked up and towed in by another project canoe which had been sent on a search mission. In all the vessel was at sea for 24 hours and overdue for 20 hours. This experience prompted the project to examine the whole question of security at sea for its own vessels and for private canoes.

A vessel operated by an agency such an FAO could carry sophisticated equipment and could afford to have it repaired when problems occurred. In fact a radio was standard equipment on the project vessel but it was found that humidity rendered them useless after a few months and during the trip in question no radio was carried because of this reason. However an ordinary fishermen could not afford either the initial cost of a radio or its constant repair. Similarly flares even if they were available would probably be too expensive for canoe fishermen. Life jackets of the approved type also would take up too much space abord a canoe if one had to be carried for each crew member (up to 17 persons).

After much thought and discussion it was decided that the safety equipment which should be carried by a canoe should be simple, attainable by the fishermen and be aimed at preserving life if an accident occurred.

In cooperation with the Marine Marchande a poster was produced to draw fishermen's attention to the need to carry certain items. Depicted on the poster were :

- A sail
- Water
- Food
- A reserve of fuel
- First aid supplies
- Paddles
- A torch and spare batteries

- Paraffin lamp plus matches
- An anchor plus rope

The posters were to be displayed provincially in each fishing village and its message was to be reinforced by a sticker depicting the same items to be issued to each fisherman with an outboard motor to be fixed on the cover.

The list of items is not exhaustive but the items were considered the most important to be carried in case of an accident at sea, and all items were within the means of even the poorest fisherman.

The regional dimension

The problem of security and accident at sea was observed by Mr Johnson of IDAF as a problem which concerned all national fishing and transport fleets in the region. A solution required a systematic approach which first identified the priority problems, suggested solutions, tested possible solutions and then implanted and diffused the solutions adopted.

A simple accident report devised by IDAF was then described in which project officers or competent authorities could note the circumstances of an accident. This report was to be used in the first phase of identifying the main causes of accidents at sea in the region.

Any solution should have specific criteria if it were to be accepted universally, these were :

- No increased danger for using equipment specified
- No decrease in catch through using equipment
- The equipment is actually useful
- Local maintenance is possible
- Fishermen and other operators see its usefulness
- Cost should be within capabilities of users
- Duality in utilisation if possible
- Local responsibility for introduction

Mr Johnson then demonstrated locally made life preservers. Those were constructed from foam plastic usually used in the fabrication of sandals. These could be made from one, two or three layers with floatability respectively of 3kg, 5kg and 7kg.

One sheet of the raw material sufficient for 4 larger life jackets cost around 6000 FCFA which gave a cost of around 1500 FCFA each jacket, while a three layer unit would cost in the region of 2000 FCFA.

A variety of colours were available and a choice could be made to improve visibility. A further advantage was that these jackets could be stored flat and could be used as sleeping mats.

Part III

Conclusions and Recommendations

The concluding session of the meeting was concerned with an open discussion of the conclusions and recommendations which could be drawn from the presentations which had been heard during the sessions.

Exchange of information

It was strongly felt that more emphasis should be given to increasing the accessibility of information. In particular it was the opinion of the participants that a free exchange of results even if negative would greatly assist projects and other workers to define priorities and reduce wasted time and effort in duplication of activities. It was also proposed that reporting needed greater standardisation so that results could be compared effectively. To assist in this it was suggested that a check list of aspects to be contained in reports could be produceed. It was generally agreed that IDAF should act as the clearing house and point of contact for the diffusion of information.

Internal motorisation programme

After the discussion on motorisation which revealed the difficulties inherent in internal diesel installation it was recommended that, while the advantages of diesel power was recognized, careful thought should be given by project management on the implication of commencing a diesel installation programme if the necessary infrastructures were not available at the project site or at least accessible in the country.

Safety at sea

This was recognized by all participants as a topic requiring urgent action. The general concensus was however that safety requirements should be reviewed within the economic context of the fishery in question. It was proposed that the international legislation already in force was adequate at this point in time for larger vessels but inappropriate for a canoe fishery which often operated at the margins or economic viability. The latter required a higher degreee of training of fishermen in safety procedures rather then the enforced introduction of sophisticated equipment. To reinforce safety measures considered locally appropriate it was proposed that local traditional power structures be involved in their enforcement. It was also suggested that projects which sold essential equipment and spares to fishermen could also exert influence to ensure compliance with safety regulations. It was noted that donors should be required to supply adequate safety equipment when supplying vessels to governments through assistance programmes. Diffusion of the recently produced IDAF accident at sea reporting forms was endorsed.

Alternative vessel design and construction materials

The participants fully supported the urgent need for greater investigation into the possible replacement of traditional vessels using alternative materials or designs in view of the rapidly depleting forestry resources in West Africa.

Appendix 1 - List of participants

A.E.K. Udolisa,	Chief Fishing Technologist, Nigeria Institute for Oceanography and Marine Research, PMB 12729, Victoria Island, Lagos, Nigeria.
P.F. Tanimomo,	Fishing Technologist, Direction des Peches, BP 383, Cotonou, R.P.Benin.
Marc Patenaude,	Mechanic, Cooperant Volontaire, O.C.S.O. (Canada), Direction des Peches (Projet Modèle), Cotonou, R.P. Benin.
P.T. Holler,	APO Master fisherman/mechanic, Projet Modèle Cotonou, R.P. Benin.
E.A. Ogundele,	S.F.O. Boatyard Igbokoda, Federal Republic of Nigéria.
L.I. Braimah,	National Director GHA/88/004, Project for Integrated Development of Artisanal Fisheries in Yeji, Yeji, Ghana.
G.T. Sheves,	Chief Technical Adviser, FAO Model Project, B.P. 1369, Cotonou, R.P. Benin.
Yves Pinard,	Directeur AIEPAS, BP 3, Dakar, Sénégal
Mme C. Hounkpe,	Projet Peches Lagunaire, Cotonou, R.P.Benin.
Akambi Liamidi,	Projet Peches Lagunaire, Cotonou, R.P.Benin.
E. Ansell,	Maitrepecheur, Projet CVI/86/006, BP 66, Praia, Cap Vert.
E. Mbye,	Fishing Technologist, Department of Fisheries, Banjul, The Gambia.
J. Prado,	FAO Fishing Technologist, FAO, Rome, Italy.
J.P. Johnson,	Senior Adviser, IDAF, FAO, Cotonou R.P. Benin.
G.V.Everett,	Programme Coordinator, IDAF, FAO, Cotonou, R.P. Benin.

R.J.Beare,	Project Manager, Shenge Project SIL/82/015 Sierra Leone.
T.D.K. Taylor,	National Director SIL/82/015, Sierra Leone
E. Giani,	Fishing Technologist, IDAF, FAO, Cotonou R.P. Benin.
B. Anum-Doyi,	Fishing Technolgist, Fisheries Research and Utilisation Branch, Tema, Ghana.

Appendix 2 - Agenda - Programme of activities

Monday 25th September

Morning	-	Trip on Lake Nokoué, to see artisanal fishing activities, and appropriate technology
Afternoon	-	Opening, introductory remarks, and preliminary presentations.

Tuesday 26th September

J. Prado	;	replacement of dugout canoes
Y. Pinard	;	methodology for introduction of new canoes
R. Beare	;	canoe motorisation, Sierra Leone
E. Giani	;	motorisation problems
R. Udolisa	;	climatic effects on synthetic fibres
J. Prado	;	offshore fishing - experience of recent part
E. Mbye	;	design and operation of fishing gears
L. Braimah	;	fishing gear of Volta Lake.

Wednesday 27th September

E. Ansell	;	fishing gear, Guinea Bissau and Cape Verde
E. Giani	;	fishing gear, West Africa
R. Udolisa	;	work with the flume tank, Lagos
B. Anum-Doyi	;	effects of small mesh sizes in artisanal fisheries
P. Holler	;	extension work in Beninese villages
P. Tanimomo	;	introduction of echosounders in Benin canoe fleet
E. Mbye	;	development of artisanal fisheriess, The Gambia
G. Sheves	;	demonstrations with echosounders and gill nets in Togo and Ghana
C. Hounkpe	;	fishing gear in Benin lagoons
L. Akambi	;	fishing in Benin Lagoons

Thursday 28th September

J. Prado	;	safety at sea
E. Ansell	;	safety at sea, plus video cassette
J. Johnson	;	safety at sea, collection of data
P. Tanimomo	;	safety at sea, Benin experience
J. Prado	;	FAO HQ support to field projects, concluding remarks.

Appendix 3.

LIST OF FAO FISHING TECHNOLOGY PUBLICATIONS

(Fishing Technology Service, FIIT)

E : English
F : French
S : Spanish

FAO FISHERIES TECHNICAL PAPERS

(Orders for the below mentioned papers to be made direct to the Distribution Sales Section of FAO at Rome address or recognised distributors of FAO documentation around the world)

N°.	Title	Languages		
96 Rev.1	Building a Sawn Frame Fishing Boat	E	F	
117	Fishisng Boat Designs:1, Flat Bottom Boats	E	F	(S)
134	Fishing Boat Designs:2, V-Bottom Boats	E	F	(S)
188	Fishing Boat Designs:3, Small Trawlers	E	F	S
239	Fishing Boat designs:4, Small Steel Boats	E	F	S
237	The Ownership and Management of Fishery Research Vessels	E	S	
267	Description and Classification of Fishery Vessel Types	E	F	S
196	Engineering Applications:1, Installation and Maintenance of Engines in Small Fishing Vessels	E	F	(S)
229	Engineering Applications:2, Hauling Devices for Small Fishing Craft	E	F	S
296	Engineering Applications:3, Hydraulic Deck Equipment for Small Fishing Boats	E	S	
189	Bottom Trawls for Small-Scale Fishing and Supp.1: Adaptation for Pair Trawling	E	(F)	(S)
199	The Fishing Technology Unit	E	F	S

222	Definition and Classification of Fishing Gear Categrories	(E)	(F)	(S)
284	Small-Scale Fishing with Driftnets	E	F	S
264	Community Fishery Centres: Guidelines for Establishment and Operation	E	F	

FAO TRAINING SERIES

(Orders for the below mentioned papers to be made direct to the Distribution Sales Section of FAO at Rome address or recognised distributors of FAO documentation around the world)

1	Pair Trawling with Small Boats	E	F	S
3	Fishing with Bottom Gillnets	E	F	S
7	Finding Fish with Echosounders	E	F	S
		also Arabic		
13	Purse Seining with Small Boats	E	F	
14	Attracting Fish with Light	E		
15	How to make and set FADs (Fish aggregating Devices)	E		

LIST OF FAO FISHING TECHNOLOGY PUBLICATIONS

FAO Catalogues of Fishing Gear
(Following publications to be purchased from Fishing News Books, Ltd., Osney Mead, Oxford OX2 OEL, U.K.)

- FAO Catalogue of Fishing Gear Designs	F	F	S
- FAO Catalogue of Small-Scale Fishing Gear (2nd edition)	E	F	S

FAO Fishing Manuals
(Following publications to be purchased from Fishing News Books)

- Calculations for Fishing Gear Design	E		
- Netting Materials for Fishing Gear (2nd edition)	E		
- Tuna Fishing with Pole and Line	E		
- Mending of Fishing Nets	E		
- Squid Jigging from Small Boats	E		
- Otter Board Design and Performance	E	F	S
- Echo-sounding and Sonar for Fishing	E		
- Fibre Ropes for Fishing Gear	E		

Fishing Vessel Design

(Following publications to be purchased from Fishing News Books)

- Fishing Boats of the World 1	E
- Fishing Boats of the World 2	E
- Fishing Boats of the World 3	E
- Design of Small Fishing Vessels	E
- FAO Investigates Ferrocement Fishing Vessels	E

Fisherman's Pocketbook
(to be purchased from Ed. Lavoisier, 11 rue Lavoisier, F75384 Paris Cedex 08, France) F

Miscellaneous

Manual for the Management of Small Fishery Enterprises FI:GCP/INT/342/AUL	E
Women in Fisheries - A Selective annotated Bibliography FAO Fisheries Circular No.811	E
Women in Fisheries, FAO Film Strip	E

( ) Out of Print

Appendix 4

SOME PRELIMINARY RESULTS OF THE COMPARATIVE PERFORMANCE OF MOTORS USED FOR FISHING AT SHENGE : (SIERRA LEONE)

by Rod Beare

Notes on statistics - depreciation of engines

All engines amortized over 3 years. This is generaly taken as upper limit of lifespan for 40 h.p. petrol outboard. It is also the likely level of life for an inboard diesel - not because the diesel engine itself breaks down, although this is quite likely, but because the peripheral bits like the gearbox, shaft couplings, shaft and stern gear are likely to break down because of lack of proper and timely maintenance. As for diesel outboards it is uncertain how long these engines will last because of their recent development and lack of thorough testing in the field. However the project's 27 h.p. Yanmar outboard diesel has been in operation for one year in a commercial environment and has so far experienced no mechanical problems and no problems which require replacement spare parts. It would appear reasonable therefore that with care these engines will last for at least three years.

Manufactures all claim their products will last longer- especially inboard diesel engines but given the operating conditions in Sierra Leone most engines are unlikely to last longer than four years although there are exceptions.

Sustainable supply of engines

In order to sustain the supply of inboard diesel outboards the importing agents would have to be established. They would be liable to the payment of import duty, and a trade mark-up, cover operating expenses, profits, and to cover the repurchase price of the hard currency used to purchase replacement outboard engines. Without such a system there can be no claims to be able to sustain the supply of engines and spare parts.

Certainly no fisheries aid projects can claim to have successfully introduced alternative inboard diesel engine technology to the canoes of Sierra Leone. It is perhaps too readily forgotten that a successfull transfer of technology has already occurred in Sierra Leone when petrol outboard engines superceded sail and paddle in the in the large Ghana canoes. The canoes have been operating with petrol outboard engines since the

1960s. We now talk about replacing this successful transfer of technology with another, but the necessity for this has only recently become necessary due to the high fuel cost of the large petrol outboards used in the Sierra Leonean Ghana canoes. The obvious answer to the motorization of the larger canoes was the inboard diesel but project after project has experienced endless problems in trying to bring inboard diesels into general service. The same problems have been experienced with the first generation of outboard diesel engines which were noisy slow and tended to vibrate themeselves and the boats to pieces. The current generation of diesel outboards (Rugerini, Lombardini, Yanmar and the Coventry Climax), of which this project has tested the Yanmar one in both fishing and transport operations, show distinct advantages not only in terms of fuel economy but in the overall return on capital employed.

Fish prices

Price of bonga has been taken as the current 11/5/89 average price for medium bonga landed in the fishing villages, Le 30 per dozen. This price has been translated into landings value which is based on a one year study of landings by all Ghana canoes in the project area.

Vessel characteristics

The cost of the hull for the inboard diesel hull also contributed greatly to the relatively poor return on capital. There are several reasons for this - to accomodate the inboard a much strengthened hull is constructed with expensive imported galvanised fastenings, a radically altered stern section, and a more rigorous use of imported boatbuilding technology. None of which makes the boat last any longer than Ghana canoes constructed by local craftsmen due to the actions of marine borers. The hull has therefore been amortised over the same period as local canoes. Extending the life of the hull with various anti-foulings was not considered a pratical sustainable option given the current situation and practices.

Catch statistics - assumptions

It has been assumed that the diesel outboard catches the same amount of fish as a 40 h.p. petrol engine. This has been proven in commercial trials which gave some tentative indications of a superior performance by the diesel outboard. In the field especially at Tombo the inboard diesel is perceived as best for catching herring and awefu (young bonga) ; these two fish groups are of lower value than bonga so there are indications that inboard diesel technology is not as high an earner as either of the two types of outboards. However for this study we have taken likely projected earnings as equal.

Diesel and petrol price structure

Due to recent changes in price structure diesel and petrol are sold at almost the same price with only a very small differential. If ever the differential were increased it would further increase the advantages of the diesel outboard.

Local boat technology versus imported technology

A hull designed and constructed to accomodate an inboard diesel currently costs more that twice the cost of a locally constructed Ghana canoe. Both the petrol and the diesel outboards use locally constructed hulls. The price for locally built Ghana canoes slightly exceeds current quotes.

Pointers to future motorization programmes

On the basis of these statistics the pursuit of the inboard diesel programme in Sierra Leone will only be worthwhile if the benefits of longevity can be truly realised. To do this will require a very thorough analysis of the real technical back up skills and training of operators who will be crucial to the success of such a programme.

In the meantime the diesel inboard motorization of Ghana canoes can be, at best, regarded as the least worthwhile of current options. It is surprising that given current circumstances the inboard diesel only gives a better return on capital when its introduction is subsidised i.e. with nil duty and nil trading mark-up. Taking all the current circumstances it looks as if the outboard diesel has become a favoured option in the motorization of Ghana canoes.

Assumptions about maintenance costs

Maintenance costs are based on the petrol outboard engine study carried out by this project. These costs have been attributed equally to the inboard diesel (there are indications that repair costs tend to be greater) and to the outboard diesel (about which we do not have sufficient data).

Background to determining engine and vessel performance in the ring net fishery

Fish behaviour : An understanding of the average way in which bonga, awefu and other pelagics behave when they are swimming in shoals is crucial to both the technique of catching, and in determining whether a perticular engine and vessel combination is suitable for that particular fishery.

Bonga : typically bonga (Ethmalosa spp.) tend to swim in straight lines and when under threat by the presence of a fishing vessel they will endeavour to escape (from an epicentre) in a straight line in the direction of the tide. It is therefore crucial to position the vessel in such a way that the down tide escape path is closed by the ring net as quickly as possible. This is achieved by rapid acceleration to maximum speed with the tide in a port hand turn to block off the escape route of the particular shoal.

Awefu : unlike the adult bonga the immature bonga (awefu) tend to behave in a more erratic manner, and although they normally escape from a threat in the same direction as the tide, they tend to zig-zag across the tide. This behaviour means that their escape tends to be slower, apart from being physically slower than adult fish, and the positioning of the vessel and speed tend not to be as crucial to a successful net shot.

Shooting procedures : like the hunted fish the crews of the hunting vessel also tend to behave in a particular way. When approaching an area where long distance observation has led the crew to suspect the existence of a shoal they will stop the engine and all the crew strain their eyes and their ears for sight and sound of fish. Characteristically bonga will smack the water with their tails - thereby betraying their position relative to the boat. The cry 'knock' will go up, an apparently joint decision of the crew, and then the cry 'chan' goes up and the engine is started, the net and buoy cast to the port side of the vessel, and then shooting of the net proceeds. This apparently simple procedure can mean the success or total failure of a particular engine and boat construction.

Engine requirements : For success in catching bonga, awefu or herring (Sardinella spp.) it is therefore necessary to identify what is required of a given engine and vessel combination to meet the requirements of speed, acceleration, and the procedure normally adopted by a typical fishing boat crew. Clearly the engine must have the following characteristics.

The engine should start easily and reliably without the necessity to repeat the starting operations. A slow or unreliable start will lose fish.

The acceleration of the engine should be sufficient to deploy the net fast enough to prevent the escape of the fish.

The engine should not alarm these sensitive fish either by sound or by vibrations which exceed those of the engines currently in use.

The vessel itself should facilitate the shooting of the net in an efficient safe manner and be of such a design that maximum speed is achieved in as short a time as possible.

Vessel requirement : with respect to the two (EDF, Kambia-Yelibuya) project constructed Ghana canoes they were designed as improved copies of local vessels, and proved themeselves to be equal and in some respects superior. They were superior in terms of construction strength and stability and in the case of "Pink Porpoise" in terms of manoevrability. In no respects did the tests carried out on project vessels show significant variations in performance to a local vessel with similar installations.

Some costs

Engine type hp	Import duty %	Total cost of boat net and Engine (Le)	Estimated annual cash flow (Le)
1.Diesel outboard-27	0	1,311,975	376,278
2.Diesel inboard -30	0	1,725,000	238,603
3.Petrol outboard-40	0	1,114,050	208,253
4.Diesel " -27	35	1,416,966	341,281
5.Petrol " 40	35	1,149,767	196,347
6.Diesel " 30	35	1,866,050	191,587
7.Diesel " -27	110	1,641,947	266,287
8.Petrol " -40	110	1,226,305	170.835
9.Diesel inboard -30		2,168,300	90,887

Summary notes

1. Diesel outboard at zero duty earns 80.6% more return on capital than the petrol outboard package.

2. The diesel outboard at the true import duty rate of 35% earns 73.8% more return on capital employed than the petrol outboard

3. At full market rate i.e. a sustainable rate through supply by the outboard engine trade which includes duty at 35% and dealer mark-up, as well as earning sufficient to repurchase foreign exchange to repeat the buying exercise, the diesel outboard earns a 56% better return on capital employed than the petrol outboard.

4. Implications for Ghana canoes motorization. It is apparent that only at zero duty does the inboard diesel package rank any higher than the petrol outboard. Its position only worsens as the import duty rises and the ouboard diesel shows a distinctly superior return on capital employed at all rates of duty.

5. The lower the price of fish, the higher the price of fuel the more likely that the diesel outboard will maintain a viable fishing operation.

6. The diesel outboard can be used in locally constructed Ghana canoes with only very minor modification to the inboard engine well. Those hulls cost less than 1/2 as much as an inboard hull.

<u>Assumptions</u>

Ghana boat for outboard			150,000 Le
Ghana boat for inboard			460,000
Net			862,000
Diesel outboard c.i.f. duty free	27 hp	$	4,615
Diesel inboard c.i.f.	30	$	6,200
Petrol outboard c.i.f.	40	$	1,570

Exchange rate ; 65 Le to $

Trips p.a. ; 255

Landings per trip ; 0.725 t

Value per tonne ; 9,345.794 Le

Medium bonga (price/doz.) = 30

Landings per year ; 184.875 t

Value per year ; 1 727 803 Le

Appendix 5

DEVELOPPEMENT DE LA PECHE ARTISANALE

AUX ILES DU CAP VERT

Présentation de Mr. Eugène Ansell, Technologiste

des Pêches , Projet FAO CVI/86/006

Securité

Bateaux de pêche à moteur fixe.

Information : sensibiliser les pêcheurs et les armateurs sur les moyens efficaces de communication et de repérage à embarquer sur les bateaux et recruter à des postes de responsabilité des techniciens compétents.

Communication, positionnement, matériel

a. Rendre obligatoire l'installation de VHF sur tout bateau de pêche à moteur, avec alimentation électrique indépendante (possibilité d'une aide japonaise).

b. Obligation d'avoir une voile de dimensions normales.

c. Equiper tous les bateaux de pêche d'une balise SARSAT COSPAS KANNAD 406 l'efficacité de ce système est démontrée depuis plusieurs années, les plaisanciers en disposent sur leurs yachts, pourquoi pas les professionnels de la mer.

Faire la démonstration de maintenance (remplacement des piles) et de mise en opération de la balise.

d. équiper les bateaux marchands faisant le trafic inter iles ou inter ports de GONIO VHF, type Polaris.

e. effectuer par les autorités maritimes des contrôles de bon état du matériel de sécurité à l'improviste, donc sans avertir l'armateur ni le patron et sanctionner tout manquement au règlement en place.

f. équiper tous les bateaux de radeau de survie : pneumatique à gonflage automatique sitôt à la mer.

g. faire en sorte que les brassières de sauvetage soient toujours à bord des bateaux, et en nombre suffisant, (20 % de plus que le nombre de persones à bord) et que les mêmes brassières ne servent pas à l'inspection de sécurité de plusieurs bateaux ; pour cela un moyen simple : peindre le nom du bateau sur chacune d'elle.

h. équiper les bateaux de réflecteurs radar.

Justification de ces équipements

a. Radio VHF : Les îles du Cap Vert sont équipés d'un bon système de communications radio, centralisé à Mindelo, la VHF peut être utile durant les premières heures de l'avarie, panne moteur ou autre, mais sa portée est limitée à 30 ou 40 miles maximum.

b. La voile : peut permettre le déplacement du bateau et donc le changement de direction de sa dérive, elle permet aussi d'éviter les rôches ou de s'approcher d'un port si celui-ci n'est pas au vent.

c. La balise SARSATCOSPAS : en Europe les bateaux de pêche ne disposent pas de cette balise pour la simple raison que toutes les côtes et lieux de pêche sont couverts par divers systèmes radio-électriques de positionnement : Decca, Oméga, Oméga différentiels, Loran C et Toran.

. Les îles du Cape Vert (et les côtes Ouest africaines) elles, ne sont couvertes par aucun de ces systèmes, la balise de détresse se justifie pleinement, elle est d'un faible encombrement et de manipulation simple.

d. Radeau de survie gonflable : d'un faible encombrement et d'une efficacité garantie en cas de naufrage.

Financement de ces équipements : pour 50 bateaux

a. VHF à la charge de l'armateur, car c'est aussi un outil de travail : communication entre les bateaux et avec l'armateur à terre. Son prix est de 1 000 USA soit 73 000 escudos CV.

b. Voile : à la charge de l'armateur

c. Balise SARSAT COSPAS : son prix est d'environ 2 000 $ soit 182 500 escudos CV. Ce coût est peut-être trop important pour certains armateurs.

L'acquisition des balises pourraient se faire en sollicitant l'aide financière de divers organismes coopérant dans la pêche actuellement ou l'ayant fait comme : les coopérations du Japon, de Hollande, d'Allemagne de l'Ouest, d'Italie et de France.

Les ONG peuvent aussi être sensibilisés à ce problème de la sécurité en mer.

Par exemple Care France, ONG présente à Praia a organisé il y a deux ans une course de voiliers, tous étaient équipés de balise de positionnement, il n'est donc pas utopique de penser que les dirigeants de cette organisation seraient disposés à aider l'achat de matériel de sécurité pour les marins.

d. Radeau de survie :

Il coûte 4 000 $ soit 292 000 escudos CV.

Son financement pourrait se faire de la même façon que pour les balises ; il faut également prévoir son reconditionnement une fois par an.

Moyens d'interventions

Après repérage du bateau en difficulté il est indispensable de disposer de moyens pour porter secours.

Ces moyens pourraient être : 3 bateaux en "fibreglass" renforcé, longueur : 10 à 11 mètres, spécialement conçus pour le sauvetage et l'assistance en mer.

Equipement : 2 moteurs donnant une vitesse de 17/18 noeuds, un radar, portée 48 miles, une VHF, un gonio VHF Polaris, une radio BLU, une balise de positionnement, un sondeur, un projecteur orientable de forte puissance.

Ces bateaux seraient basés à S. Vincent, Boa Vista et Santiago, ce positionnement ferait que la distance maximum en cas d'intervention ne dépasserait pas 70 milles.

Pour le choix du type de bateau on pourrait se baser sur l'expérience de différentes sociétés de sauvetage qui couvrent les côtes d'Europe.

Les équipages seraient formés de volontaires travaillant dans des organismes oeuvrant pour la marine : capitainerie des ports, direction des ports, et aussi des marins pêcheurs.

Le prix de ces bateaux dépendra du choix décidé, et se situera entre 200 000 et 250 000 US $ l'unité.

<u>Sécurité pour les embarcations plus petites : les "botes"</u>

La réglementation interdit aux "botes" de s'éloigner du port de plus de 2 miles, mais chacun sait que ceci n'est pas respecté, les "botes" de Praia vont au Sud de Maio, distant de 21 milles.

Il faut donc améliorer leur sécurité.

a. autant de brassières à bord que de marins

b. installer 2 caissons flottants, l'un à l'avant, l'autre à l'arrière, caissons en bois remplis de liège ou de matériel flottant

c. obligation d'avoir un mât et une voile

d. avoir un aviron ou une pagaie de rechange

e. recommander les sorties en groupe.

Ansel Eugène
Technologiste des Pêches FAO

Appendix 6

AMELIORATION DES EMBARCATIONS TRADITIONNELLES

METHODOLOGIE

Sommaire de la présentation verbale de Yves PINARD
Table Ronde DIPA/FAO Bénin, 26 Septembre 1989

Avant propos

A - Expérience spécifique à la pêche artisanale basée sur 4 projets :

- . Amapala Honduras 1980 : introduction d'embarcations 9 M en bois, moteur in bord diesel
- . Maldives 1987 - 1988 : bateaux en bois de coco, moteurs in bord (6 M : 10 HP, 9-12 M = 23-30 HP)
- . São Tomé 1985 - 1989 : H.B sur monoxyles 6-12 M pirogues fibre de verre Yamaha : 7 M : HB, 12 M : in bord.
- . De façon spéciale, Pro-Pêche Sénégal 1989 - 1994 prévision/planification

- Expérience connexe : 12 ans d'expérience dans les PVD : formation et développement rural.

B - Présentation sommaire Pro-Pêche

Composante SERVI PECHE : - crédit/micro réalisations

Composante ATEPAS :
- transformation (techniques/appui)
- production : techniques
  équipement
  services connexes
- introduction des innovations technologiques.

.../...

INTRODUCTION

Quand on songe à introduire une technologie nouvelle dans le domaine de la pêche artisanale, il faut bien définir au départ les objectifs personnels (individu ou organisme) visés.

Il y a 2 grands types d'objectifs qui déterminent les orientations d'interventions :

A - Ce que j'appelle "avoir son monument devant sa porte"
C'est-à-dire faire du développement pur ou introduire un appareil d'avant garde, révolutionnaire.
C'est très risqué sur le plan acceptation ; on risque les éléphants blancs.
Toutefois, celui qui réussit laissera sa marque : il aura son monument.

B - L'autre : l'assistance aux pêcheurs.
Par l'apport de techniques nouvelles, on aide le pêcheur, on évolue avec lui, on s'assure d'une acceptation du milieu.
Cet objectif nous oblige à la prudence ; il nous oblige à avancer à "petits pas".
On ne laisse rien de révolutionnaire, on courre le risque que son intervention soit moins apparente et tout changement majeur prendra plus de temps.
Mais, à mon point de vue, c'est encore le plus efficace et c'est l'orientation que je privilégie.

CONDITIONS PREALABLES A L'INTRODUCTION D'UNE NOUVELLE EMBARCATION

1° Faut tenir compte de la qualité de l'embarcation existante et utilisée par le groupe visé.

2° Faut tenir compte de l'expérience/capacité et de la tradition des pêcheurs.

3° Faut tenir compte de la rentabilité comparée embarcation existante/embarcation nouvelle.

4° Faut tenir compte de la capacité des charpentiers locaux ou du niveau d'avancement technologique du milieu.

5° Il faut accepter de construire le prototype sur place, en tenant compte des observations des pêcheurs et des charpentiers locaux qui eux construisent en fonction de l'usage qui en est fait.

6° Il faut avoir le temps de vulgariser l'utilisation des prototypes et d'accepter de les modifier selon le système "d'essais et erreurs"

7° Il faut enfin tenir compte de leur mode de gestion, spécialement si on parle de financement/crédit.

.../...

CLASSIFICATION DES PAYS :

Il peut être difficile de classifier les pays en fonction de toutes les conditions préalables ci-haut.
Cependant au niveau des embarcations traditionnelles (qualité et évolution) en Afrique de l'Ouest, territoire qui nous concerne, si nous voulons, situer les extrêmes, je placerais Guinée Bissao (sans embarcation depuis plus de 150 ans)au bas de l'échelle et le Sénégal au point culminant. Entre les deux nous retrouvons divers degrés d'évolution du monoxyle parmi lesquels le Ghana s'attribue probablement le premier rang.

On pourrait procéder ensuite aux choix des meilleurs pêcheurs en analysant les statistiques : engins utilisés, prises annuelles par pêcheur et par embarcation, la diversité des espèces, etc.

On pourrait comparer ensuite les autres conditions pour se rendre compte des différences. Mon objectif n'est pas de comparer sinon de montrer qu'il est possible d'analyser ces conditions pour chaque projet distinct. Nous limiterons ici notre étude à l'embarcation du Sénégal.

LA PIROGUE SENEGALAISE :

La pirogue sénégalaise telle qu'on la connait aujourd'hui est le fruit d'une longue recherche.
De monoxyle qu'elle était, elle a pris sa forme actuelle (à peu de chose près) il y a plus de 130 ans. Il existe quatre grands types selon les régions, adaptés à la barre et aux conditions d'échouage.

Description de la pirogue sénégalaise :

Les caractéristiques générales de la pirogue :

1° - longueur : 8 à 16 m (sans les éperons)

2° - largeur : 1.3 à 2.5 m (au haut du bordé)

3° - profondeur : de 1 à 2 m

4° - base : pièce maitresse taillée dans un demi ou un quart de tronc d'un arbre à bois rouge (très dur - très lourd - très résistant (12-15 ans) à l'eau.
Le tronc est prolongé de 2 éperons sur-ajoutés (à l'avant et à l'arrière).

5° - Les bordées sont faites de planches (habituellement 4) assemblées sans membrures (assemblage longitudinal). Les 2 planches du bas sont "clouées" (fer à ciment)à la base et sont de bois dur (même que la base), tandis que les 2 planches supérieures sont en bois léger (moins résistant à l'eau) et sont reliées "à clains" aux 2 planches inférieures . Les joints sont recouverts d'une toile clouée pour améliorer l'étanchéité.

6° - L'embarcation représente une forme en V.

Ses principales qualités :

- tenue de mer incroyable pour affronter les tempêtes ;

- il est facile de maintenir la proue dans la vague

- mouvement lourd qui ouvre la vague sans déséquilibrer le pêcheur au travail ;

- capacité de traverser la barre tant au départ qu'à l'arrivée (avec charge) ;

- facilité d'échouage ;

- Capacité de charge ;

- bas coût de construction ;

- facile à construire et répond au niveau de technologie du milieu, peut donc être construite et réparée sur la plage.

Ses points faibles :

- Le manque d'étanchéité.
  Les joints entre les planches superposées présentent à certains endroits un large espace (2 à 15 mm) où l'eau pénètre.
  La bande de tissus clouée sur le joint bloque partiellement l'entrée d'eau, le premier mois, mais par la suite perd beaucoup de son efficacité. il faut 1 ou 2 mousses à bord pour vider l'eau.

- Le manque de stabilité lors de la levée des filets.

- Le mode de construction sans gabarit et sans membrure occasionne des faux flancs (ouverts d'un côté plus que de l'autre).
- Les clous communs, en fer, pour les joints ainsi que le fer à ciment qui retient les bordées à la base rouillent rapidement et font pourrir le bois. Les 2 planches supérieures doivent être renouvelées chaque 2 ans.

- Durée de vie courte et entretien coûteux.
  2 planches du haut de la bordée en bois mou : 2 ans
  2 planches du bas de la bordée en bois dur : 4 ou 5 ans
  la base en bois dur : 12 à 15 ans

- Résiste mal aux vibrations du moteur entre autre dans le cas du diesel in bord.

- manque de flotabilité en cas de naufrage (moteur et filet).

Interventions prévues :

Nous prenons pour acquis que la pirogue, dans sa forme actuelle, répond aux besoins des pêcheurs. Elle est très performante et est construite à un coût minimum.

Nous tiendrons compte de ces facteurs, car notre approche se situe nettement au niveau de l'assistance plutôt que du "développement" tel qu'énoncé au début.

Au niveau des embarcations, nous prévoyons donc :

1 - Garder la pirogue dans sa forme actuelle avec moteur hors bord.

A - Mêmes matériaux

Essais 1 : en planches, tel qu'actuellement :
améliorer l'étanchéité (joints et membrures supports)
améliorer la stabilité : éliminer les faux flancs et ajouter de la flotabilité.

Essais 2 : garder la base (tronc)
bordée en planches avec membrures et gabarit même forme et forme légèrement modifiée pour les endroits où le mouillage est possible.

B - Nouveaux matériaux :

Essais 3 : bordées en contreplaqué marin :
partie du haut d'abord (2 planches supérieures)
partie haut et bas ensuite.
Peinture époxie en gardant les mêmes motifs.

Essais 4 - fibres de verre, fabrication sénégalaise, même forme, même mouvement lourd, possibilité d'échouage.

Essais 5 - fibre de verre, modèle japonais Yamaha pour fin d'essai. Si probant, fabrication sénégalaise

Essais 6 - fibre de verre, modèle modifié, pour les endroits où il n'y a pas de barre : ex : entrées des estuaires.

.../...

2 - Moteurs :

Maintiendrons le hors bord :

- réduction de la puissance : économie de carburant

- introduction du H.B diesel

  Ferons peut-être essais avec in bord ou in/out pour les embarcations modifiées, la construction actuelle ne peut résister aux vibrations.

  Nous choisirons alors des in bord refroidis à l'eau, type Yanmar, pour éviter le surchauffement;

- nous proposerons le maintient de la voile secours

CONCLUSION :

Nous comptons évoluer lentement, avec les pêcheurs, les charpentiers et les mécaniciens. Notre projet doit s'étendre sur cinq ans, nous croyons pouvoir améliorer l'embarcation mais ne visons pas l'introduction de modèles révolutionnaires.

Nous voulons maintenir le système de construction/réparation/ entretien sur les plages ou dans de petits ateliers répartis sur la côte.

Nous favorisons le bois qui permet les échanges sud/sud plutôt que le fibre de verre qui accentue la dépendance sud/nord.

Tout en maintenant le système de capitaine propriétaire, la qualité de la ressource et la compétence du pêcheur sénégalais nous permettront d'introduire une embarcation légèrement plus dispendieuse si nous pouvons en prolonger la vie utile, modifier la gestion actuelle et introduire un sytème de crédit formel à long terme.

Appendix 7.

UNE NOUVELLE TECHNIQUE DE PECHE AU LAC NOKOUE "MEDOKPOKONOU"

Par Cathérine HOUNKPE

1) Historique

"Mèdokpokonou" est né à Ouèdo-gbadji en Mars 1987.

Un homme invité par son ami pour l'exploitation de son acadja tomba malade. Il dut abandonner son filet à l'endroit où il l'avait posé.

Au bout de 72 heures quand il se sentit mieux, il voulut savoir qui de ses confrères lui avait gardé son filet. Or son filet fut abandonner sur les lieux de pêche. Donc il alla sur le lac pour le ramener. A sa très grande mais heureuse surprise, son engin était rempli de poissons. Quand il fait la récolte et la vente, ceci lui rapporta quinze mille francs.

L'idée lui vint donc de laisser son filet près de l'acadja. Au bout de 24 heures, sa pêche lui rapporta douze mille francs.

Jaloux des profits tirés de ce filet, le propriétaire d'acadja invita son ami à éloigner son filet. Ingénieux, l'homme du nouvel engin alla l'exposer en pleine eau. Les résultats n'ont pas été moins encourageants. C'est ainsi que "Mèdokpokonou" (c'est-à-dire une seule personne est joyeuse) est né.

2) Description

"Mèdokpokonou" est généralement constitué de quatre ou parfois cinq nappes de filet de 25 mètres chacun lesté de plomb à la ralingue inférieure et pas de flotteurs à la partie supérieure. Au moment de la pose, le pêcheur descend dans l'eau, fixe les filets aux piquets et enfouie la ralingue inférieure dans la vase.

La technique consiste à étendre le filet sur une distance de 50 mètres environ et à former une poche à chaque extrémité. Lorsque le poisson au cours de son déplacement heurte le filet il cherche à le contourner mais il se retrouve dans l'une des poches d'où il ne pourra plus sortir.

3) Matériels et Méthodes

Le lac Nokoué a servi de cadre pour l'étude. C'est un plan d'eau alternativement saumatre et doux et d'une superficie de 15.000 ha. La salinité de l'eau varie de 0,12% en Septembre et 30% en Avril et la profondeur de 0,70m en Décembre à 2,25m en Septembre à So-Zounko (non loin de Vekky).

Le village de Vekky a été retenu pour les observations compte tenu de la disponibilité des Pêcheurs.

92 "Mèdokpokonou" de 15 mm (maille étirée) ont été observés de Mars 1988 à Mars 1989. Le suivi a lieu tous les quinze jours et à chaque séance la production de deux ou trois pêcheurs est pesée, les différentes espèces sont triées, pesées et mensurées. Chaque pêcheur visité represente une observation.

Les longueurs totales et standard des poissons ont été mesurées à l'aide d'une planchette graduée. Quand aux crevettes, il s'agit de la longueur du céphalo-thorax mesurée en mm à l'aide d'un pied À coulisse.

4) Résultats

"Mèdokpokonou" a été très vite répandu au Lac Nokoué. Le recensement de cet engin effectué en Juillet 1988 a permis de se rendre compte que 517 "Mèdokpokonou" au moins sont installés sur le lac.

Par ailleurs le suivi de la capture de cet engin de Mars 1988 à Mars 1989 a permis de constater que les crevettes représentent en moyenne 16,95%, de la production, les Ethmaloses 47,23%, les Gerridae 7,49%, les callinectes 11,81%, les Sarotherodon, Tilapia et les "divers" représentent respectivement 4,59%, 0,30% et 11,63%. Ces divers sont constitués surtout de Citharichthys, Lutjanus, Elops, Pomadasys et caranx qu'on rencontre en saison sèche et Kribia, Schilbe, Hemichromis pendant la crue. Il ressort donc de ce constat que les Ethmaloses constituent l'espèces dominante dans les captures de cet engin, viennent ensuite Penaeus, callinectes, les divers '(cités ci-dessus) puis les Gerres, Sarotherodon et tilapia on s'apergoit que Sarotherodon melanotheron et Tilapia guineensis qui sont des espèces rencontrées majoritairement dans les acadjas sont capturés occasionnellement par "Mèdokpokonou". (Voir Tableau N°.1).

Tableau N°.1 : Récapitulatif de la composition des captures de Mèdokpokonou de Mars '88 À Mars '89 (Pourcentage de la capture totale)

Espèces Capturées	Penaeus	Callinectes	Ethmalosa	Gerres	Sarotherodon	Tilapia	Divers
%	16,95	11,81	47,23	7,49	4,59	0,30	11,63

5) Inconvenients et Avantages

L'effet néfaste dde Mèdokpokonou se situe au niveau de la taille des Ethmaloses capturés, cette taille varie de 4,5cm à 15cm et que ceux de 6cm sont majoritaires dans les prises. Ce qui reste largement en dessous de la taille de première maturité qui est de 9,9 cm longueur totale chez les Ethmaloses femelles au Lac Nokoué.

Pendant la crue de Septembre À Octobre, le niveau élevé des eaux rend difficile la pose de cet engin en pleine eau; ce qui explique son abandon par la plupart des pêcheurs au profit d'autres engins. D'autres pêcheurs néanmoins, remontent dans les plaines d'inondation où ils pêchent des Sarotherodon de petite taille (7 ou 8 cm). On remarque par ailleurs que pendant cette période les prises sont généralement faibles et sont majoritairement constituées d'espèces d'eau douce.

En comparant la taille des crevettes capturées par "Mèdokpokonou" à celle des crevettes de nasses de Février à Avril 1989 (période d'abondance des crevettes) on s'aperçoit que les crevettes pêchées par Mèdokpokonou sont plus petites que celles des nasses. (Voir Tableau N°.2).

Pour ce qui est des avantages la production de Mèdokpokonou est plus rénumératrice que celle des autres filets compte tenu des espèces capturées et du prix de ces dernières sur le marché.

Par ailleurs, Mèdokpokonou exige moins d'effort physique que le filet épervier.

6) Conclusion

Il ressort de ces observations que "Mèdokpokonou" capture surtout des Clupeidae des Gerridae et des crustacés et occasionnellement des Cichlidae qui sont majoritairement rencontrés dans les acadjas. Nous pouvons donc en déduire que cet engin capture des espèces de poissons et crustacés qui effectuent la migration mer-lagune et vis-versa.

Par contre un filet de 20 mm est actuellement en essai sur le lac à Tchonvi et à Vekky. Des résultats jusqu'ici obtenus on peut déduire que ce dernier filet capture des Ethmaloses dont la taille est supérieure à celle de première maturité.

Tableau N°.2 : Comparaison des pourcentages des différentes tailles de crevettes capturées par "Mèdokpokonou" et les nasses de Février à Avril 1989 (LCT en mm)

Engin	Classe de Taille					
	(12 14)	(14 16)	(16 18)	(18 20)	(20 22)	(22 24)
Mèdokpokonou	1,36	16,42	36,72	23,28	13,39	6,03
Nasse	0,17	6,1	30,13	35,79	19,07	7,17

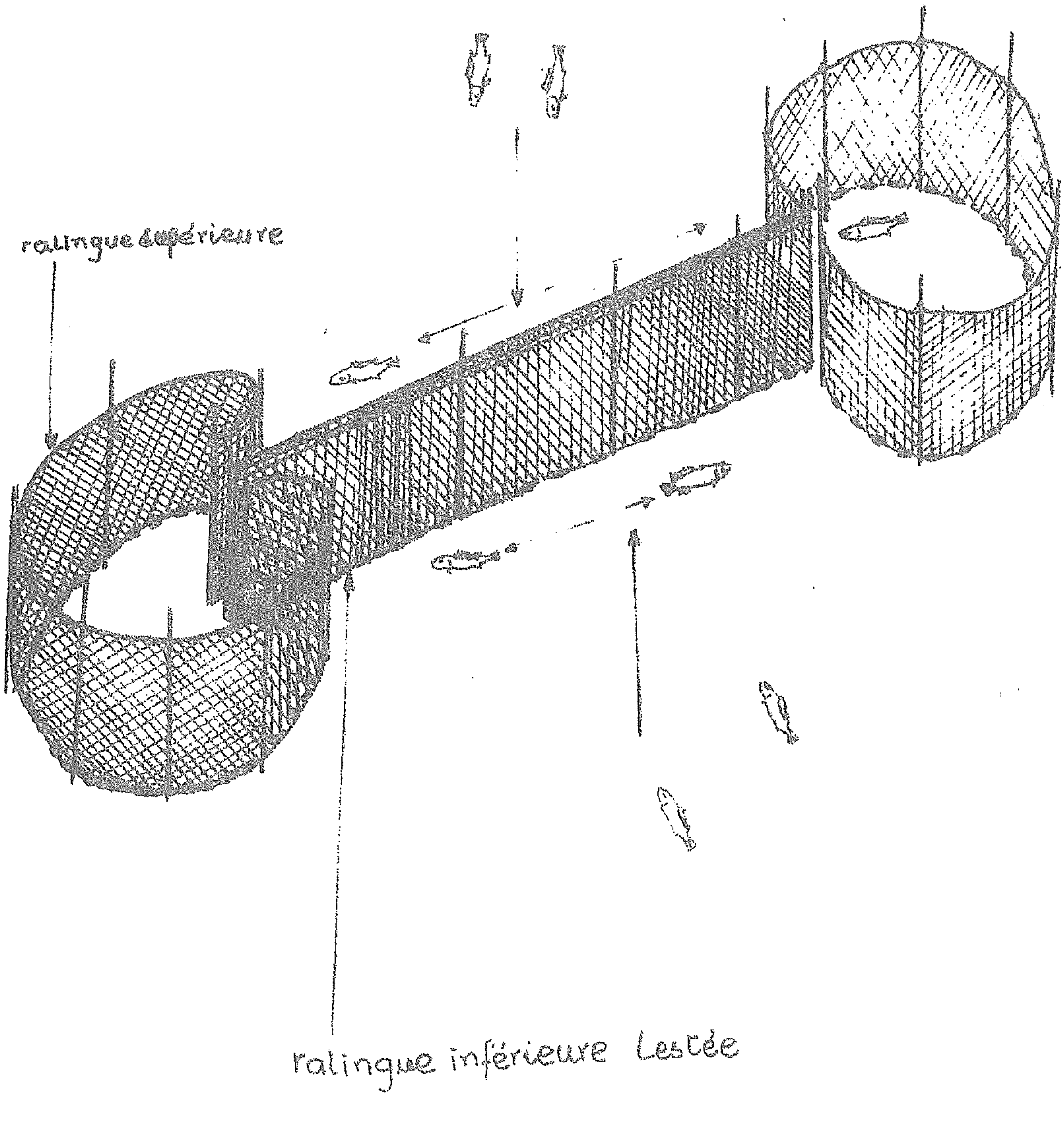


Schéma du fonctionnement de "mèdokpokonou"

Appendix 8

The vertical water circulating channel in Nigeria

by

R.E.K. Udolisa of NIOMR, Lagos

The present development of the artisanal fishing industry in Nigeria has been mostly due to the introduction of improved fishing techniques and methods over the years. The establishment of a vertical water circulating channel (flume tank) in 1988 at the Nigerian Institute for Oceanography and Marine Research, Lagos, has thus introduced new dimensions in the development of these fishing gears and techniques to fishermen. A flume tank is a powerful tool in research as well as for development of fishing gear and the training of better fishermen/net makers. It is to the fishing gear scientist/technologist what the wind tunnel is to the aero-nautical engineer and is the first of its kind in the west coast of Africa. It consists of a large stainless steel structure, 7.60 m long by 2.11 m wide by 3.20 m deep completely installed in a pit to avoid flooding even if the observation window is broken. The flume tank although small, is similar to some of the Japanese models. Flume tanks are also present in different parts of the world such as in France, USSR, Denmark, Britain and Canada.

Models of trawls, with textiles and fish cages and other types of fishing gear where the effect of velocity of water is critical can be demonstrated and tested in the central portion of the tank. This area measures 4.05 m length by 1.3 m in height by 1.7 m wide and has a water depth of 0.9 m. The following fishing gear types can be demonstrated and tested at present.

S/N°	Fishing Gear Types	Actual net size in length (M)	Scale of Model Net
(1)	Conventional shrimp trawl nets	17-25	1 : 10 to 1 : 20
(2)	Conventional demersal/pelagic fishing trawl nets	20-40	1 : 10 to 1 : 40
(3)	Gillnets including drifting types	-	"
(4)	Long lines, beach seine etc.		

It is envisaged that in future, the fishing gear types such as deep sea trawl nets (both pelagic and demersal types) and purse seines will be handled in the flume tank.

The total water capacity of the tank is 20 tonnes or 20 m3. Fresh water and not sea water is used. No additive is used to retard corrosion because the whole body is made up of stainless steel. A filtration system (reverse flushing sand type) capable of cleaning the whole tank contents in approximately 3 hours, is part of the flume tank system.

The water is circulated round the flume tank by two impellers driven electrically. In testing the models, the velocity of water varies from 0.02 to 1.0 m per second (0 - 2 knots) which at a scale of 1 : 15 gives a maximum full-scale water velocity of 7.75 knots. The water velocity in the tank is aided by a surface flow accelerator, suppression plate ducts and rectification devices in order to obtain as near as possible uniform water speed in the measuring area.

The model trawl nets are not towed through the tank but remain stationary when under test with the water flowing through them.

The model fishing gear under tests, are observed through the observation window in one side of the tank and from a movable platform which runs along the top of the tank. The window has a side glass with a thickness of 19 mm and is 1. 1 m high by 2.5 m length.

A control system which is of free standing console type, situated in front of the flume tank, houses all the controls, stop-start buttons and other items of equipment.

The laboratory is now in a position to fabricate full-scale nets and also provide improved designs of either new or existing fishing gear types for the fishing industries and agencies. Tests on existing types require a good deal of detail. Such confidential information from any agency will not be released to other individuals or companies.

Fishing companies or agencies will be delighted to see (directly or through recorded videos) how their fishing gear types perform.

Appendix 9

A study on the deterioration rates of the artisanal polyamide twines exposed to sunlight. Extract from paper by R.E.K. Udolisa, F. Aniebone and B.B. Solarin of NIOMR, Lagos

Introduction

The introduction of man-made netting fibres in the 1950's is one of the main technological revolutions in modern fishing in Nigeria. These days, fishing gear made of polyamide netting fibres commonly known as nylon, are widely used in both the artisanal and industrial sub-sectors of the capture fisheries.

The artisanal sub-sector covers the operation of small-scale canoe fisheries operating in the coastal areas, creeks, lagoon, inshore waters and in the inland rivers. Fishermen in this sub-sector operate small canoes of about 6-13 metres length-over-all (LOA), some of which are motorized while others are powered by paddles. Over 70 percent of the total domestic fish production is contriubted by this sub-sector using various fishing nets such as cast nets, gillnets, beach seines, liftnets and surrounding nets. All these fishing nets are fabricated with polyamide netting materials of various thickness ranging between R 50 Tex to R 312 Tex (Reed, 1967, FAO, 1969, Udolisa and Solarin 1979, Udolisa and Balogun 1988). These nylon materials are sourced from different countries and in certain cases the quality of the materials is often questionable. In addition, the small-scale fishermen often preserve their fishing nets by drying them directly under sunlight after each fishing trip. In some cases where they carry out seasonal fishing such as in the Bonga (Ethmalosa sp) fishery, the surrounding nets are left under the sun for a long duration of 3-6 months.

The paper therefore highlights the studies carried out by the authors to ascertain the following :

a. The relative wet knot strength of the twisted polyamide netting twines used in the fabrication of artisanal fishing nets in the country

b. The weathering (sunlight) effect on artisanal polyamide netting twines.

Materials and methods

Five polyamide twisted artisanal netting twines ranging between R 57 Tex to R 308 Tex were collected and used for the experiments between June and mid-September, 1989. This period falls withing the rainy season in Nigeria when the temperature of the experimental site ranges between 22 ° c to 320° c. Two experiments were performed namely the wet knot breaking strength test and the weather (sunlight) effect on the artisanal polyamide netting twines.

a. Wet knot breaking strength tests :

For each size of netting twines, two pieces, each 50 cm in length were tied together to form a weaver's knot (English Knot), 30 test pieces each of both knotted and unknotted of the various twines were then put in a tank containing sea water and left for over 36 hours. The test specimens of polyamide netting twines were then brought out of the water tank and tested as described by Klust (1973). Each test specimen was fastened between two clamps of a Japanese electronic dynamometer and was stretched by an increasing load until it broke. At least an arithmetic mean of 20 test breaks was taken. The relative knot strength was then computed as a per cent of the wet strength of the unknotted material using Brand's formula which was revised by Carrothers in 1963. The formula is a follows ;

$$\text{Relative knot Strength} = \frac{\text{Wet knot breaking strength} \times 100}{\text{Wet breaking strength (unknotted)}}$$

b. Test on weather effect on the netting twines :

The test pieces of the polyamide netting twines were made into a weaver's knot as in the wet knot tests. But in this case 50 % of the test materials were exposed directly under the sunlight while the rest of the knotted twines were put under shade. The test specimens were continuously left at the experimental sites. Sunlight was obtained each day for 10 hours (0800 - 1800 GMT). In every 10 days, 30 test pieces from both shade and unshaded sites were removed and the stregth test of the materials carried out with the Japanese electronic dynamometer.

Results and discussion :

The relative wet knot strength of the various artisanal netting twines varied from 64.55-75.37 %. Wet knotted netting twine of 154 Tex thickness had the highest relative wet knot strength while the lowest was obtained from R 51 Tex. Although the load in these knot -strength test was carried by two strands of twines, knots of the various artisanal netting twines were only 64 to 75 % of the strength of the wet synthetic twines which form the mseshes. It is to be noted that the knot strengths themselves are generally higher than the mesh strength values of the same twine thickness (Fridman, 1986).

The knot and mesh strengths are therefore very important in the selection of netting materials for the fabrication of artisanal fishing nets. The relative knot strength of the fishing gear nettings must be of greater values than the strength of the various fishes which the fishermen intend to catch.

The weathering resistance of the various artisanal polyamide knotted, netting twines was tested. Weathering has been used to describe the combined effects of sunlight, rain, wind, humidity, temperature and athmospheric gases on the characteristics of the polyamide netting materials. However, the ultraviolet rays of the sun-light causes the strongest deterioration on the synthetic materials.

After directly exposing the various polyamide knotted netting twines, for a period of 400 sun hours, they lost between 13.5-24.8 % of their initial breaking strength. The knotted netting twine of R 51 Tex lost the lowest breaking strength of 13.5 % while the knotted netting twine, of R 77 Tex lost the highest breaking strength of 24.8 % after 400 hours direct exposure to sunlight. The effect of weathering has been expected to depend on the thickness of the netting twine. The thicker the netting yarn, the lower the losses in the breaking strength (Klust 1973 and 1982). The data obtained in the tests, has not followed Klust's observation in 1973 because of the following reasons :

1. The test materials were of small diameters ranging between 0.30 to 0.74 millimetres. The ultraviolet rays of the sun would have uniformely penetrated the twines since aggressive UV radiation component can penetrate up to 1 mm under the surface of synthetic materials (Klust, 1981).

2. The test materials were obtained from the open market which gets its supplies from synthetic netting manufacturers in Nigeria, Asia, Europe and other parts of the world. The quality standards of the test materials (polyamide twines) are therefore not the same since synthetic netting materials of inferior quality are often manufactured and sold not only in Nigerian markets but also in other developing countries.

Nigerian artisanal fishermen still preserve their synthetic fishing gear by exposing them directly under the sun. There is no need for that. This practice brings about higher costly fishing production inputs such as skilled labour (man-hours for repairs), material resources and shortening of life-span of the fishing gear.

In order to lower the losses in the breaking strength of these nets made with polyamide fibres, they should be spread under shade such as under the coconut trees which are abundant in many of the coastal areas.

The weathering resistance of the various artisanal polyamide knotted netting twines which have been exposed under shaded sun-light was tested. After 400 hours of shaded exposure, they have lower losses of strength ranging between 10.0-18.9 % of their initial breaking strength. The lowest value of 10 % loss in shaded twines was obtained from the R 51 Tex while the R 154 Tex shaded twine had the highest loss of breaking strength of 18.0 %. The differences in the loss of breaking strength between unshaded and shaded polyamide knotted twines are therefore in the range of 1.9-8.7 %. These value are expected to increase as the duration of the trial tests is extended for an additional 1 000 hours of sun-light and also during the dry season when the intensity of sun-shine and temperature are often high.

<u>N.B.</u> : Full copy of the report available from DIPA, FAO, B.P. 1369, Cotonou

Appendix 10

ARTISANAL FISHERIES IN NIGERIA WITH EMPHASIS ON THE DEVELOPMENT OF A SMALL PROTOTYPE FISHING BOAT IN FIBERGLASS REINFORCED PLASTIC (FRP), UNDER THE AUSPICIES OF FAO/UNDP PROJECT NIR/77/001

Paper presented by E.A. Ogundele.

The importance of the artisanal and inshore fishery sector in the Nigerian fishery scene is very well known not only in terms of the hundreds of thousands of fishermen actively engaged in this occupation but also in terms of nearly 80% of the country's fish production which comes from these sources.

Over 500,000 artisanal fishermen have settlements scattered along the 960 km coastline of Nigeria with its extensive coastal lagoons.

The mode of operation is characterised by the use of out-moded traditional wooden fishing canoes of various sizes, a small percentage of which are fitted with outboard motors of different horse power. Fishing gear used from these canoes comprise mainly set-gill nets, beach seine, long lines, basket traps, cast nets etc. This fishery as being practised is labour intensive and because of the limited capabilities of the craft and gear results in low productivity. Furthermore the carved fishing canoe is fast becoming an endangered species as suitable big logs are just not available.

Therefore over the last four years the Federal Department of Fisheries in collaboration with the F.A.O. has been endeavouring to develop a prototype sea-going fishing canoe in fibreglass suitable for future production in order to replace the existing dug out or plank canoe aimed at improving the lot of the artisanal fishermen.

In fact, the recently terminated FAO/UNDP Project for Artisanal and Inshore Fisheries Development Project (NIR/77/001) had contributed much to upgrading of the artisanal fishery by providing technical assistance and inputs where necessary. Furthermore it has rightly laid emphasis on the primary aspects of the activity which is improvement of fishing technology, comprising fishing.

Traditional fishing craft

The indigenous coastal fishing craft of Nigeria fall into three main categories based mainly on the topography of the areas they operate from.

- the Rivers and Cross Rivers states use mostly planked canoes ranging from 9m - 12m and are used to take off from river mouths and shallow beaches.

- the surf-beaten sandy coasts of Lagos and Ogun State use similar large and rugged Ghana type carved canoes 8m - 12m specially developed for operation from the beaches.

- the muddy beaches of the coast of Ondo State use the mud-flat banana type planked canoes 7m - 9m specially adapted for dragging on the mud in low waters.

FRP prototype fiberglass canoe

The efforts of the Federal Government of Nigeria has resulted in the introduction of Ghana type fibreglass beach canoes in Lagos State and the banana type muddy flat fiberglass fishing canoe in Igbokoda Ondo State to serve other riverine states.

The boat building project at Igbokoda was established in collaboration with FAO/UNDP assistance to develop, test and construct FRP fishing boats and mechanised medium size wooden trawlers for the eventual adoption by small scale fishermen cooperatives.

It was also envisaged that local manufacture of fibreglass boats and medium size wooden trawler apart from making fishing craft available will also bring prices down to a level affordable by the fishermen cooperatives. Therefore, the project has been engaged in training not only operators of fishing boats and extention personnel, but also technicians in building boats thus helping to expose Nigerian technicians to the latest development in fisheries technology.

In order to effectively implement the project operations FAO/UNDP assigned S.C. Parmentier as boat building consultant for three months to the NIR/77/001 project from March 1985 to May 1985 and February 1986 to August 1986 with the following terms of reference.

(a) Study existing FRP boat building facilities in Ondo and Lagos States and extend technical assistance as necessary to the builders.

(b) Assist the Federal Department of Fisheries in establishing a simple and practical pilot FRP boat building and servicing facility.

(c) Train counterpart technicians and other local boat builders.

The first two weeks of the expert's assignment was spent on study and familiarization visits to fishermen communities along the coastline of Ondo State, with a view to getting them fully involved with the project. Also, local boat building workshops were inspected in order to observe methods used and type of boats produced.

At the conclusion of the familiarization and study tour it was agreed that Mr. Parmentier should embark on a design and construct prototype version of a beach landing banana boat as used on the muddy beaches of Ondo State.

The dimension of a typical wooden boat was taken as a basis for a new design in FRP..

Meanwhile, lists of required tools and relevant materials for smooth operation of the project were prepared and purchased locally.

Design of the prototype FRP boat

The typical traditional wooden boat was modified for FRP construction with paddles evenly distributed along the length of the boat.

Since most of the fishermen use outboard motors especially Yamaha 25 HP with long shaft, and the crew tends to sit relatively far aft a new hull design was developed with finer forward and fuller aft to compensate for the changed weight distribution of engine and crew. Beam was somewhat increased to compensate for the loss in stability for the lighter FRP construction. Invariably all the lines and dimensions reflect the typical wooden boat. Airfilled flotation tanks were added.

Construction of the plug

For individual stations a frame was cut and set up. Mahogany battens, 3/4 x 1 inch, were recessed and nailed to the frames at about 20 cm spacing throughout. This framework was covered by 1/8 inch hard board panels in certain areas.

Brads, 3/4 inch were used for nailing the hardboard. This harboard conformed quite well to the required shape.

Butts, seams and nail heads were covered with automotive body putty and sanded up. The process from setting up the frames to completion of the plug took two weeks.

Construction of mould

Six coats of wax were applied to the plug. PVA was sprayed of the plug, and was left to dry.

Gelcoat was sprayed on the dried P.V.A., and also left to dry.

Lay up of fiberglass mat with applied polyester resin followed. A cradle made from ply wood and fiberglassed was mounted outside of the mould.

The mould was released from plug after eight working days.

Construction of the prototype boat

(1) Mould was washed

(2) Waxing of mould, applying PVA and Gelcoat was completed within two days. This time no spray equipment was used since rolling on Gelcoat was acceptable for the boat hull.

As in the process of lay up with the mould the lay up for the boat was :-

One	300g	mat	overal
Three	450g	mat	overal
One	560g	mat	overal
One	450g	mat along gunwale	

The boat was completed with the installation of buyancy tanks, engine buckets, seats, gunwale mouldings and the opening for the outboard motor was cut.

Testing of canoe

The canoe was first tested in the flood condition for buoyancy, with an old 25 HP mounted on the well. The canoe floated quite well and sufficiently high, so that she may be bailed out under any condition.

Sea trials

Four prototype boats were completed and handed over to viable fishermen cooperatives in four of the marine states. Comments received varied considerably among the fishermen. They agreed that they liked the low weight because it made it much easier for them to move the boat in mud. Some found it too beamy and one considered the boat two slow.

The second prototype canoe referred to as the improved version had since been constructed taking into consideration some obvious technically acceptable complaints of sea trials by fishermen cooperatives. The most significant achievement of the project is that the prototype FRP canoes have been widely accepted by cooperative fishermen for profitable fishing. The stability of the FRP canoe is much greater than that of the dugout canoes and the fishermen were quite pleased. The increased stability no doubt gives them a sense of security, yet no complaints were heard about uncomfortable rolling. Speed under power is considerably better than the dugout canoe.

It is heartening to report that the boatyard has succeeded in up-grading the boat building activities gradually from FRP canoe construction to a simple wooden trawler construction with the recent completion of two 9.2m wooden fishing trawler designed by FAO capable for pair trawling and gillnetting.

Finally the main component of fiberglass fabrication which is polyester resin is now locally manufactured in Nigeria by Nycil Limited Ota Layout Nigeria.

TABLE I.

NIGERIA FISH PRODUCTION BY SECTORS' 1960 - 1987
(UNIT METRIC TONS)

SECTORS	1980	1981	1982	1983	1984	1985	1986	1987
TOTAL	597,342.	660,163.	920,784.	694,280.	553,926.	304,229.	372,301.	498,150.
1. ARTISANAL:								
i. Coastal & Brackish Water	274,158.	323,916.	377,683.	376,984.	246,784.	140,873.	160,169.	145,755.
ii. Inland: Rivers & Lakes	188,409.	157,867.	119,527.	146,267.	112,219.	60,510.	106,967.	103,232.
iii. Fish-farm: (Aqua-culture)	-	-	-	20,476.	22,012.	15,000.	14,881.	15,221.
2. INDUSTRIAL: (COMMER-CIAL TRAWLERS)								
i. FISH	11,667.	7,070.	17,648.	13,951.	22,992.	23,766.	22,419.	21,383.
ii. SHRIMPS	1,964.	2,541.	1,513.	5,294.	2,650.	2,376.	2,623.	3,517.
3. DISTANT: (Imports)	121,144.	168,769.	404,413.	131,308.	147,261.	61,704.	65,242.	209,042.

Appendix 11

The introduction of echosounders in Benin artisanal fisheries

by

P.F. Tanimomo

1. BACKGROUND

Benin artisanal fishermen using mostly purse seines throughout the year with a long lean season of eight to nine months, one of the possible reasons or the lack of catch increase may be the relative absence of a diversification in fishing techniques or the improvement of the existing methods. This lack is now being partially dealt with by the model project staff through the introduction of deepwater hand-lining and bottom set gill-netting on coral reefs by the use of a portable echosounder.

2. TRAINING OF THE FISHERMEN

2.1. First and second stage of training

The first training phase for fishermen interested in the technique was in dugout canoes, the search for fishing grounds being made in the traditional manner with a leadline. The objective was by comparison to draw the attention of the young fishermen to the advantages of using an echosounder for fishfinding. This phase was followed by intensive training in seamanship, mechanics and navigation through which the fishermen learn to repair their lines, read a compass and operate the echo-sounder.

For the second training phase, fishing trips were made on a cygnus marine fibroglass craft of 6m L.O.A. with a 110 HP. engine. The rocky depth 52 m and at the limit of the continental shelf were, explored with very satisfactory catches. At that stage the fishermen had already realised that :

In order to avoid problems of watertightness and damages which can be caused to the transducer when beaching of the pirogue, it was found better to install the transducer on the starboard side rather than through the hull. For that point, a steel tube, a sheet of metal, a wooden block and a clamp have been put together to build a support that allows the transducer to point straight down. (see annexe II : the transducer support).

2.2.3. Fishing technique

A fossil reef parallel to the Benin Coast at a distance of 12-15 miles at 52 m deep, is easily identifiable because it rises abruptly 5-6m from the sea bed. This is where most gill-netting is practised by the project vessels or crews trained by the project.

The search for the rocks is from North to South and from South to North moving slowly to the East or the West. This gives a zigzag figure of the vessel course. After the rock is located on the recording paper, the pirogue moves slowly to the windwardd side and the net is shot down the wind straight across the rock with the engine running slowly. The net is set in the evening and hauled the following day. The pirogue facing the wind.

For hand-lining the pirogue is maintained on the rock peak as long as there is fish taking the bait. Each time the crew get a "good ground", the canoe is anchored for fishing.

3. ADVANTAGE OF USING AN ECHO-SOUNDER FOR GILL-NETTING AND HANDLINING

Among the numeroos advantages that an echo-sounder can give to a fisherman, the most important as found in the Benin experience are as follow.

- Precision : To set the net on a rock, you need to know its location and its extent. This information can only be given with precision by an echo-sounder.

- Time saving : To know approximately the water depth with a leadline, you first have to stop your engine and wait until your boat nearly stops moving. Then you throw the leadline into the sea and haul it back after you have counted the marks. This system is obviously time

- the hand line fishing does not require too much investment and it is financially profitable.

- it is possible to increase the catch through fishing trips of two and three days.

- there is an increase in catch through the use of the echo-sounder because it is much easier to search for rocks and move rapidily to another area.

2.2. Third stage of training

After the two first steps where the fishermen became acquainted with the echo-sounder observed and practiced handline fishing assisted by experienced professionals and gear technologists, the training has been transfered to MATAHEKO (first training canoe of the Pilot project) fitted for the purpose.

2.2.1. The type of echo-sounder

On account of economy and level of technology as well as education, one of the simplist types of echo-sounder has been used in the training. That is the Japanese AQUASCOPE recording echo-sounder with the very basic control knobs and switches of "ON-OFF" ; " DEPTH RANGE" ; "PULSE LENGTH" ; "GAIN" and "PAPER SPEED".

The echo-sounder caracteristics

- Power SOURCE : 1,5 v "c" size dry batteries
- TRANSDUCER : CERAMIC type 200 KHZ
- Recording paper : Dry 100 m/m x 15 m
- Practical depth recording : 150 m

Being a portable echo-sounder, it can be used on small boats as well as on pirogues with a supporting device for the ceramic transducer.

2.2.2. Echo-Sounder Installation

To protect the echo-sounder cabinet and its power source from sea water, rain, sunlight and accidental damage a small wooden box of two partitions was fixed to the thwarth in front of and at the port side of the engine bracket. The cabinet is fixed in the upper partition on a steel support from which it can be easily removed, (see annexe I : Installation of the echo-sounder).

consuming whereas echo-sounder readings are direct, precise and continuous.

- More information : Traditional technique of measuring the depth can not tell you for exemple whether or not you are on a flat rock or on a rock peak. But echo-sounder recording paper shows you the configuration of the sea bottom.

4. PROBLEMS ENCOUNTERED

Traditional young fishermen in Benin have for a very long time been under a custom that have kept them inside the distance at which they can see. It means that the fishermen have to stay where they can still see the land marks to be protected during the fishing trips by the "Fetiche" of the village. This kind of rule has been the biggest obstacle that the staff of the Pilot project overcame for the training.

Moreover they were not used to stay overnight at sea for fishing. The fishing grounds are too far from the coast (12 miles - 2 hours sailing) to afford to come back home after setting the nets and return to the ground the next day. The only way to make the fishing profitable is to spend two or three days at sea.

Most of the trainees have never attended a school. They can not read the depth on the recording paper. The fishing ground being at 52 m depth, the training has been directed only on the reading of 52 m in the beginning. The fishermen knew what range to use and where to read 52 m on the paper. Slowly thereafter they got used to the variation of the ranges.

CONCLUSION

Experience has proved that any kind of introduction of new technology or modification of existing technology has often faced the problem of disinterestedness or simple rejection. New fishing methods and improvement of gear consequently lead sometime to incompatible traditional priorities on conceit and narrow mindedness and at the end, the fishermen may turn back and return to more traditional but less lucrative fishing.

Introduction of new technology logically if successful means more fish and more money. But in the begining did you:

- Think about the level expertise
- Consider the market and the economy
- Look over the level of education and
- The balance between your technology and the level of development of the community.

For a long term run all these factors are as important as the technology itself and should be given equal consideration.

And now comes your savoir-faire, your know-how. How to deal with someone who thinks he has nothing to learn from you who drive a car and go to sea once in a while. You who can talk and write a lot.

And at the end of your planning are you aware that more fish means and involve more labour and better management and organisation of the rest of the folk ? In other words, the development of artisanal fisheries should not stop out of the level of fishermen, but rather spread to the fishing community as a whole with support to the training of the national staff to bring up to date the level of competence, to secure the post training period.

All these consideration and factors have cost to the model project a year of hard work and investigation which have produced today after four years.

- 13 very experienced trainers in echo-sounding for gillnetting and hand-lining.

- more than 50 fishermen experienced in bottom set gillnetting and hand lining

- 12 boats owners that have adopted the technique

It is obvious that all the work involved in such development is intense and now calls for continued support.

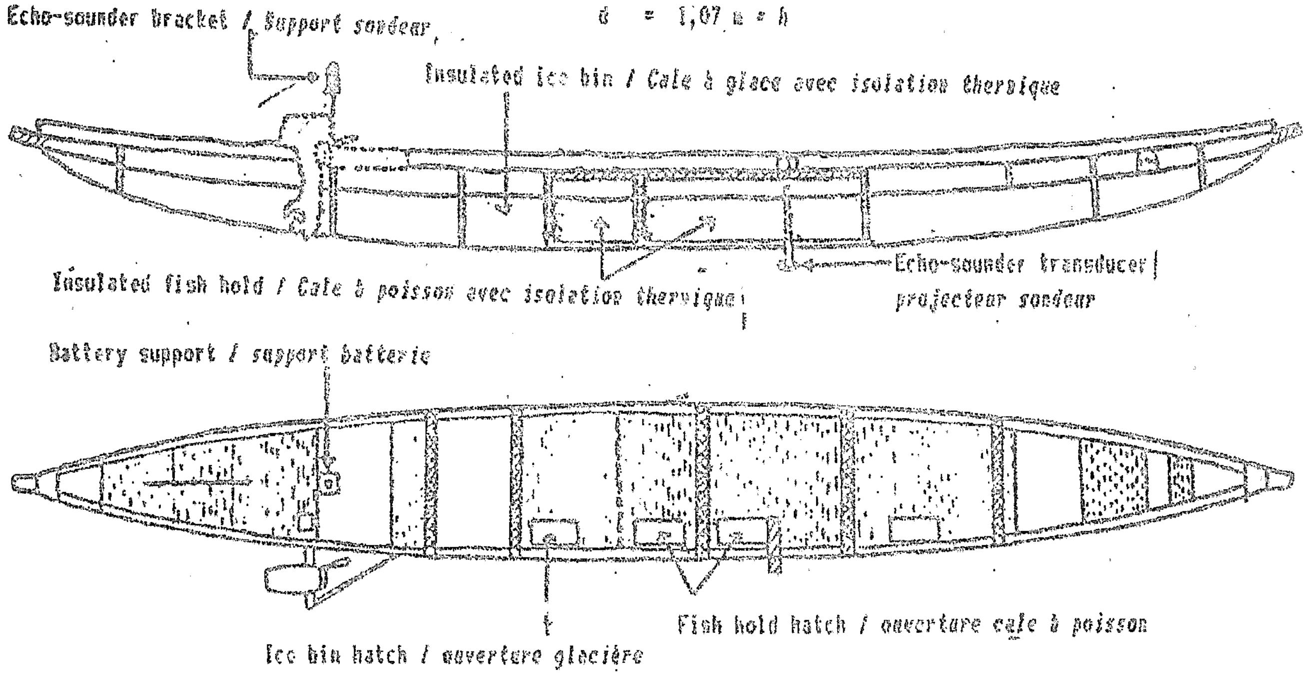
Annex 1

IMPROVED DUGOUT CANOE "MATAHEKO" USED FOR DEEP WATER HANDLINING / *PIROGUE AMELIOREE "MATAHEKO" UTILISEE POUR LA PECHE DE FOND A LA LIGNE A MAIN*

Used for deep water handlining, equiped with a portable echo-sounder and insulated iced-fish hold.

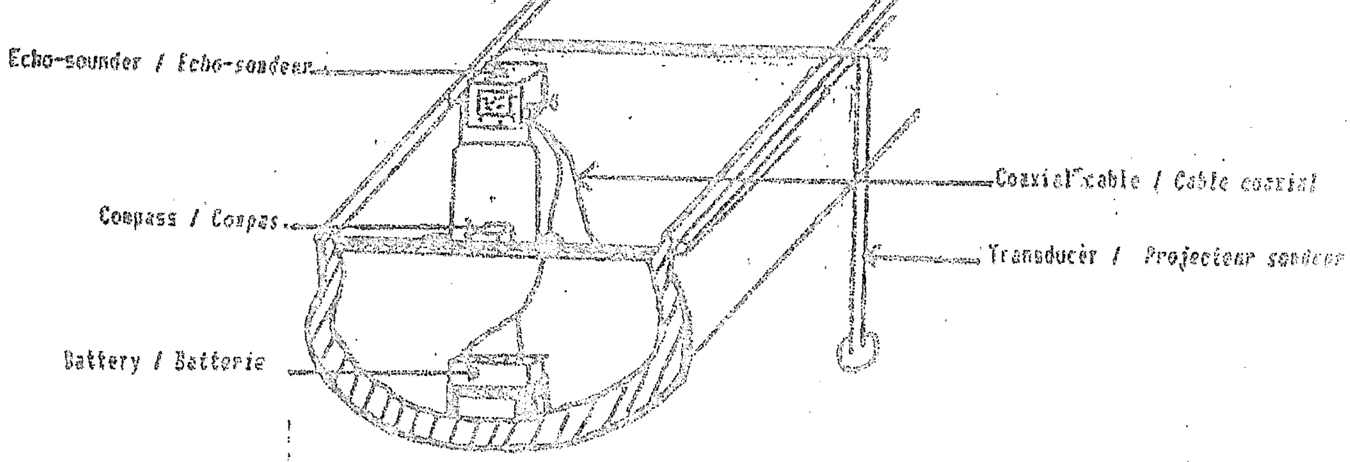
Pirogue utilisée pour la pêche à la ligne à main, munie d'un écho-sondeur, de cales à glace et à poisson avec isolation thermique.

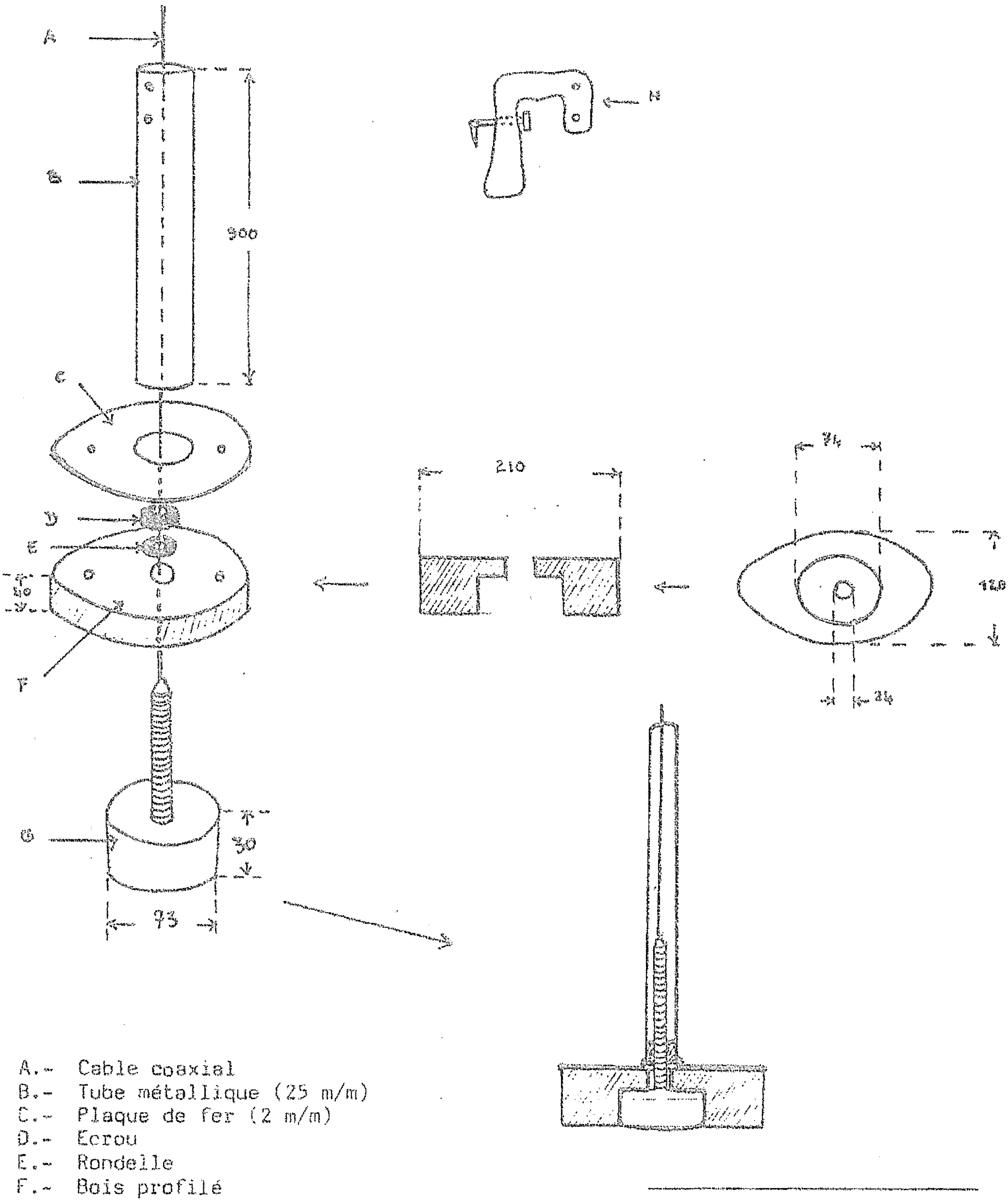
LOA = 14,20 m = L
W = 1,92 m = l
D = 1,07 m = h



ECHO SOUNDER MOUNTING / *MONTAGE DE L'ECHO-SONDEUR*

CROSS SECTION / *COUPE TRANSVERSALE*





A.- Cable coaxial
B.- Tube métallique (25 m/m)
C.- Plaque de fer (2 m/m)
D.- Ecrou
E.- Rondelle
F.- Bois profilé
G.- Sonde
H.- Etau de fixation

Sonde montée avec son support

Appendix 12

Fishing Technology : Extension in Beninese villages

P.T. Holler APO Masterfisherman/Mechanic
Project Model Benin
GCP/RAF/198/DEN

Objectives:

- Diffuse some of the technical improvements, introduced by the Model Project in the port of Cotonou, to the rural fishing villages in Benin.

- If possible, introduce alternative fishing methods for the low season of the traditional fishing activities along the Benin coast.

Introduction:

The technical work of the Model Project has kept the fishing technologists occupied in the port of Cotonou for a long period and created a vacuum in the technical extension work in the coastal villages.

The concentration of the work in the port has nevertheless been necessary, for demonstrating increased returns of the new fishing techniques to the artisanal fishermen operating from the port and by that encouraging the fishermen to invest in these techniques.

The Model Project has experimented with the use of compass, echosounder, improved nets, long-lines, insulated compartments in the canoes and diesel inboard-engines, for fishing on the reefs. The success of these innovations has given the impression that any investment in these improvements would have to comprise the whole package. This would be far beyond the financial means of artisanal fishermen in the rural villages.

In discussions with fishermen in the villages the improved Tohunga was by the fishermen actually referred to as "des filets de pêche FAO de Cotonou", and was considered as only useful for the reef fishery practised from the port of Cotonou.

In fact the improved fishing gear can easily be adjusted for use on soft bottoms, the traditional fishing grounds used from the villages.

Visits in the rural fishing villages:

The fishing technologists - in collaboration with the FDU's(1) concerned - studied and discussed with the fishermen the technical problems they face when fishing from the beach.

The villages visited were :

- Ayiguinnou, Zogbédji and Nikoué-Condji in the Mono Province
- Avlékété, Hio and Adounko in the Atlantique Province
- Okwunseme in the Ouémé Province.

The most essential fishery technical problems discussed and observed during those visits were :

- Non-availability of fishing gear
- Low level of fishing operations
- Insufficient mechnical knowledge among the fishermen
- Insufficient fishery technical knowledge of the FDU members.

Of all traditional fishing methods observed, the following were included in the inital training, as they would require relatively small changes to improve their performance.

- Tohunga. 80 m/m meshsize 6-8 nets x 200 yards. 4-6 fishermen
- Sovi 46 m/m meshsize 6-8 nets x 200 yards. 4-6 fishermen.
- Both used from canoes 9 m and equipped with paddles or sail.
- Longline, 10-30 hooks attached to a mainline, 1 fisherman. The longline is swimmed out through the surf and after fishing hauled from the beach.

Two training programmes were planned upon the results of the visits : one for the fishermen and the second one specifically for the FDU members.

Since September 1988 the project has undertaken :

- 3 training programmes for artisanal fishermen (the Mono Province)
- 2 training programmes for FDU members (Mono and Atlantique Provinces).

Planning of the training programme for artisanal fishermen

In close cooperation with the FDU in Grand Popo and artisanal fishermen a training programme was planned including the following subjects :

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(1) FDU - Fishery Development Unit - a team of extension workers based in a fishing village, supported by the Model Project.

- Mounting of an improved Tohunga
- Mounting of an improved Sovi
- Construction of a longline

After the sessions on mounting the fishermen tried the new gear on the normal fishing places just outside the villages.

The following principles were used for the training programme :

- The site for mounting the gear had to be in an actual fishing village.
- The project would supply all material needed for mounting the gear.
- The fishermen would supply a canoe for the experiments.
- The 5 fishermen selected for the practical experiments had to be well experienced and belonging to one family unit.
- During the mounting of the gear a per diem of 700 FCFA per fisherman would be paid.
- The days of the experiments the entire catch would go to the fishermen.

Here it has to be underlined, that more than to prove the economic viability of the gear, the intentions were to show that the fishing gear developed in Cotonou could easily be adapted to the traditional methods of fishing practised from the rural villages.

Execution of the training programmes for the artisanal fishermen

All the fishing material was brought from Cotonou and the gear was mounted by the artisanal fishermen in their village.

This mounting phase is seen as the most important phase, both from the point of view to familiarize the fishermen with the gear as with respect to their responsibility for the maintenance of the gear thereafter.

The training session in Nikoué-Condji has shown a positive impact : The fishermen maintain the gear regularly and they have even introduced some alterations to it, to suit the local conditions. The training sessions for fishermen from Ayiguinnou and Zogbédji were held too recent to allow for any reflections on their impact.

The actual experiments were undertaken with a non-motorized canoe (9m long) with the fishermen using paddles. The fishing gear was joined together and placed late afternoon on soft bottom at a depth of 10-18 meters and hauled early next morning.

During the training in Nikoué-Condji some experiments with "beachrollers" were added to the programme. It is a system of rollers facilitating the beaching of the canoes. The experiments were abandoned, following recurrent deflation of the rollers: the canoes appeared too heavy for the rollers and woodsplinters pierced the outlayer and punctured the innertubes. The Model Project will continue to experiment with beachrollers.

After each training programme a meeting was arranged with the participating fishermen, the FDU and the fishing technologists to discuss the results of the training. The following observations were made :

- the improved Tohunga is fishing well, but comparison with the traditional Tohunga is difficult, due to insufficient length of the improved Tohunga (4x100 yards) used during the training;

- the thread used for the improved sovi, is too thick (1.5x6), but the fishermen expect that it will catch well in the right season;

- of the hooks used for the long lines, the Mustad N°.9 is considered too small, as several hooks have been stretched out or even broken by the fish;

- the arrangement with the baited line in plastic baskets was easy to use, but covers are needed for in the surf.

- Beachrollers: once developped correctly, could be a big improvement. However, the fishermen anticipated social problems for their introduction, as beachrollers would reduce the number of canoe haulers needed. These normally receive fish for home-consumption and the introduction of beachrollers could thus upset an indigenous system of food security.

- Credit : Requests have been brought up for credit to purchase fishing gear, outboard engines, canoes etc.

Problems encountered during the training programmes :

- Availability of canoe : all participants were crew-members. The canoes needed for the practical training had to be borrowed. In one case the owner needed his canoe right after the training and no further experiments could be done.

- Féticheur: The féticheur in Ayiguinnou has banned the consumption of catfish, creating local marketing-problems.

- Bad experience, fear : the fishermen, from Hio didn't want to use the longline, as they considered fishing with hooks too dangerous, following an accident which happened in 1985. Furthermore they fear catching big rays with the longline.

- Technologists - not all government employed fishing technologists appeared interested in undertaking this kind of training programme. No specific reasons were mentioned but their attitude might have been influenced by :

  . no payment of their salaries for several months
  . the difficult working conditions in the rural fishing villages
  . the low status of extension work in the rural areas when compared with working in the port of Cotonou.

However, an intensive "introduction-training" period was expected to facilitate the acceptance of the new gear. Therefore, much of the time of the training programme was used to discuss the advantages and possible disadvantages of the new techniques. These discussions included not only those still active in fishing but also the elder fishermen.

However, the before mentioned possible disadvantages and the time-consuming discussions and demonstrations are only minor set-backs compared with the benefits of working with artisanal fishermen in their own environment. Furthermore, the upgrading of the technical knowledge of the FDU members is seen as a key factor in the follow-up phase of the training programmes.

A far greater problem could be the observed reluctance of some of the government employed technologists, to work in rural areas. This clearly conflicts with the role they have been assigned in the original project document : to work from the harbour and to provide support at village level. Many fisheries projects are based on similar village level interventions. Project planners therefore should be well aware of the constraints this attitude may cause.

Appendix 13

RAPPORT SUR LES ESSAIS DE PECHE AUX FILETS MAILLANTS ET PALANGRE DE FOND ET LES CHARIOTS DE MISE A SEC DANS LE VILLAGE NICOUE-CONDJI (BENIN)

Par P.F. Tanimomo et P.T. Holler

I. Introduction - Objectif

L'extension de la pêche aux filets maillants sur les fonds rocheux par le projet modèle Bénin est un des éléments de la diversification des méthodes de pêche artisanale. Pour ce faire, le "Tohunga" traditionnel a été modifié pour être adapté à ces fonds et du matériel nouveau a été introduit. La modification porte essentiellemnt sur le remplacement des plaques de plomb par des anneaux en fer & béton sur la ralingue inférieure montée avec un rapport d'armement correspondant et strictement respecté.

Après plusieurs années d'expérience, il a été remarqué que la tendance générale qui se dégage des communautés de pêcheurs est que les "filets de pêche FAO de Cotonou" ne s'utiliseraient que sur des fonds coralliens. Les pêcheurs qui seraient intéressés par l'adoption de la nouvell technique devraient avoir du matériel et équipement à l'instar des unités-écoles du projet modèle : pirogue aménagée de câles isothermes, écho-sondeur portatif, compas... etc. et qui nécessite un investissement relativement élevé pour le pêcheur artisan.

Une telle appréhension de la stratégie de développement des pêches entrepris par le projet a vu le pêcheur se convaincre de son incapacité financière à suivre la voie tracée. Or le filet amélioré peut être utilisé sur n'importe quel fond (rocheux, sableux, vaseux/lorsqu'il est correctement monté. Mais cette évidence, il fallait encore la demontrer ensemble avec les pêcheurs intéressés dans leur milieu en utilisant leur propre éqnipement. C'est à cette tâche que s'est attelée la section technologie des pêches qui a voulu en même temps introduire ou améliorer la technique de pêche aux palangres de fond tout en essayant un système de mise à sec des pirogues sur la plage.

II. Visite des campements de pêche

Cette visite avait pour but de reprendre le contact avec les pêcheurs dans les villages afin de nous imprégner de leurs problèmes de l'heure et chercher ensemble avec les UDP des alternatives de solutions en vue de leur application immédiate dans la mesure du possible.

C'est ainsi que les villages de Ayiguinnou, Zogbédji et Nicoué-Condji ont été visités dans la Province du Mono, Avlékété, Hio, et Adounko dans l'Atlantique de même que le village de Okounseme dans la Province de l'Ouémé.

Au cours de cette visite on peut noter que les problèmes enregistrés dans les villages se résument aux aspects liés à :

- matériels et équipement de pêche
- la pêche
- la mécanique

III. Démonstration de Techniques de Pêche à Nicoué-Condji

3.1 Travail de base effectué par l'UDP

Une séance de travail avec l'UDP de Grand-Popo a d'abord eu lieu à la direction du projet. Au cours de cette séance, il a été clairement défini les modalités et les conditions d'intervention de la section dans les villages.

A cet effet, compte tenu de l'expérience acquise au cours des années écoulées et de la qualité du travail que nous tenons à accomplir, l'accent a été mis sur les points suivants :

- l'équipe à former doit être une équipe de famille de pêcheurs
- l'équipe doit posséder une pirogue et avoir une bonne expérience de la pratique de la pêche en général
- l'équipe sera composée de 5 membres
- 600 FCFA de frais de nourriture seront versées par jour et par pêcheur au cours des séances de formation.
- toute la production de la pêche revient entièrement aux pêcheurs

Les essais ont eu lieu le 20-23 et 26-30 Septembre et le 3-7 Octobre 1988.

3.2 Montage des engins

Contrairement à ce qui avait été conclus ensemble avec les pêcheurs, ce sont plutôt huit éléments qui ont été mobilisés pour faire le travail à terre. Des huits pêcheurs, deux équipes ont été constituées pour le montage des engins et la confection des rouleaux de mise à sec. Il n'avait pas été possible de changer le rythme de travail auquel les pêcheurs sont habitués. Toute l'équipe se retrouvait dans la maison du propriétaire-chef de famille tous les matins de 9h à 12 heures puis de 13 heures à 17 heures de l'après-midi du Lundi au Vendredi.

3.2.1 Les filets maillants câlés

a) Le "Tohunga amélioré"

Les flotteurs étant épuisés au projet et en attendant une nouvelle commande, il n'était pas possible de travailler à partir d'une nappe de filet. C'est pour cela que quatre filets entièrement montés au projet ont été complètement démontés pour être remontés de nouveau en changeant quelques paramètres: Réduction de la flottabilité totale et du rapport d'armement sur la ralingue inférieure.

b) Le soir

Une des nappes multimono 1.6 x 4 de 40 mm de maillage a été coupé pour monter deux filets "SOVI" en utilisant la technique traditionnelle avec 4 mailles dans chaque boucle au taux d'armement de 50% sur la ralingue inférieure de fil câblé N°.12 a été enfilée dans chacune des mailles en bordure du filet de 50 mailles de chute.

3.2.2 Les palangres de fond

Deux montages différents de palangres ont été adoptés suivant que l'on utilise des hameçons N°.9 ou N°.6. La ligne principale est en PVA de 0 2 mm et de 0 2,5 mm. Les avonçons en PA fixés à tous les 1.2 ft.

Chaque palangre de 220 hameçons appâtés a été soigneusement rangé dans un panier et sur un cadre de planche dont les bords sont surelevés sur trois côtés. Cet arrangement permet de filer la ligne avec beaucoup de facilité.

3.3 Pêche et production

Bien que l'équipe ayant été choisie pour suivre la formation soit une équipe de senne de plage nous n'avons enregistré aucune difficulté dans l'apprentissage des opérations de pêche. Les engins (filets, palangres) sont posés le soir à proximité de la côte à 10-18m de profondeur puis relevés le lendemain matin. La pirogue utilisée est une pirogue monoxyle d'environ 9m de longueur HT. La traversée de la barre se faisant à la pagaie.

Deux palangres sont posés dans l'alignement des filets formant une tesure de 6 unités. Ils sont mouillés face au vent et relevés le dos au vent. Les appâts utilisés sont de petits poissons tels que mussolini, Ilisha africana et les petits harengs achetés auprès des senneurs de plage le matin et conservés avec du sel gros grains. Les petites crevettes de lagunes ont été aussi utilisées au cours d'une marée et n'ont permis d'attraper que de petits machoirons.

Au terme des essais de pêche, les résultats suivants ont été enregistrés.

N° de Marée	Les filets de 100 yrds 80 2 filets de 100 yards 40 220 hameçons N°.6 220 hameçons N°.9	Frais de Marée	Production kgs	Espèce
1	"	1000	50	bar-silure blanc
2	"	1200	25	"
3	"	1000	30	"

* Les frais de marée indiqués représentent le coût de l'appât acheté. Toutefois les pêcheurs s'approvisionnent aussi en gari.

IV. Essais de mise à sec

Les chariots utilisés pour la mise à sec des pirogues ont été construits à partir de lamelles de caoutchouc coupées dans les pneux de camion. Trois lamelles cousues à leurs extrémités forment un ballon oval à l'intérieur duquel une chambre à air de voiture crée la pression voulue. L'ensemble est habillé d'un filet manuellement lacé avec du fil 0 4 mm. Les ballons sont reliés deux à deux par un cordage de 0 16 mm de manière que l'écartement entre deux ballons puisse être volontairement varié.

Deux paires de ballons dont une de taille plus petite ont été utilisées pour mettre à sec une pirogue de senne de plage de 9 m de long à vide. Deux tentatives ont été faites. A chaque essai un des plus gros ballon a cédé sous la pression de la pirogue : A la première tentative la chambre à air est sortie de l'enveloppe. Au deuxième essai, après que les lamettes de caoutchouc aient été solidement cousues, la chambre à air servant de vessie a éclaté. L'expérience a dû être abandonnée.

V. Réunion de synthèse

A l'issue des essais, nous avons tenu à avoir une réunion de synthèse avec les pêcheurs. A cette réunion étaient aussi présents les membres de l'UDP. L'objectif était de recueillir les impressions des uns et des autres sur ce qui a été fait et leurs suggestions pour la poursuite des activités. Les interventions peuvent se résumer sur ce qui suit :

- Les filets de 80 mm en multimono sont de très bons filets pour la pêche côtière de par le maillage et la transparence du filet dans l'eau. Mais les essais ont été menés avec un nombre très insuffisant de filets : 4 filets de 100 yards

- les filets de 40 mm au multimono 1,2 x 6 sont de fils trop gros pour cette taille de maille. Les pêcheurs demeurent très optimistes quant à sa performance à prendre de petits poissons en période de bonne pêche.

- l'arrangement des palangres dans le panier et sur la planche est très pratique. Les hameçons N°.9 sont trop petits et le fil utilisé pour les avonçons est très souple.

- Il faudra prévoir un couvercle sur le panier à palangre afin d'éviter la perte de l'engin et des accidents corporels en cas de chavirement dans la barre.

- Le système de mise à sec allègerait effectivement les opérations du hissage si les ballons n'avaient pas éclaté. La confection demande beaucoup de travail.

À toutes ces remarques et suggestions, il faut ajouter des doléances telles que :

- l'acquisition d'un moteur hors-bord de 15 cv, d'une voile, de 10 filets le tout sous forme de crédit remboursable par échéance mensuelle de 10.000.

Concernant les problèmes relatifs aux doléances des pêcheurs quant à l'acquisition du matériel de pêche (moteurs, pirogues, filet, voile...) il serait difficile de ne pas y accorder une petite attention bien que la crédibilité de la plus part des pêcheurs soit toujours mise en cause.

Une brève évaluation nous a déjà permis de voir qu'il est possible d'étudier une forme de crédit bien limité à de petits groupes de pêcheurs ayant porté un intérêt à la méthode et disposé à assurer une participation effective en nature. Des rencontres futures avec les responsables du projet et élargies aux UDP permettrons de définir les contours et les modalités de mise en exécution.

Appendix 14

OBSERVATIONS ON FISHING GEAR IN THE YEJI AREA - VOLTA LAKE

Excerpt from a paper presented by L.I. Braimah

INTRODUCTION

Yeji is one of the 190 villages that constitute stratum 7 of the Volta Lake. It has been established that the number of fishermen in the stratum total 15,581 and all use Yeji as the marketing centre to sell their fish. It was also realised that these numerous fishermen use varied methods of fishing and that the methods change from time to time depending on conditions in the lake.

As a first step to determine stock levels and to establish plans towards monitoring of the fish stock, The Yeji Project decided to make preliminary investigations to determine the methods of fishing and the various gear deployed.

It must be stated that this paper is based solely on investigations at Yeji and Accra Town Village and it is hoped that it would extend later to cover all the 190 villages in stratum 7. It must be emphasised that more work is still underway especially on the traps and it is hoped that eventually there would be a full inventory of the gear, methods, and designs.

1. GILL NETS

During the survey only simple, single-walled gill-nets of twine size 210/2 or PAR 47 tex and monofilament twine of 0.2mm were found. Mesh sizes range from 1 1/4" (31mm) to 2" (50mm). It is reported that in some areas mesh size of 6" (150mm) is used for the purpose of capturing citharinus, lates, labeo and distichodus.

Design consideration

In order to chose twine size and ropes for gill nets F.I. Baranov suggests the underlisted tables.

Table 1.

FISHING CONDITIONS	ROPE CIRCUM-FERENCE (mm)	DIAMETER (mm)
1. Fishing in places sheltered from winds and waves (lakes, sheltered lagoons, rivers with weak currents fishing under ice etc.	10 - 12	3 - 4
2. Fishing from small boats in open but not deep waters	14 - 18	4.5 - 6
3. Fishing from very large open boats or smaller decked vessels (seiners) in the open seas and open areas in large lakes	20 - 25	6.4 - 8
4. Fishing from large vessels (SRT etc) in the open sea using deep-walled gillnets. (In this case the cork lines and lead-lines are made of 2 ropes with 20-25 opposite twist directions)		

Also considering the second table:

Table 2.

d/a	Rope circumference in lines of gillnets (mm)	diameter (mm)
0.005	10 - 12	3 - 4
0.010	14 - 18	4.5 - 6
0.015	20 - 25	6.4 - 8
0.020	2 x (20 - 25)	"

From table 1 it would be obvious to conclude that fishing conditions in the Volta especially Yeji is 1. Therefore the diameter of mainline e.g. Headropes and footropes should be 3-4mm.

This is the case observed in Yeji as all mainlines are 3 mm to 4 mm in diameter.

b) It also means that the ratio d/a must be 0.005 to satisfy table 2, where d is diameter of twine and a, meshsize.

If twines of 0.2 mm are used it means that meshsize of 40 mm must be deployed. Here to from the observations of what really is in use as stated earlier complies with what Baronov suggests.

Hanging Coefficients of 0.5 to 0.55 are commonly used and this is also theoretically acceptable.

In theory it is suggested that hanging (stapling) twines should be 2 to 3 times stronger than the extreme twine.

It is common in Yeji to observe hanging twines which are of size 210/6.

<u>Buoyancy and Sinking Force</u>

Weight in water of a material (solid) is obtained from the weight of the object in air W by affording the value of specific Gravity of materials, C,
Buoyancy F = W (1/c - 1)
Sinking force = W (1 - 1/c)

From the calculations it was realised especially for gill nets that the sinking force was greater than the buoyant forces which means that the nets should sink. There should be no way that such nets could be called floating gill nets.

Enquiries from the fishermen however, show that these nets are tied to tree branches and thus make good the excess sinking force.

2. <u>BEACH SEINE (ADRANYI)</u>

This net is also called drag net. It was constructed using materials of meshsize less than 2" (50mm). However, the enforcement of Fisheries Regulations (1979) has led to use of materials of 2" (50mm). It has long wings and a centrally placed bag to hold the catch.

During the fishing operation, a beach seine filters the whole depth of the water from the surface to the bottom.

The use of the adranyi became popular in the Volta Lake with the recession in the level of the lake, the fishermen identified the areas that are free of stumps and cleared the shores of all obstacles felling the crews. With the rising of the water level areas became suitable for the use of the beach-seine net.

Design considerations

The fishing efficiency of a lake beach seine is approximately proportional to its length. Therefore as far as the local conditions allow, it is expedient to use beach seines of the maximum length. In lakes, the length of beach seines is usually limited by the size of the fishing sites enabling fishing with beach seines not exceeding 500 m in length and mostly 250-300m. The only beach seine observed in Yeji was of length 150m.

Normally the hung depth should be 1.3 to 1.4 times the water depth of the fishing site. The average depth of the inshore where the nets operate is about 7 meters. This means that the hung depth of the adranyi should have been about 10 m. However, due to financial contraints the fishermen are not able to meet this design requirement. The average hung depth is about 6 m.

The net is uniform along it's whole length i.e. long and rectangular.

Choosing materials for construction

Seines designed for moderate catches of mixed fish, the mesh size of the wings is twice as large as that of the mesh in the bag; the wing is divided lengthwise into several sections with the mesh size decreasing gradually towards the bag. It is enough if the wing has 3 kinds of netting with meshes equal to 1.25a; 1.6a and 2.a where a = meshsize of the bag.

If the twine size for the netting with the meshsize equal to 2a is chosen so that the ratio d/a = 0.02 and the same twine is used along the whole seine, then d/a for the bag will be 0.04, this ratio also being suitable for the intermediate net sections.

However, the availability of the prescribed netting is a problem in Ghana as a whole and thus fishermen prefer to have net sections of 2" (50mm) mesh size throughout and bigger twines for the bag (210/45 - 210/60) and smaller twines (210/9) for the wings.

Construction of the bag

Usually the depth of the bag is 1.0 - 1.5 - 2.0 times the depth of the seine at the bag. With deep seines the bag is not constructed in the whole depth of the net. In-such cases a part of the opening left for the insertion of the bag is covered with a patch of netting in its lower part or sometimes both in its lower and upper parts as is the case of the adranyi that was investigated at Yeji. The size of this patch, the so-called 'shirt' depends upon the seine depth. The deeper the seine the longer the 'shirt'.

Hanging the beach seine

The hanging coefficient of the bag is normally 0.5 but in this case the adranyi has a hanging coefficient of 0.6 and that for the wings should have been 0.67 but it is 0.5.

Buoyancy

The total surplus buoyancy of the floats is normally approximately 100% more than the sinking force of the sinkers. In the case of the adranyi the buoyancy is 19.3 kgf and sinking force 7.6 kgf. This means that the buoyancy is 300% more than the sinking force.

3. ROUND-HAND NETS

The whinch net is a one boat type of purse seine with the bunt at one end of the net. This whinch net was introduced by fishermen from the coast. Its deployment is fairly recent.

An area is encircled by the net and with the use of purse rings and purse ropes it is folded like a purse with the fish trapped and collected at the bunt after drawing in the net.

Design considerations

The depth of most purse-seines is 7 - 10 times less than the length. The stretched length of the whinch surveyed is 421 m and the stretched depth is 40 m. This is approximately 10 times and falls within the expected ratio.

The bunt is made of the thickest twine, containing 3 - 6 plies more than the twine of the adjacent netting panels. The selvage is made of twine 2 to 2 1/2 times stronger than the twine in the bunt. However, for the whinch at Yeji the bunt is made of twine size 210/60 and the selvage is made of 210/18 which does not comply with the design requirement stipulated. The netting is itself 210/9.

The hanging coefficient of the bunt should be 0.5 while that for the other parts should be 0.75 - 0.87. The whinch surveyed shows a hanging coefficient of 0.78 in the panels.

4. LINE FISHING

(1) LONG-LINES

There are 2 main fishing methods with hooks and lines (a) with hook-fence and (b) with baited hooks.

(a) MARIMARI:-

The principle consists in hanging sharp hooks hung close to each other across the path of fish movement on short gangions (snoods or branchlines). Fish are caught and held by the hooks when they attempt to pass between them. Therefore only scaleless fish can be successfully fished with hook fences. Hooks of sizes ranging 4/0 to 1/0 (River Numbering System) are used. 1000 hooks are normally used on one line.

(b) Baited hooks are used with longlines (setlines) which may be about 2 km in length mostly with 500 hooks of sizes 1/0, 8, 13 (River Numbering System).

(2) HANDLINES

Baited hooks are also used in handlines and rods. This type is normally used by children. The size of these hooks is 2 - 6 (River Numbering System).

Live fish mostly young ones of Tilapia and chrysicthys are captured and used as bait for the hooks.

It is understood that Guadian soap is used as bait especially for clarias.

5. NIFA NIFA

Nets of twine size 210/6 or 210/9 and mesh size 2" are hanged on stakes in the water near the shore. These nets have a hung length of about 1 km and hung depth of 3.6 m and as many as 500 stakes can be deployed. Trap nets made of chicken wire are placed a distance behind the sticks and under the net. The net is placed in such a way that there is no other exit but through into the trap. Thus a cordon is made by the net. The nets are rolled up in the day time and are let down at dawn when it is just time for the fish to leave the shore back into deeper waters.

Sometimes nylon monofilaments nets referred to as Disco are placed in the cordon to enmesh fish that stubbornly stay out of the traps. These Disco nets have twine size of 0.2 mm and range from 2 1/2" to 3 1/2". See Scheme N°. 8. This method is used mostly for the capture of Tilapia.

FALLING GEAR

6. HANDCAST NET

Generally these are circular nets which are thrown. They have to be thrown or cast with great skill in order to fall flat upon the water's surface.

The nets are sufficiently weighted to allow the gear to fall over the fish as quickly as possible.

Their size is designated by the radius or the circumference of the net. The radius of the gear is identical with the height of the collapsed net.

The meshes can be of such a size that the fish are gilled in the meshes as with gillnets. Many of Volta Lake cast nets are simple entangling fishing gear or designed to keep the fish in the meshes.

At Yeji the cast nets have pockets at the edge in which the fish gets caught when the net is being hauled. The pockets are fixed by turning up the lower edge of the net and fastening it by short lengths of twine forming a cast net with fixed pockets. This is sometimes called the Spanish type of cast net.

7. TRAPS

Survey of this type of gear is still underway. However, so far those inspected are made of chicken wire, stalks of guinea corn, palm fronds, sticks, bamboo and in some cases made of nets.

All these traps have within them funnel shaped entrances leading to the pot where the fish is collected. Some traps have double funnels which increase their efficiency.

The bait commonly used is a cooked paste made from cassava dough, waste of palm kernel oil extraction, maize dough and sometimes pito waste.

This bait is used to attract mostly chrysicthys.

8. DRAGGED GEAR

It is a sweep net with a wall of netting attached between 2 sticks and towed in water to collect slow moving fish or fish that swim in the opposite direction of the net.

The nets are hung very loosely to the Headrope ($E = 0.3$) leaving a lot of slugginess to enable the net to form some sort of a bag.

This gear is used mostly to collect young live fish to be used as bait in long lining. The fish caught are Chrysicthys and Tilapia.

Appendix 15

Extract from a report on construction of Fish Aggregating Devices in Cape Verde.

by J. Wood (Consultant to CVI/86/006)

Introduction

The island complex of the Republic of Cape Verde has virtually no continental shelf, except for the three small islands of Maio, Boa Vista and Sal. The demersal stocks around these islands is very limited, and any concentrated fishing effort would soon deplete the existing demersal stocks.

Cape Verde, however, has a large and virtually untapped resource of seasonal migratory fish, such as skipjack tuna, yellowfin tuna, and certain scrombroids. There is a small pole-and-line fishery for tuna but this is hampered by the lack of live bait. It is estimated that it takes up to one week to collect sufficient live bait for one day's fishing, which does not seem to be economically viable for a fishery.

The artisanal fishing is mainly handled using 3-4 metres row boats, with a few driven by 5 H.P. outboard engines. The 10-15 metre vessels use a small purse net for mackerel when in season.

It is estimated that Cape Verde exports around 2 000 tons of tuna per year, mainly from the port of Sao Vicente where there is a large cold store and freezing complex.

Being of volcanic origin, the islands have very limited areas suitable for the introduction of trawling, or bottom seine net fisheries, which leaves only pelagic stocks, the main potential fisheries to develop.

In 1988, Cape Verde received from Japan three sophisticated Fish Aggregating Devices (FADs) with solar panels on the marking buoy. One of these was positioned by the Japanese in 1988 south of the island of Maio, which is 24 miles from the nearest port, and cannot be used by the artisanal fleet.

The fisheries division in Cape Verde requested FAO to recruit a FAD consultant for the construction of FADs made from locally available materials, and for their deployment in suitable localities around the islands. The consultancy was for a period of two months.

2. Construction of FADs floating device

The first week was spent studying various materials available, 40 gallon oil drums were considered, also wooden cable drums, but these items were in short supply and there was no guarantee of continued supplies for construction of FADs. However, after visiting one of the hardware stores in Praia, a large stock of 2 mm thick steel sheeting, was found. It was decided to proceed to make two floating devices for the two FADs from this steel. The idea being that if the first two succeeded, more could be constructed due to the large stock available.

A small welding shop was selected to construct two floats for FADs to evaluate the quality of welding and workmanship. These two FADs were constructed in one week with the help of the consultant. The workmanship and the speed of construction was very good, so an additional eight FADs were ordered - making a total of ten floats for FADs produced in this local welding shop.

The first operation was to weld two plates 2 m long by 1 m wide, secondly these were rounded to make a cylinder. This was then welded down the seam, two more sheets then being cut to weld the top and bottom together. The bottom was first welded in place, both from the outside and the inside to give it strength and make it water-tight. A double coating of black bitumen paint was then applied inside the tank before the top was welded into place.

Once the drum had been welded, the anchoring legs were welded to the side. The legs were then drawn together and the steel holding ring was welded into place. The next operation was to weld four steel 8 mm diameter rods on the FAD which was finally welded to the radar reflector.

The whole FAD was painted three times ; n° 1 oxidized paint (undercoat) then a black bitumen coating, finally the flotating device of the FAD was painted red for visibility at sea.

3. Anchoring of FADs

The most important factor with regard to FADs is a good anchor for holding in strong winds or currents. In many countries FADs have been lost due to insufficient anchoring. Developing countries cannot afford to import heavy duty anchors, plus chain, and therefore a simple but effective method is the use of scrap engines, fly wheels etc., but using double anchor systems.

All FADs positioned in Cape Verde which have been locally constructed have been anchored in this way, excluding the Japanese FADs which were supplied with 70 metre 22 mm diametre heavy chain plus a 240 kilo anchor.

The double anchor system acts on a lever principal. The heaviest holding anchor 2 - 300 kilograms is joined by 20 m of 4 or 5 mm diametre chain to a secondary smaller anchor of 80 - 100 kilo leading from the secondary anchor to the anchor rope and attached to a deep water float, which keeps the chain free from chaffing on rocks, etc.

With this double anchoring method, the second anchor is allowed to move in heavy seas, which reduces the strain on the main anchor, making sure the FAD is always in position and will never move in heavy seas or strong currents.

4. Cost of construction of one FAD

Quantity	Item	Measurement	Cost
5 steel plates x 2 m thick x 2 m long x 1 m deep			29 920 CVE
4 steel strips x 14 cm wide x 8 m long x 4 mm thick			3 800
4 x 1,65 steel 8 mm dia. rod			350
3 tins of paint			1 500
Labour cost for welding			12 575
Total			48 145
Total			635 US$
Mooring line			200 US$
Cost for a complete FAD			835 US$

(rope chain, swivels, anchor blocks were from various scrapyards and stores. Since there was no payment for mooring anchor, the estimated cost would be in the region of US $ 200 per FAD).

The type of fishing gear recommended for working in the area of FADs are :

1. hand-lines
2. trolling lines
3. long lines
4. pole-and-line
5. purse seine
6. drifting gillnet
7. light attraction (with drifting gillnets, purse seine)

Obviously, the long-line and drift nets must be worked on the lee side of the FAD to stop the fishing gear from becoming entangled around the FAD. Finally, under no circumstances should nets, lines or vessels use the FAD as an anchor.

If funds are to be made for the further deployment of FAD, which is to be recommended in order to give fishing communities an equal chance for the capture of tuna, etc., more FADs should be positioned in the following areas :

1. Santo Antao : Tarrafal and Carvorivos
2. Sao Vicente : Be de Salamanca
3. Sao Nicolau : Ponte de Pdegal
4. Maio : Ponte Jampata, Calheta
5. Boa Vista : Morro Negro, Salnei

This would give a total of ten more FADs to cover the main fishing communities around the whole of Cape Verde islands.

5. Positioning of FADs

This proved to be the most difficult part of the project due to the very heavy double anchor method used.

The actual positioning depended on finding suitable grounds with the echo sounder, 2 - 400 metre water depth was looked for, and as near to the edge of the deep water as safety allowed, for good anchor-holding.

Once suitable ground was traced on the echo sounder the main anchor rope had to be measured. If, for example, the recorded water depth was 350 m, the length of the rope played-out, to allow for tide and wind, would be 500 metres. When the rope was ready the FAD was put over the stern and the vessel steamed slowly ahead to the limit of the anchor to make sure there were no knots or tangles in the rope.

When the vessel reached the selected position, the two anchors were then hauled over the side of the vessels on the ships derrick. The rope was then cut allowing both anchors to fall to their anchoring position, on the sea bed.

- 3 FAD were installed off Sao Nicolau
- 2 FAD were installed off Sao Vicente
- 6 FAD were installed off Santiago

6. Main findings

The ten FADs have now been placed in position in various localities around the islands of Cape Verde. One Japanese FAD was assembled by the consultant and anchored in the North West Bank 15 miles from the island of Sao Vicente.

The eleven FADs anchored around Cape Verde were taken to sea aboard the fifteeen metre Japanese Yamaha vessel "Sinagoga".

A third Japanese FAD is still in the store, but the consultant was informed that the fishermen would assemble and position it themselves.

News items have been broadcast on the weekly radio station's fishery programmes explaining why these FADs have been put the sea. Similar information has been provided to the television station. In addition, the consultant initiated the design for a poster and pamphlets to be distributed throughout the island's fishing villages, explaining and advising fishermen that a report be made if they are damaged. A third pamphlet is being produced to advise fishermen on the most suitable and productive fishing gears to use when fishing around FADs.

The consultant, in his last week, visited the villages of Cidade Velha, and Porto Mosquito with the masterfisherman of the project, and was informed by local fishermen that there were large concentrations of mackerel around the two FADs, also whilst aboard the vessel "Sinagoga", the consultant saw large shoals of skipjack tuna jumping around the FAD near Cidade Velha.

The request in the terms of reference to have quotations for the importation of ready made FADs would seem impractical to Cape Verde fisheries. If the quotes are requested from Europe, shipping companies charge by volume and weight which would make imported FADs very expensive and therefore economically unfeasable.

7. Recommendations

7.1 Maintenance

There are now 12 FADs in position around Cape Verde islands. The recording of fish taken from around these FADs is important for future developments of the Cape Verde fisheries. A simple recording form should be produced for distribution to local fishermen, or given to someone of responsibility who can record on behalf of the fisheries division ; these should be collected monthly, and analyzed by the research department, with a view to establishing more FADs should there be a significant increase in catch.

The expected life span of the FADs should be 2 - 3 years, but obviously a yearly inspection of each FAD should be undertaken. Each FAD should be taken on board and a replacement buoy should be put in its place until the FAD is returned newly painted and cleaned.

The establishement of these FADs throughout the islands is for the benefit of the local artisanal fleet. This would be a good opportunity for the fisheries extension unit to visit all villages near the newly positioned FADs and to discuss directly with the fishing communities the reasons why the FADs have been placed in the sea and explain their utilization and care.

7.2. Introduction of floating reefs and long lines

The consultant became aware after visiting several villages of the very poor catch rate being obtained by handlines, possibly due to overfishing, plus the very limited fishing areas in most islands of Cape Verde. An alternative fisheries must be introduced. One idea would be to establish a type of floating reef FAD made of four FADs 100 metres square. The four FADs would be connected by a series of ropes, criss-crossed ; the floating reef would be suspended from these ropes, and on these ropes various materials could be attached, e.g. nylon sacks, old netting, car or lorry tyres, etc. and anchored on the seabed by scrap anchors.

The floating reef should be suspended 10 metres below the four FADs to allow fishermen to use a small purse net for the capture of pelagic species, also the introduction of fishing by light attraction (lift net). However, a single unit would become overfished, and therefore a method of rotation fisheries could be introduced by installing three floating reef FADs, ten kilometres apart.

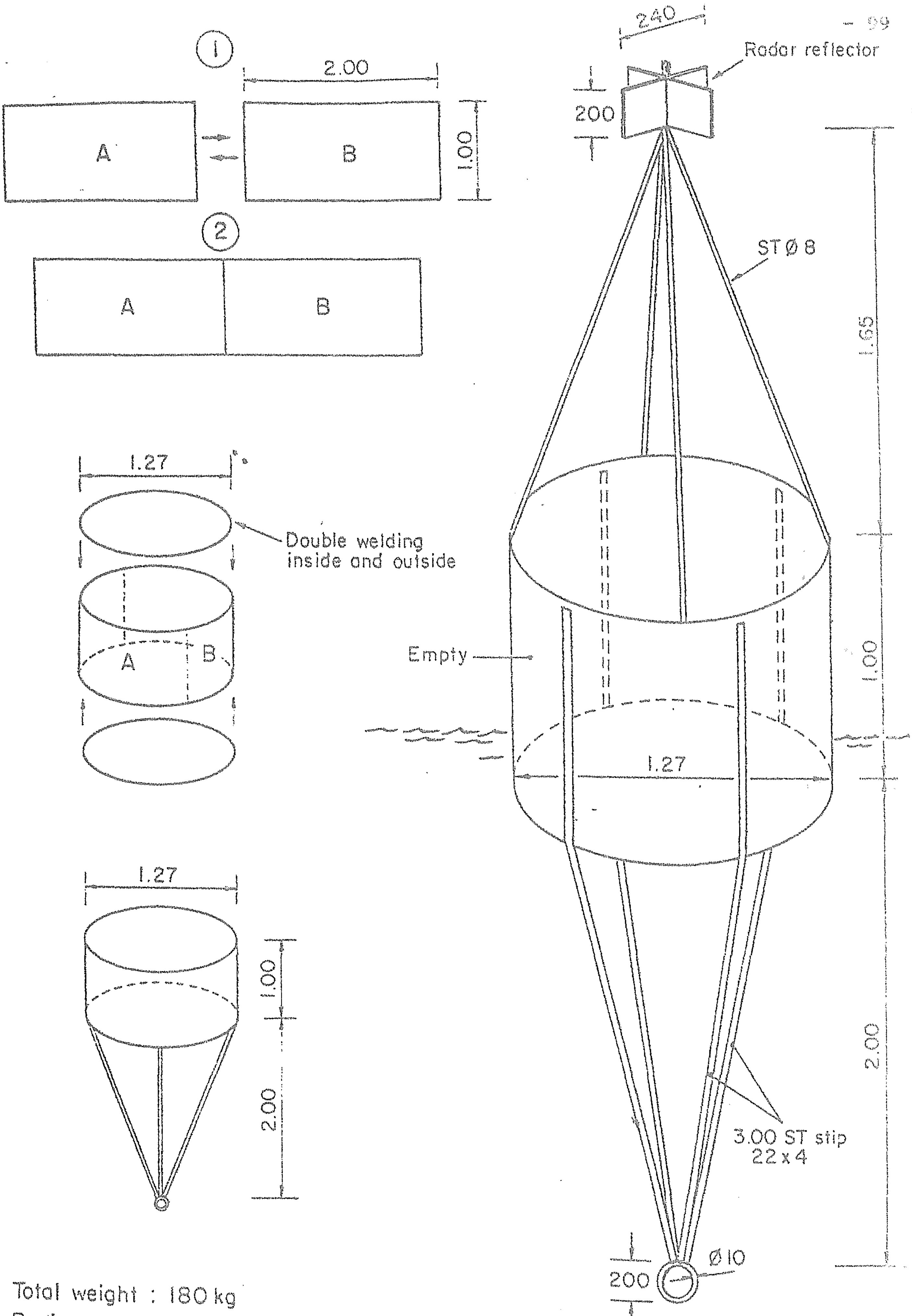
The most suitable area for this first experimental floating reef deployment would be the island of Sao Nicolau, near to the village of Tarrafal, where there is calm water due to the natural shelter of the bay.

Due to the scarcity of live bait, pole-and-line fisheries are also limited. For the purse seining method the problem is the investment (size of vessel, large nets, etc).

There is, however, one fishery which could be introduced, which is long-lining. It is simple to use, cheap to construct, but would require good bait. Introduction of the long-line should be considered for future development and exploitation of tuna stocks. The equipment at present being used for long-line is not suitable, and will not give definite results for the future development of long-line fisheries for the Cape Verde fishing industry. A viable economic unit of long-line is 10 kilometres. Cuba has similar problems with regard to live bait pole-and-line fisheries, but the introduction of long-line methods has proved to be economically viable for tuna fisheries.

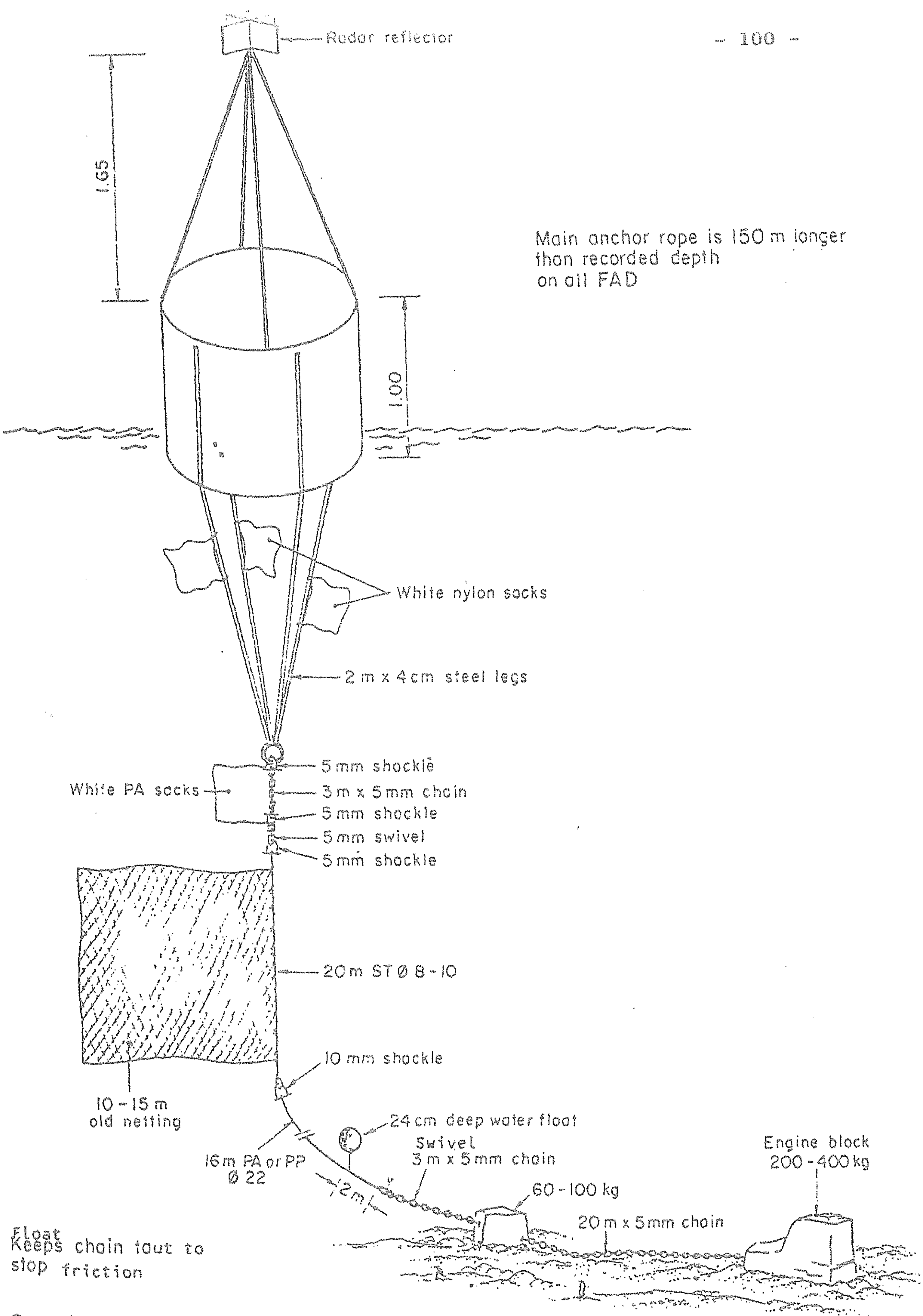
7.3. Utilization of lift net used with light attraction

One of the simplest methods of fishing which could be introduced around the FADs is a lift net, with the use of kerosene pressure lamps to attract the small pelagics. This would require teamwork between four of the 4 m rowing boats. Due to the financial difficulties of most fishermen, a simple lift net suspended from wooden poles could be introduced since there are ample stocks of old purse netting available which could be distributed free.



Total weight : 180 kg
Bouyancy : 600 kgf

Main anchor rope is 150 m longer than recorded depth on all FAD



Float
Keeps chain taut to stop friction

Second anchor very important acts as lever in heavy seas stopping main anchor from jumping

Figure 2

RAPPORT ET AVARIES SUR PIROGUES DU PROJET MODELE BENIN

INTRODUCTION

Voici un bref résumé des performances et différents problèmes rencontrés sur le moteur Lombardini 8LD-665, présentement installé dans la pirogue Cairnbulg, et de nos moteurs Volvo en operation sur les pirogues St-Jude et Gamrie. Mes informations sont basées sur les réparations que j'ai moi-meme effectuées, ainsi que sur les rapports precedant mon arrive sur le terrain. Mentionnons ici que le moteur fut gracieusement donné par la firme Lombardini, et qu'au départ ce moteur de type industriel à depuis longtemps fait ses preuves sur le marché.

- Moteur Lombardini
- Type 8LD - 665. 2/1
- Puissance 23 CV
- Refroidissement à l'air
- Inverseur Hurt HBW 150

ASPECTS POSITIFS DU MOTEUR

- De par son excellente conception, ce moteur est facilement réparable. L'accès aux parties importantes du moteur est facile. La compréhension est tout aussi aisee, ce qui fait que n'importe quel mécanicien possédant un minimum de formation diésel sera efficace sur ce type de moteur, aprés avoir fait un simple apprentissage.

- Le 8LD -665 est un moteur possédant des chemises, ce qui donne à son utilisateur l'importante possibilité de pouvoir effectuer des réparations majeures sans nécessairement avoir à changer le bloc cylindre au complet. Dans le cas d'une panne ou d'une avarie extremement sérieuse, du fait que chaque partie du moteur soit divisée en sections, les couts sont souvent réduits.

- Les culasses sont aussi indépendantes, donnant ainsi une meilleure mobilite sur le plan travail.

- La simplicité du systéme de controle d'arrivée du gas oil (rack fuel) est un gros avantage, car il n'y a presque pas de pièces mobiles à l'intérieur, et facilement accessible.

- L'inverseur utilisé sur ce moteur HURT HW 150 est parfaitement adapté, signalons peut etre une petite faiblesse de la bague d'étanchéité (oil seal) au niveau du levier d'embrayage.

- L'accouplement élastique qui fut installé après les premiers essais est efficace, les problèmes que nous avions, etaient dus au fait que les boulons de retenue étaient filetés sur toute leur longeur, et de diamètre trop petit. Une petite modification à ce niveau a été apporté supprimant par le fait meme les problèmes. (la dernière fois que l'accouplement s'est cassee, le négligence du mécanicien en place, fut en partie responsable du bris, ce dernier n'ayant pas comme il se doit vérifier le relachement possible de ces boulons.)

ASPECTS NEGATIFS DU MOTEUR

- Le système de refroidissement à l'air est déficient dans la mesure ou le moteur se trouve compartimenté, dans le fond de la pirogue. L'air entre bien, mais ne circule pas suffisamment.

- La turbine de refroidissement est aussi très sensible à la chaleur. Nous avons connu beaucoup de problèmes avec les roulements qui s'usaient prématurément. Il a meme fallut changer complètement la turbine (rotor, casing, bushing, bearing).

La fragilité de la turbine oblige une surveillance constante, car un manque mécanique à ce niveau peut facilement endommager le moteur de façon irrèversible. Je signale ici, que dés le premier essai sur ce moteur, déjà nous avions eut des problèmes avec cette turbine.

- La courroie qui entraine la poulie de la turbine versus le vilbrequin du moteur est placée de telle façon que l'on doit démonter le moteur pour la remplacer. C'est le genre d'installation dans le fond de la pirogue qui nous oblige à toujours en garder une de rechange attachée sur le bati du moteur et nous occasionne inutilement une longue réparation.

- Le systeme d'échappement (exhaust pipe) fournie par Lombardini s'avère inefficace à 100 % Le moteur étant en vase clos, et le silencieux étant directement attaché au moteur, il s'en suit une hausse de température dans le compartiment moteur.

Nous avons certes modifié le système, mais la ventilation meme actuellement est plus ou moins efficace, encrassant constamment le filtre a air.

- Les rondelles de cuivre (copper ring) qui assurent l'étanchéité entre le fourreau pour l'injecteur et l'injecteur lui-meme occasionnent régulièrement des problémes de fuite de compression.

En ce qui concerne les supports moteurs que nous avons changes plusieurs fois, depuis que le moteur est monté sur un bati fixe le probleme ne se présente plus. La période ou les problèmes de supports sont apparus datant d'avant mon arrivée sur le terrain, j'ai consulté les différents rapports sur les travaux effectués à ce niveau.(Réf: rapport de Monsieur Claude Flock Surveyor maritime pour Loyds Inssurance qui nous a offert ses services à cette époque) Voir figure numéros 1.

Il appert que les vibrations occasionnaient des problèmes sur tous les accessoires boulonnés après le moteur.(Filtre à gas oil, et tuyau d'échappement qui cassait à toutes les deux marées. Solutionne avec le bati fixe)

L'arbre porte hélice était aussi mal aligné, et des modifications aux niveaux des bagues supportant l'arbre on été apporté. Originellement des bagues de teflon furent installées et s'usèrent très rapidement, après la pose d'une bague fixe en bronze a chacunes des extremitees de l'etambot et d'un graisseur interne pour les memes bagues, le problème ne s'est plus représenté. Le moteur lui meme est maintenant fixe sur un bati, le presse étoupe est fixe et nous n'utilisons plus les supports fournis par la compagnie.

- L'inventaire des pieces de cette compagnie est compliqué à tenir, les catalogues sont particulièrement confus, ainsi que le manuel d'entretien.

- Finalement le plus gros handicap de ce moteur est son manque de puissance. La puissance développée par ce moteur étant nettement insuffisante, les pecheurs font virer le moteur constamment à plein régime, ce qui, il va sans dire, n'est rien pour augmenter l'espérance de vie de l'engin.

CONCLUSION

Je pense qu'il est inutile de vouloir mariniser des moteurs dont la disponibilité des pièces demeurent une problématique, nous aurions intéret à utiliser des moteurs connus déjà marinisé à l'usine reduisant de beaucoup les problemes occasionnes par l'adaption de ces moteur.

J' ai eu l'occasion de voir travailler des moteurs similaires, mais à des taches industrielles, et les gens étaient satisfaits de la performance de leur moteur.

Le choix d'un moteur de 23 chevaux est inadéquat, il aurait fallut penser à quelques choses de l'ordre de 35 chevaux afin de pouvoir se garder une marge de puissance et éviter de faire fonctionner le moteur à plein régime constamment.

EVALUATION DES PERFORMANCES DES MOTEURS VOLVO PENTA 2003

Voici une évaluation sommaire sur les performances et les problèmes rencontés jusqu'à aujourd'hui sur nos moteurs Volvo Penta 2003.

Moteur: Volvo Penta 2003
Puissance: 28 chevaux
Inverseur: MS 2 B
Ratio de l'inverseur: 2,37 : 1
Refroidissement: Keel cooling
Pirogues: Gamrie et St-Jude

ASPECTS POSITIFS DU MOTEUR

-- Le manuel de service de Volvo est très bien écrit et façile à utiliser.

-- Le système de filtre centrifuge proposé par Volvo est efficace, et élimine l'achat de cartouches de remplacement tres dispendieuses et difficiles à trouver à Cotonou.

-- Les outils de précisions pour quelqu'un qui a une tres bonne base en mécanique sont efficaces.

-- Le système de commande pour les pièces fonctionne, très bien, si l'on fait abstraction de temps nécessaire pour avoir les pièces, occasionne par la lourdeur administrative de la FAO..

-- L'accouplement elastique envoyé par Volvo pour le relevage de l'arbre porte Hélice du St-Jude est parfaitement adapté.

ASPECTS NEGATIFS DU MOTEUR

-- Le système de refroidissement s'est avéré inefficace dès le début des essais. Une déformation de la culasse nous a obligé a effectuer des réparations majeures sur le moteur. Nous avons remédié à la situation en augmentant la longeur des tuyaux du système de refroidissement. (voir figure 2)

-- Les douilles de cuivre qui contiennent les injecteurs (injector sleeve) causent des problèmes régulièrement, nous obligeant à sacrifier les buses d'injecteurs pour en extraire l'injecteur, du au fait qu'il n'y a pas d'outils d'extraction.

-- Le filtre à air est difficile à nettoyer et est inapte pour le climat tropical. La crépine intérieur s'oxyde rapidement, et des élements métalliques pénètrent à l'intérieur du moteur. Du fait de l'inefficacité du meme filtre à air, le sable en suspension dans l'air pénètre à l'intérieur du moteur, provoquant l'usure prématurée de ses pièces internes.

Nous avons changé une culasse et un bloc cylindre complet suite à ce problème. Mentionnons, que dans le cas du bloc cylindre, La maison Volvo a gracieusement remplacée les pièces mobiles abimes par des neuves.

J'ai remédié à la situation en installant un filtre à air avec base rempli d'huile qui receuille les impuretès et est facilement nettoyable. (filtre Lombardini)

-- La visite du carter (crank case) nous oblige à pratiquement démonter tout le moteur, et cela meme pour une simple inspection.

-- La boite d'inverseur à des faiblesses au niveau du pignon balladeur qui controle la marche avant et arrière. L'utilisateur dans la pirogue ne faisant pas le point mort avant d'embrayer en marche arriere, j'ai installé un système qui élimine le reculons. Je mentionne ici que l'inverseur de Lombardini avec le meme utilisateur n'a pas de probleme.

-- Les outils de précisions de Volvo sont efficaces dans la mesure ou l'utilisateur peut s'en servir. Il ne faut pas perdre de vue que l'ensemble des pecheurs sont illétrés et ne peuvent utiliser ces outils nécessaire pour des réparations.

-- Les sièges de soupapes (valve) du coté échappement s'oxyde rapidement et nécessiteront très bientot une rectification.

-- Le systeme de réglage de l'arrivé du gas oil (rack fuel) est trop complexe et comporte trop de petites pièces mobiles, sensibles au taux d'humidité que nous connaissons au Benin. Très rapidement toutes ces pièces sont éliminées par l'utilisateur.

-- Le controle d'arret du moteur est maintenu en place par un ressort dont la faiblesse est prouvée, et le mécanicien utilise le décompresseur pour arreter le moteur ce qui n'est peu recommandable, et abime le moteur.

-- Les problèmes de vibrations causé par le presse étoupe flottant, (figure 3) ont été résolu par l'installation d'un presse étoupe flottant mais supporté par un manchon de bronze fixe. Ce ne fut qu'à ces conditions que les supports moteurs de Volvo furent efficaces. Par contre l'arrière du moteur est maintenant fixe sur le bati et les silent bloc ne sont utilisé qu'à l'avant.

-- La goupille de démarrage située au bout du Vilbrequin (crank shaft) est faible et nécessite d'etre changée régulièrement, et pose des problèmes malgré l'extracteur de Volvo.

-- Ce moteur ne possédant pas de chemise nous oblige à changer tout le bloc cylindre dans le cas d'usure excessive, ou encore nécessite d'etre rectifié par un machiniste dont la precision du travail n'est pas facile à trouver dans le pays.

-- Un point qu'il faut mentionner est la faiblesse du moteur coté puissance. Les pecheurs doivent utiliser le moteur constamment à plein régime pour etre efficace dans la sorte de peche qu'il pratiquent, une puissance minimum de 35 chevaux serait à envisager.

-- Le système d'échappement conventionnel utilisé sur ce moteur provoque une hausse de la température du compartiment moteur, diminuant les performances du moteur.

De plus s'il y a une fuite au niveau de l'échappement, la fumée pénètre dans le moteur souillant l'huile et diminuant ses capacités de lubrification.

CONCLUSION

Ce moteur très performant en Europe et au Canada n'est pas adapté au climat tropical, et démontre trop de faiblesse de par sa complexite pour les utilisateurs.

RECOMMANDATIONS

Il n'existe pas de solution miracle à tous ces problèmes, mais un minimum de critéres pourront éviter des réparations couteuses, et contribués à la continution et l'amélioration de projets de ce genre. Il ne fait aucun doute dans mon esprit que tot ou tard il faudra diéséliser les pirogues, à cause du cout excessif du carburant. Une evaluation comparative sur le moteur inboard versus le hors bord diesel pourrait etre interessante pour evaluer le bien fonde de poursuivre dans dieselisation des pirogues avec des moteurs inboard.

Il est aise de constater que peut importe le type de moteur utilise nous nous heurtons constamment aux memes problemes, et je trouve dommage qu'il n'y ait pas plus de communications entre tous ces projets qui utilisent ou tentent de dieseliser les pirogues. Beaucoup d'erreurs ne seraient pas repetees et nous assisterions a une progresion valable tout en diminuant les couts excessifs que ces erreurs occasionnent.

Au niveau pièces de rechange, il faudrait s'assurer avant de faire le choix d'un moteur, qu'il existe un fournisseur proche du projet et que ce meme fournisseur n'est pas simplement un bureau avec télex qui fera la commande à notre place, avec tous les délais que cela pourraient impliquer.

Beaucoup de pannes onéreuses auraient pu etre éviter si au départ du projet, on avait embauché un mécanicien compétent, qui aurait pu faire une petite formation avec les mécaniciens Béninois, et par le fait meme faire un suivie un peu plus sérieux sur le plan mécanique.

L'absence d'un homologue mecanicien est aussi une serieuse lacune. Malgre la demande repetee du CTP aupres du gouvernement pour en avoir un.

Sur le plan mécanique, les quelques recommandations qui je pense pourrait eviter des couts onereux a bien des niveaux sur l'éventuel choix d'un autre moteur pour un autre projet:

- Moteur avec chemise.

- Silencieux refroidit à l'eau évitant l'installation d'un pot d'échappement couteux et sensible à la corrosion.

- Refroidit à l' air ou à l'eau suivant le genre d'installation; à l'air si la circulation d'air dans le compartiment moteur est efficace, et à l'eau, si dès le commencement on allonge le systèeme de Keel Cooling, car trop souvent les parametres de refroidissement Europeens sont inadaptes dans les eaux chaudes de l'Afrique..

- Le moteur devra etre de puissance suffisante (35 chevaux minimum) afin de donner une bonne flexibilité de mouvements à l'utilisateur sans forcer le moteur.(Toujours en fonction d'une pirogue de type Ghaneenne.)

- L'arbre porte hélice se doit d'etre installé avec un accouplement flexible pour absorber le torque du moteur lorsque l'on embraye d'avant ou de reculons.

- Le tube d'étambot est plus facilement alignable, lorsqu'il est retenu par des bagues fixe à chaque extrémitées.

- Le régime de travail du moteur devrait etre de type medium ou slow speed.

- Dans le cas des supports moteur, il est préférable qu'ils soient placés fixes sur un bati et non pas boulonné directement dans le fond de la pirogue.

- Les culasses indépendantes (cylinder head) éviteront de tout changé dans le cas d'avaries majeures.

- Une formation sur les moteurs utilisés dans le futur, serait très utile, dans la mesure ou de nombreuses pannes couteuses pourraient etre éviter par la connaissance du produit utilise. Parfaire la connaissance des outils de précison au sein de cette meme formation ne peut etre que bénéfique pour tous.

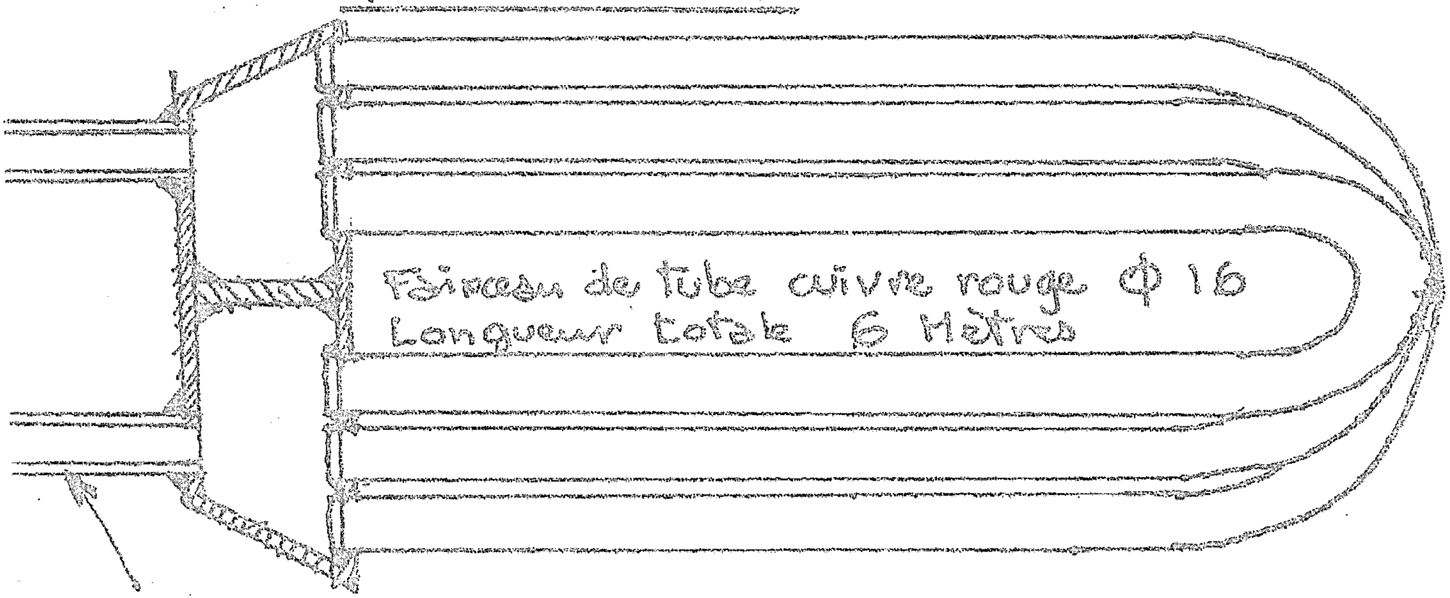
- Demander dès le commencement les livres de réparations ainsi que les outils de précisions indispensables à la bonne marche du produit.

- Eviter dans la mesure du possible, tout appareillage électrique, (démarreur, alternateur) ces derniers ne supportant que peu ou pas l'humidité que nous connaissons ici.

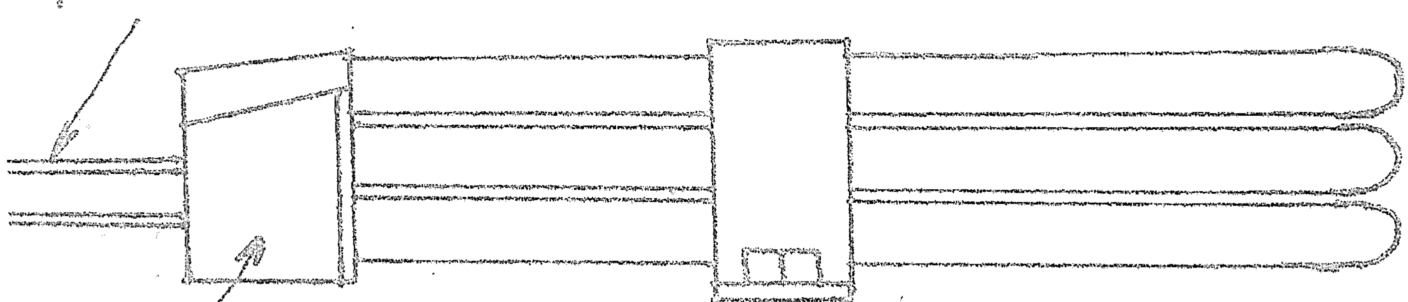
Marc Patenaude
Mécanicien diésèliste / hors-bord
Coopérant Volontaire O.C.S.D / F.A.O.

SAINT JUDE -

KEEL COOLING -



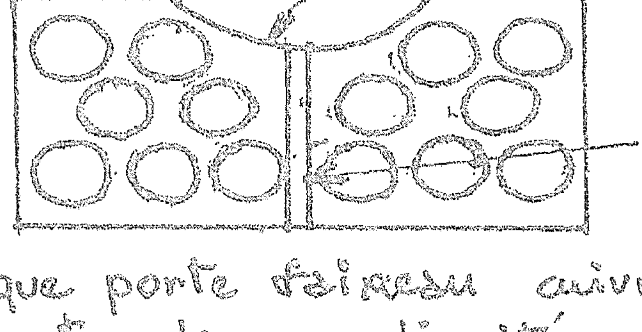
Tuyau d'entrée et sortie



Collecteur
cuivre rouge de 15/10e

Collier de fixation

Dégagement pour le tube
d'étambot

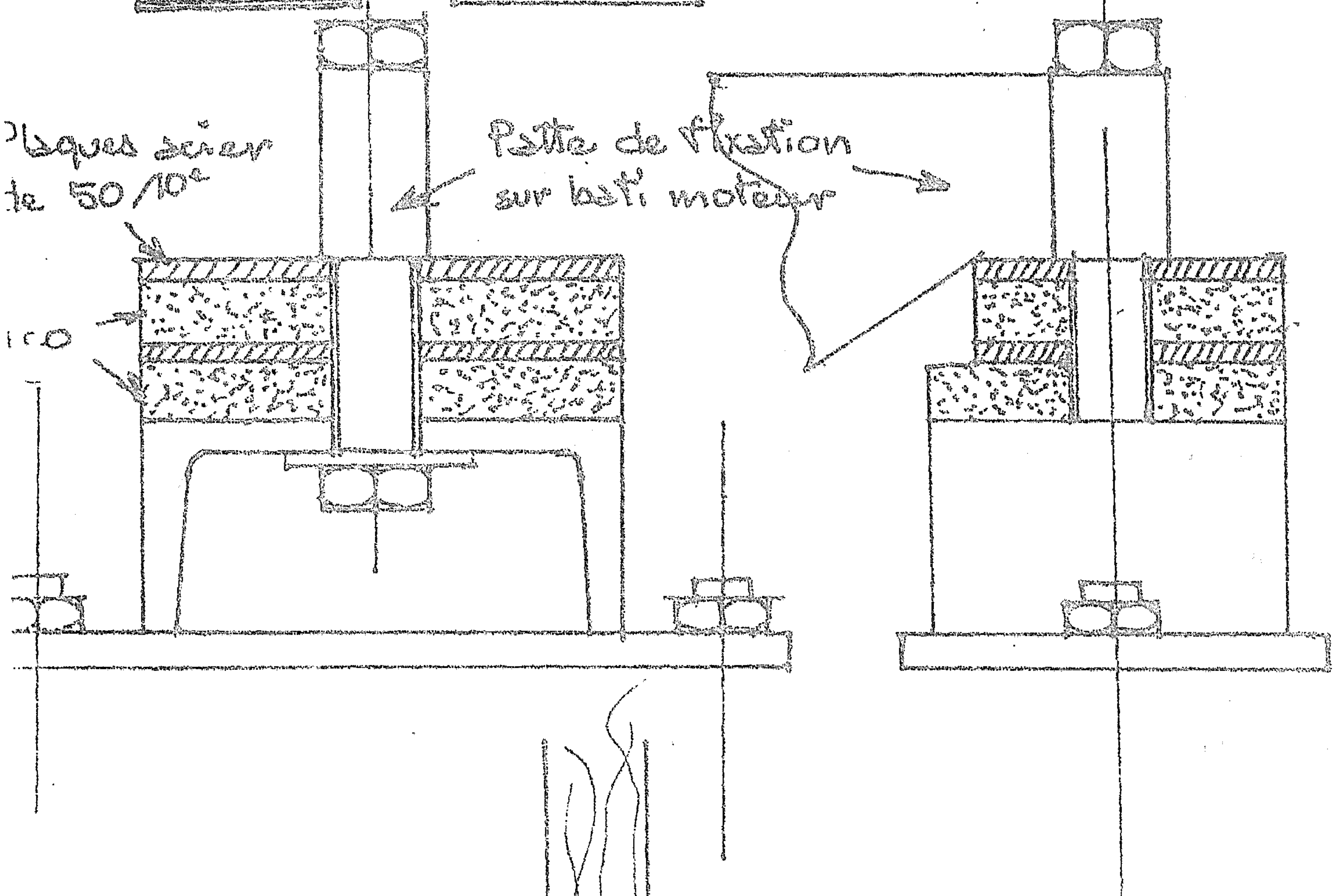


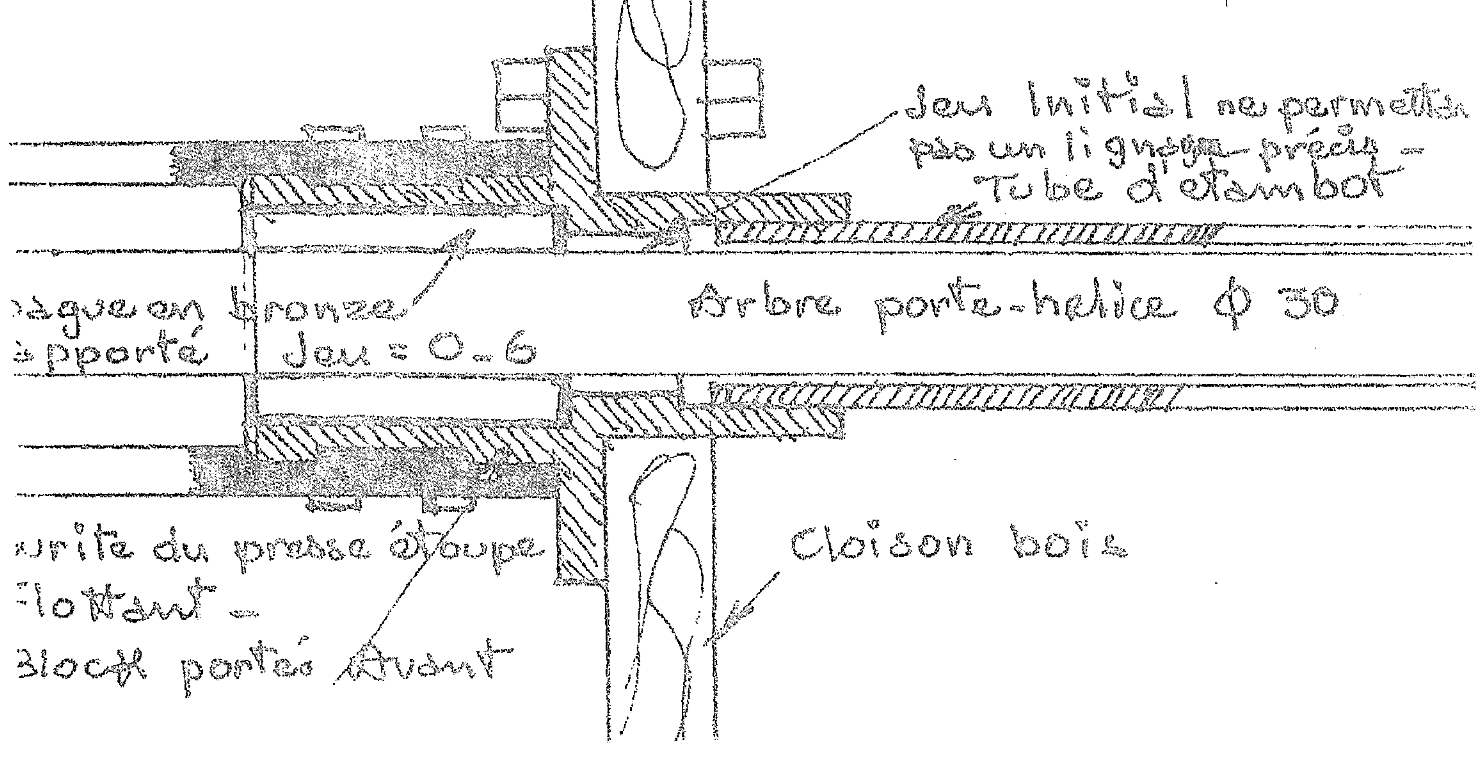
Cloison

Plaque porte faisceau cuivre rouge 30/10e
Encombrement en largeur limité pour le passage
dans le puit de relevage ..

CAIRNBULG -
REMPLACEMENT DES SILENT-BLOCK par des sabots métalliques et éléments TICO -

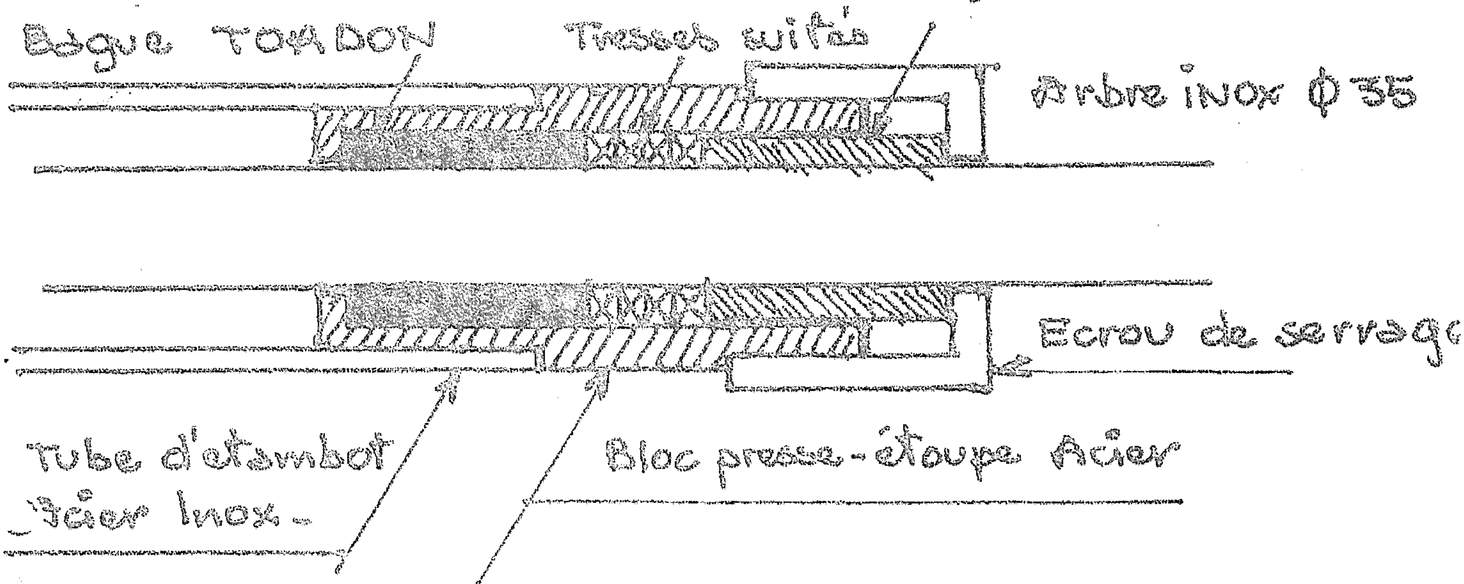
AVANT - ARRIERE -





SAINT-JUDE -

BLOC PRESSE ETOUPE

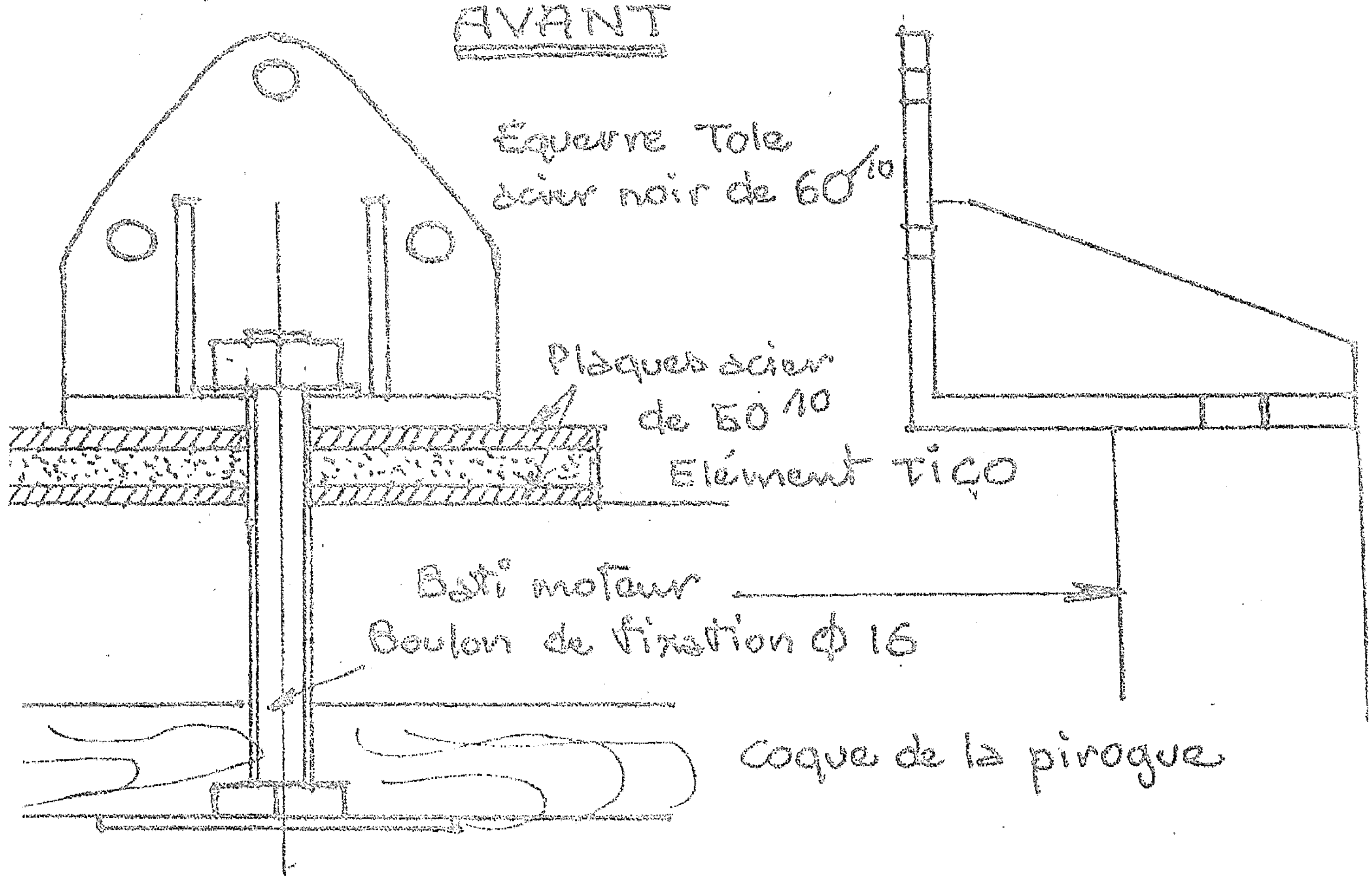


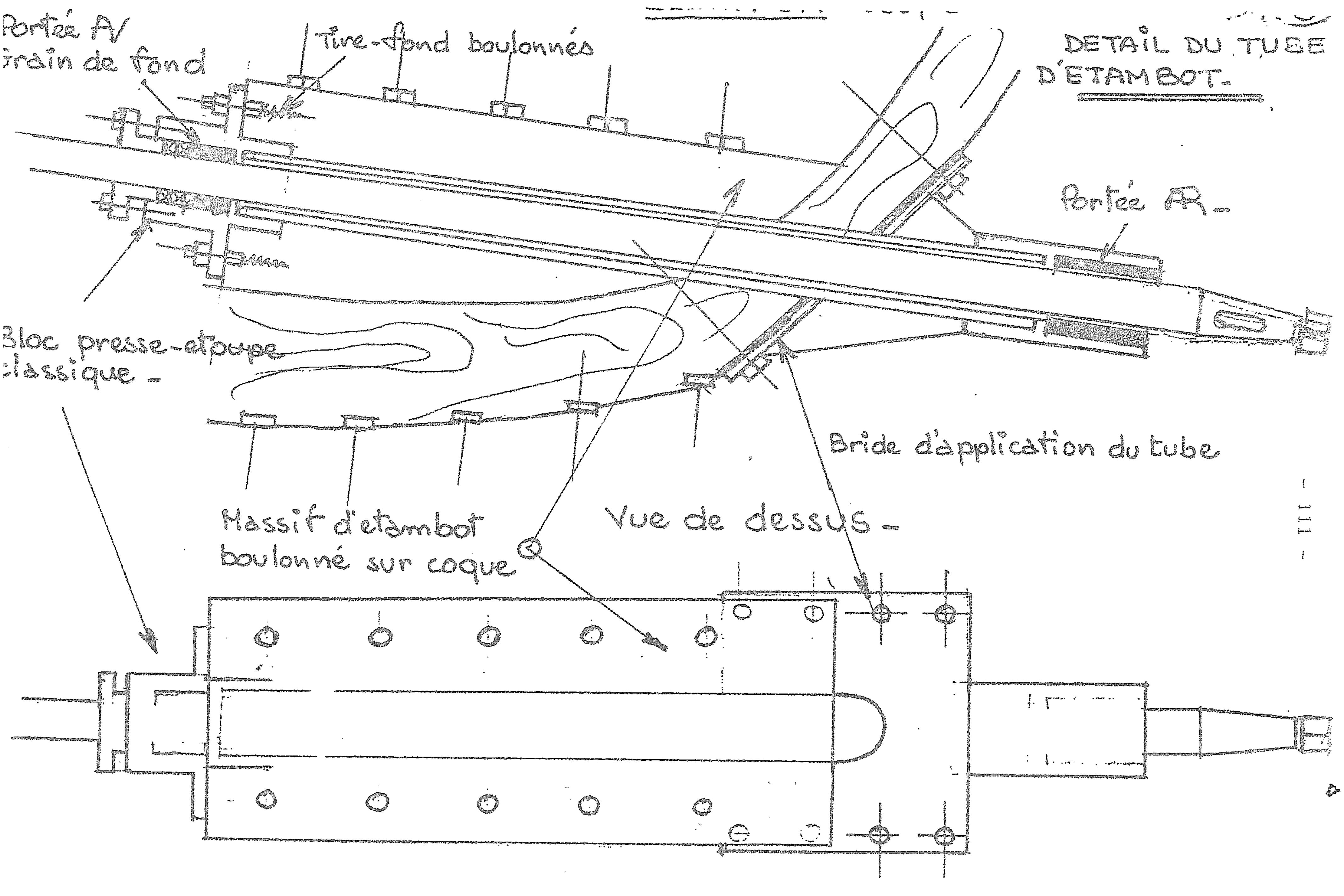
REMPLACEMENT DE LA BAGUE DE PORTÉE ARRIERE (TEFLON)

SAINT - JUDE et GAMRIE -

REMPLACEMENT DES SILENT-BLOCK par des sabots métalliques et éléments TICO -

AVANT




DETAIL DU TUBE D'ETAMBOT.
Portée A/ grain de fond
Tire-fond boulonnés
Portée AR -
Bloc presse-etoupe classique -
Bride d'application du tube
Massif d'etambot boulonné sur coque
Vue de dessus -

LISTE DES RAPPORTS DIPA - LIST OF IDAF REPORTS

a) Documents de travail/Working papers

De Graauw, M.A., Etude de préfactibilité technique de l'amé-
1985 nagement d'abris pour la pêche maritime artisanale au Bénin. Cotonou, Projet DIPA. 55 p., DIPA/WP/1.

Black Michaud, M.J., Mission d'identification des communautés
1985 littorales de pêcheurs artisans au Bénin. Cotonou, Projet DIPA, 24 p., DIPA/WP/2.

Gulbrandsen, O.A., Preliminary account of attempts to introduce
1985 alternative types of small craft into West Africa. Cotonou, IDAF Project, 51 p., IDAF/WP/3.

Jorion P.J.M., The influence of socio-economic and cultural
1985 structures on small-scale coastal fisheries development in Bénin. Cotonou, Projet DIPA, 59 p., IDAF/WP/4.

Jorion P.J.M., L'influence des structures socio-économiques sur
1985 le développement des pêches artisanales sur les côtes du Bénin. Cotonou, Projet DIPA, 59 p., DIPA/WP/4.

Tandberg, A., Preliminary assessment of the nutritional situation
1986 of subsistence fishermen's families. Cotonou, Projet DIPA, 31 p. IDAF/WP/5.

Wikjstrom, O., Recyclage des personnels pêche en gestion et
1986 comptabilité. Cotonou, Projet DIPA, 25 p. DIPA/WP/6.

Collart, A., Development planning for small-scale fisheries
1986 in West Africa, practical and socio-economic aspects of fish production and processing. Cotonou, IDAF Project, 34 p., IDAF/WP/7.

Collart, A., Planification du développement des pêches
1986 artisanales en Afrique de l'Ouest ; production et traitement du poisson, ses aspects matériels, techniques et socio-économiques. Cotonou, Projet DIPA, 67 p. DIPA/WP/7.

Van der Meeren, A.J.L., Socio-economic aspects of integrated
1986 fisheries development in rural fishing villages. Cotonou, IDAF Project, 29 p., IDAF/WP/8.

Haling, L.J., et Wijkstrom, O., Les disponibilités en matériel
1986 pour la pêche artisanale. Cotonou, Projet DIPA, 47 p., DIPA/WP/9.

Akester S.J., Design and trial of sailing rigs for artisanal
1986 fisheries of Sierra Leone. Cotonou, IDAF Project, 31 p., IDAF/WP/10.

Vétillart, R., Rapport détude préliminarie sur l'aménagement
1986 d'un abri pour la pêche maritime artisanale à Cotonou. Cotonou, Projet DIPA, 31 p., DIPA/WP/11.

Van Hoof, L., Small-scale fish production and marketing in
1986 Shenge, Sierra Leone. Cotonou, IDAF Project, 36 p., IDAF/WP/12.

Everett, G.V., An outline of West African small-scale fisheries.
1986 Cotonou, IDAF Project. 32 p., IDAF/WP/13.

Black-Michaud, J., et J. Johnson, Participation communautaire
1987 aux projets intégrés des pêches artisanales. En cours de préparation (DIPA/WP/14).

Anon., Report of the second IDAF liaison officers
1987 meeting ; Freetown, Sierra Leone (11 - 14 November 1986). Cotonou, IDAF Project, 66 p., IDAF/WP/15.

Anon., Compte-rendu de la deuxième réunion des officiers de
1987 de liaison du DIPA. Cotonou, Projet DIPA, 27 p., DIPA/WP/16.

Campbell, R.J., Report of the preparatory technical meeting
1987 on propulsion in fishing canoes in West Africa (Freetown, 15-18 November 1986).Cotonou, IDAF Project, 88 p., IDAF/WP/18.

Davy D.B.,Seamanship, Sailing and Motorisation. Cotonou,
1987 IDAF Project, 85 p., IDAF/WP/18..

Anum-Doyi, B., and J. Wood, Observations on fishing methods in
1988 West Africa. Cotonou, IDAF Project, 53 p., IDAF/WP/19.

Anon., Report of the third IDAF liaison officers meeting
1988 (Cotonou, 2 - 4 December 1987). Cotonou, IDAF Project, 88 p., IDAF/WP/20.

Anon., Compte-rendu de la troisième réunion des officiers
1988 de liaison du DIPA (2-4 Décembre 1987). Cotonou, Projet DIPA, 85 p., DIPA/WP/20.

Haakonsen, J.M. (Ed.) Recent developments of the artisanal
1988 fisheries in Ghana. Cotonou, IDAF Project, 69 p., IDAF/WP/21.

Everett, G.V., West African marine artisanal fisheries.
1988 Cotonou, IDAF Project, 41 p., IDAF/WP/22.

Everett, G.V., Les pêches maritimes artisanales en Afrique
1988 de l'Ouest. Cotonou, Projet DIPA, 44 p. DIPA/WP/22.

Coackley, A.D.R., Observations on small fishing craft
1989 developments in West Africa. Cotonou, IDAF Project, 22 p., IDAF/WP/23.

Zinsou, J. et W. Wentholt, Guide pratique pour la construction
1989 et l'introduction du fumoir "chorkor". Cotonou, Projet DIPA, 33 p., DIPA/WP/24.

Zinsou, J. and W. Wentholt, A pratical guide to the construction
1989 and introduction of the chorkor smoker. Cotonou, IDAF Project, 29 p., IDAF/WP/24.

Chauveau, J.P., F. Verdeaux, E. Charles-Dominique et
1989 J.M. Haakonsen, Bibliographie sur les communautés de pêcheurs d'Afrique de l'Ouest- Bibliography on the fishing communities in West-Africa. Cotonou, Projet DIPA - IDAF Project, 220 p., DIPA-IDAF/WP/25.

Everett, G.V., Small-scale fisheries development issues in
1989 West Africa. Cotonou, IDAF Project, 47 p., IDAF/WP/26.

Haakonsen, J.M., et W. Wentholt, La pêche lacustre au Gabon.
1989 Cotonou, Projet DIPA, 36 p., DIPA/WP/27.

Anon., Report of the ad hoc technical meeting on artisanal
1990 fisheries craft, propulsion, gear and security in the IDAF region ; Cotonou, 25 - 26 September 1989. Cotonou, IDAF Project, 100 p., IDAF/WP/28.

Anon., Report of the fourth IDAF liaison officers meeting
1990 (Dakar, 21 - 23 November 1989). Cotonou, IDAF Project, 135 p., IDAF/WP/29.

b) Liste des documents de travail du Projet Modèle, Bénin/

List of working papers of the Model Project, Benin

Coackley, A.D.R., Report on installation of a diesel inboard
1988 motor in a Ghana canoe. Cotonou, Model Project, 7 p. + annexes, PMB/WP/1 (En).

Coackley, A.D.R., Installation d'un moteur diesel "inboard"
1988 dans une pirogue ghanéenne. Cotonou, Projet Modèle, 9 p. + annexe, PMB/WP/1 (Fr).

Zannou, L.H., Etudes technico-économiques des fours améliorées
1988 pour le fumage de poisson en République Populaire du Bénin. Cotonou, Projet Modèle, 8 p. + 6 tableaux, PMB/WP/2.

Atti-Mama, C., et M. Raïs, Etude démographique des communautés
1988 cibles du Projet Modèle Bénin. Cotonou, Projet Modèle, 20 p. + 10 annexes, PMB/WP/3.

Jorion, P., Non-monetary distribution of fish as food in Beninois
1988 small-scale fishing villages and its importance for auto-consumption. Cotonou, Model Project, 26 p., PMB/WP/4.

Tanimomo, P.F., Catalogue des engins de pêche maritime artisanale
1989 du Benin. Cotonou, Projet Modèle, 46 p. + 3 annexes, PMB/WP/4, PMB/WP/5.

Tanimomo, P.F., Rapport de consultation sur la formation des
1989 jeunes pêcheurs de l'UNICOOPEMA à Lomé. Cotonou, Projet Modèle, 17 p. + 6 annexes, PMB/WP/6.

Atti Mama, C., Impacte Socio-économique de la piste Pahou-Kpota.
1989 Cotonou, Projet Modèle, 10 p. + 3 annexes, PMB/WP/7.

Ahouanmènou, C., C. Atti-Mama, B. Houndékon, D. Tempelman et
1989 D. Turcotte, Animation, gestion et planification, séance de travail avec les agents de terrain. Cotonou, Projet Modèle, 142 p. + annexes, PMB/WP/8.

Atti-Mama, C., D. Turcotte, et W. Wentholt, Evaluation interne
1989 des activités du projet modèle Bénin dans le secteur de Ouidah. Cotonou, Projet Modèle, 36 p + 7 annexes, PMB/WP/9.

Tempelman, D., The participatory approach in an integrated
1989 artisanal fisheries project ; structuring community development - womens activities. Cotonou, Model Project, 43 p. PMB/WP/10.

Landry J., Cours d'alphabétisation fonctionnelle en calcul.
1989 Cotonou, Projet Modèle, 59 p. + 3 annexes. PMB/WP/11.

c) Rapports techniques et des documents choisis/

Selected list of technical reports and documents

Direction Nationale du Projet Modèle Bénin, Mise en place et plan
1985 d'exécution. Cotonou, Projet DIPA, 43., + 3 annexes.

Sheves, G.T. Integrated small-scale fisheries projects :
1985 principles, approaches, and progress in the context of the Benin prototype project. Paper presented at the workshop on Small-scale Fisheries Development and Management, Lomé, 20-29 November 1985, 33 p.

Sheves, G.T. Projets intégrés de pêches artisanales : approches
1985 et évolution dans le contexte du projet pilote. Document présenté à l'atelier régional sur le développement et l'aménagement des pêches artisanales, Lomé, 20-29 Novembre 1985, 36 p.

IDAF Newsletter/Lettre du DIPA, 1, October/Octobre 1985, 4 p.
IDAF newsletter/Lettre du DIPA, 2, January/Janvier 1986, 14 p.
IDAF Newsletter/Lettre du DIPA, 3, June/Juin 1986, 40 p.
IDAF Newsletter/Lettre du DIPA, 4/5, Sept./Dec. 1986, 76 p.
IDAF Newsletter/Lettre du DIPA, 6, September 1987, 58 p.
IDAF Newsletter/Lettre du DIPA, 7, June/Juin 1988, 84 p.
IDAF Newsletter/Lettre du DIPA, 8, June/Juin 1989, 74 p.
IDAF Newsletter/Lettre du DIPA, 9, October/Octobre 1989, 84 p.

Paraïso F-X., rapport sur stages de recyclage en identification
1985 des poissons Cotonou, GCP/RAF/192/DEN 24 p.

Collart, A. et M. Guidicelli, Développement des pêcheries
1984 maritimes et continentales de la pisciculture au Gabon. Rome, FAO (GCP/RAF/192/DEN) 77 p.

Johnson, J.P. et M.P. Wilkie, pour un développement intégré
1986 des pêches artisanales ; du bon usage de participation et de la planification. Cotonou Projet DIPA, 157 p. + annexes, Manuel de Terrain N° 1.

Meynall, P.J., J.P. Johnson, and M.P. Wilkie, Guide for planning
1988 monitoring and evaluation in fisheries development units. Cotonou, IDAF Project, 116 p. IDAF Field Manual N° 2.