AN APPRAISAL OF FISH CULTURE PRACTICES IN NORTHERN NIGERIA

BY

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A thesis submitted in partial fulfillment of the requirements for the degree of:

MASTER OF SCIENCE IN FISHERIES

of the

Department of Biological Sciences
Ahmadu Bello university
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MARCH, 1983.

THESIS APPROVAL

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I declare that this work is wholly the authors and has not been part of any presentation for any other qualification.

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ACKNOWLEDGEMENT.

While preparing this thesis, I received help from many sources and cannot within the available space mention all of them. My major supervisor Dr A.A. Olatunde, Associate professor of Fisheries Biology has been more of an elder brother than a lecturer. I am grateful for all his words of advice and for all his personal books that he placed at my disposal. Dr. J.C.D. Adegboye who is my minor supervisor has also been helpful especially in designing the questionaires and the format for the presentation of this thesis. Dr Charles G. Vajime receives my gratitude too for being a very good source of energy and encouragement when the going was rough.

The members of the Agwuegbo family of Ugamuma Obosi have all been equally concerned with my progress. They include Ezeamalu, Ben, Eddy, Nelson, Dozie, Amaechi, and lastly Uche who is always around. Nonyelum and Adaora are great for they always gave me a reason to work hard. They also bore my absence without complaining and gave me a reason to want to go home to a warm welcome.

I am grateful to Mr B.F. Dada, the Director of the Federal Department of Fisheries for nominating me for this course. I also appreciate his interest in the progress of my studies. Several other officers of the Federal Department of Fisheries and Fisheries Divisions of the states surveyed who gave me a lot of co-operation

A B S T R A C T

The present status of fish culture development in the ten northern states were investigated. All the relevant data on one fish culture projects in the ten states were collected by visitation and the use of questionaires, it was found that a few states, notably Bauchi and Gongola are as at now, still trying to construct their first fish farms. it was also found that generally, fish culture is yet to be developed in the area under review though there are potentials for increased productivity. The problems militating against the development of fish culture in this area were discussed side by side with recommendation for future development. The recommendations amongst others include, strategies for better fish farm management techniques, training and staff development, site/cultivar selection and communication with research institutes and universities.

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CHAPTER ONE

INTRODUCTION.

1.1. SUBJECT OF STUDY

Fish culture was first introduced into the Northern parts of Nigeria by a Hungarian Professional fish farmer named K.K. Zwelling in 1952 (Essien 1981). Since then there has been a spread of this aspect of agriculture to various nooks and corners of the area under review. This study is aimed at determining the level of fish culture practices in the ten northern states. It will also show the present status of each state in the field and attempts will be made at identifying factors that are responsible for its low level development or total absence in some states. Recommendations will be made for the improvement of the management techniques, personnel, preservation, marketing etc.

1.2. JUSTIFICATION FOR THIS WORK

There is a constant demand for protein in the world especially in developing and under developed countries where population increase is almost without control. Such countries too are less equiped to tackle some natural disasters like drought, flood and earthquakes which are likely to present further demand for protein in particular and food in general Human population growth rates are increasing by leaps of large magnitude and there is

no corresponding increase in food production. This is because the increments (in population) occur not arithmetically, by adding fixed amounts to the present total but geometrically, by multiplying the current numbers by the rate of increase and then multiplying the new larger number again and then again (Idyll, 1978). Olatunde (1982) pointed out that the rapid increase in the world population has resulted in the need for animal protein and other nutritional requirements.

The level of total protein required in the diet per day is affected by the quality of the protein, and the higher the level of animal protein in the diet, the lower the total required. This is because of the high nutritive value of animal protein as well as the fact that the assortment of amino acids in the animal protein is closer to that in the human body than the assortment of amino acids in the plant protein. Ademosun (1973) stated that the average Nigerian requires about 60gm of protein per day out of which 27gm or 45% should be of animal source such as milk, fish, meat or eggs. In Nigeria, the daily animal protein intake (for the average Nigerian) is between 5 and 8 grams in constrast to the recommended minimum of 20 grams (FAO, 1971). But perhaps a more salient point is the fact that the animal protein level in the Nigerians diet is so low that it constitutes only 9% of the animal protein of his counterpart in New Zealand, 11% of that in Denmark, 10% of that in the U.S.A. and 12%

of that in U.K. Therefore, from the above, it is abundantly clear that there is a serious need to increase the level of animal protein production in the country.

1.2.1. Justification for fish

With the above in mind the serious problem that requires urgent solution is a constant source of animal protein for human consumption. The source not only has to be regular but it has to be cheap too so as to be within the reach of many poor countries. Fish is regarded as the cheapest source of animal protein. It is cheaper pound for pound to grow aquatic animals rather than animals (Bardach et al, 1972). It is common knowledge that one of the best and probably the cheapest source of animal protein is fish (Olatunde, 1982). Stanley (1968) writes that fish are more efficient feed converters than most land animals, fish are 50% more efficient than hogs, and perhaps three times more efficient than cattle. Also the poikilothermic nature of fish further enhances its food to flesh conversion ratio. Since they are cold blooded animals, they simply adapt to the environmental conditions instead of wasting energy to keep warm. Such conserved energy is adequately channelled to building of more flesh. As a matter of fact, for every five pounds of food given to a typical fish, it returns one pound of flesh to man while cattle returns one pound only when it has taken 10 pounds of feed. Hickling (1974) observed that a piece of land used

for fish ponds and growing herbivorous fish can often produce a greater weight of protein than when used in grazing cattle. This superiority may be as much as 20:1 on poor sub-tropical soils.

1.2.2. Justification for fish culture.

From the foregoing it is therefore crystal clear that in a situation where animal protein is required in a large quantity and relatively cheaply too, fish is the best source. But if there is no significant difference between capture fish and cultured fish, then the whole idea of fish culture should be jettisoned while efforts should be concentrated on capture fisheries. However, the reasons for the continued emphasis on fish culture and the immense benefits derivable thereof are legion. First and foremost, there is the serious need to increase food production (and animal protein in particular) by whatever possible way to feed the worlds growing population. Aquaculture (and fish culture in particular) happens to be one of such ways. Gone are the days when the seas and oceans are regarded as in exhaustible. Some experts believe that the maximum sustainable yield of the oceans - the point beyond which the total fish stock actually starts declining - is now being approached and that by the end of the century (i.e in less than 20 years!) many important fish species will have been totally fished out (Stanley, 1968). In addition the technology for capture fisheries is becoming increasing sophisticated, expensive

and energy consuming; the capital cost of establishing and maintaining the attendant infrastructure and manpower is simply overwhelming (Stanley, 1968), and by contrast, the potential for increasing fish production through fish culture is simpler in technology and cheaper in terms of financial and energy investments.

Furthermore, because the artificially created environment in the fish farm can be regulated and maintained optically, culture fish grow faster than in natural waters. Hickling (1971), observed that the natural waters of Eastern Europe produced about 21 Kg of fish per hectare annually but the fish ponds produced an average of 242 Kg per hectare annually, or more than eleven times as much per unit area. Hickling (1974) noted that culture fish has more value because the fish can be marketed at a time when there may be a scarcity of naturally caught fish since they (cultured fish) are not subject to fluctuations of glut and scarcity.

Also the occupational harzard involved in capture fisheries is much despite the use of advanced fishing vessels and gear. The mental strain imposed on fishing crew whose vessel is being driven by a gale of 200 kilometres per hour is worth remembering. They may not always be lucky and though an insurance company may replace the vessel, the lives of the crew members are irreplaceable. In culture fisheries, the farmer knows what is in his ponds and he goes for it as at when he desires. This is unlike the situation in capture fisheries where

a ship may come back to tell eagerly awaiting customers that there is no catch.

Having discussed the merits of fish over other sources of animal protein, and the merits of fish culture over sea fishing, it therefore becomes imperative that fish culture projects should be encouraged to the highest possible level of development. As stated earlier on, the average Nigerian takes in about 5-8 grams of animal protein per day, needless to say, this is grossly inadequate. Sagua (1976) reports that there is no modern fish farm in Borno, Benue, Bauchi, Gongola and Kwara States despite the fact that there are over two thousand fish ponds in the country. It only means that this rich and cheap source of animal protein has been deliberately neglected or that the government agencies in the area under review are not aware of the potentials of this sector. Amongst other things, this research work will seek to bring to light the present level of development of fish culture practices in the ten northern states, it will also identify for possible remedy all impediments to the development of fish culture in this area. Recommendation on future development will be made and it is hoped that if implemented, the north will equal or even surpass the south in the production of fish through fish culture.

1.3. HISTORY OF THE PROBLEM

Fish culture arrived in Africa late. One of the earliest recorded practice of fish culture in Africa was in

Kenya in the early part of the 1920's (Bardach et al, 1972). The trials were carried out with Tilapia and milk fish, Chanos chanos. The results of the trials were apparently neglected or they were not encouraging enough since there was little or no response from government agencies and private entrepreneurs. To support this assertion, milk fish, Chanos chanos that was successfully cultured was simply not acceptable for consumption by the people.

Fish culture was introduced simultaneously in Congo, Zambia and a few other central African countries in 1942/43 but it only assumed a good dimension after the second world war. But before this period, what can be regarded as a form of primitive or crude fish culture practice was already in existence in Nigeria. This involved the construction of trenches and canals into which tide water and fish flowed during high tide. When the water receded, the contents of such trenches and canals were left for some time and subsequent harvest yielded larger fish. Sagua (1976) observed the age long tradition of throwing hardy fishes such as Clarias, Synodontis and Heterobranchus into shallow wells and dumping left over food and kitchen wastes into the wells from time to time. Such fish are harvested later for consumption or sale.

Organised fish culture practice in Nigeria is only a recent event. In the early 1940's a rather unsuccessful

attempt was made in a brackish water pond in Onikan near Lagos. Construction work on what can arguably be called the first fish farm in Nigeria started in 1951 in Panyam near Jos under the supervision of Mr. K.K. Zwelling - a professional fish culturist from Hungary (Essien, 1981). A few years later, the then Eastern and Western governments followed suit. Dada (1975) noted that in response to a request by the Federal Government, the development of brackish water fish culture was initiated in the Niger delta area in 1965 by the FAO and this was followed by a second project in 1968. The number of fish farms has been on the increase ever since.

Nigeria produces about 75,000 tons of fish from fish culture (Nagel, 1979). This quantity of fish is derived entirely from about 2,000 fish ponds covering an area of about 1,000 hectares scattered all over the country (Dada, 1975). This figure (75,000 tons) represents 10% of the country's total production, that is, 90% of all our locally produced fish as at now comes from the Rivers, Lakes, Streams and the Sea. A conservative estimate is that less than 10% of Nigeria's aquacultural potentials is being exploited at present. About 1 million hectares of mangrove swamp which is unsuitable for any other kind of agriculture except fish culture is awaiting to be harnessed. Further, despite the high evapo-transpiration rate of the rivers and streams that transverse the hinter-land, Awachie (1975) feels

strongly that the Niger/Benue flood plains can similarly be used for fish culture or will be rendered adequate by planned construction of dams at appropriate points.

1.4. RESEARCH PROBLEMS AND OBJECTIVES.

Since the establishment of the Panyam fish farm in 1951 under the supervision of K.K. Zwelling, a large number of fish culture projects have been embarked upon both by government agencies and individuals. With the creation of new states, some areas that by virtue of the new boundary lines had no developed fish culture sites made frantic efforts to establish one or two. One of the objectives of this work will be to determine the states (among the ten states in the north) that have or are proposing to establish fish farms. It will also investigate the extent or level of development of fish culture in the area under review. The overall efficiency and performance of the management techniques employed in the farms will also be investigated.

Recommendations on ways of improvement of the farms and hints for future development will be an integral part of this work.

1.5. RESEARCH METHODOLOGY

The research was conducted by the aid of questionaires and visits to some of the fisheries division offices, Federal Department of Fisheries Offices, some known fish farms and some proposed sites. Of course all the places are within the area under review.

A major advantage of visiting the farms is that it gave a chance of seeing and appraising the level of work done in the particular fish farm. However, the vastness of the area and the inaccessible nature of some of the roads militated against this. The financial involvement is staggering too. In most cases, questionaires were very useful in that they got information from very distant areas. On the other hand, many of the questionaires were neither completed nor returned. Another disadvantage of questionaire is that the officer completing it may give an exaggerated or under-estimated account of his projects. More frequently the account is exaggerated.

CHAPTER TWO

REVIEW OF LITERATURE.

2.1. AQUACULTURE

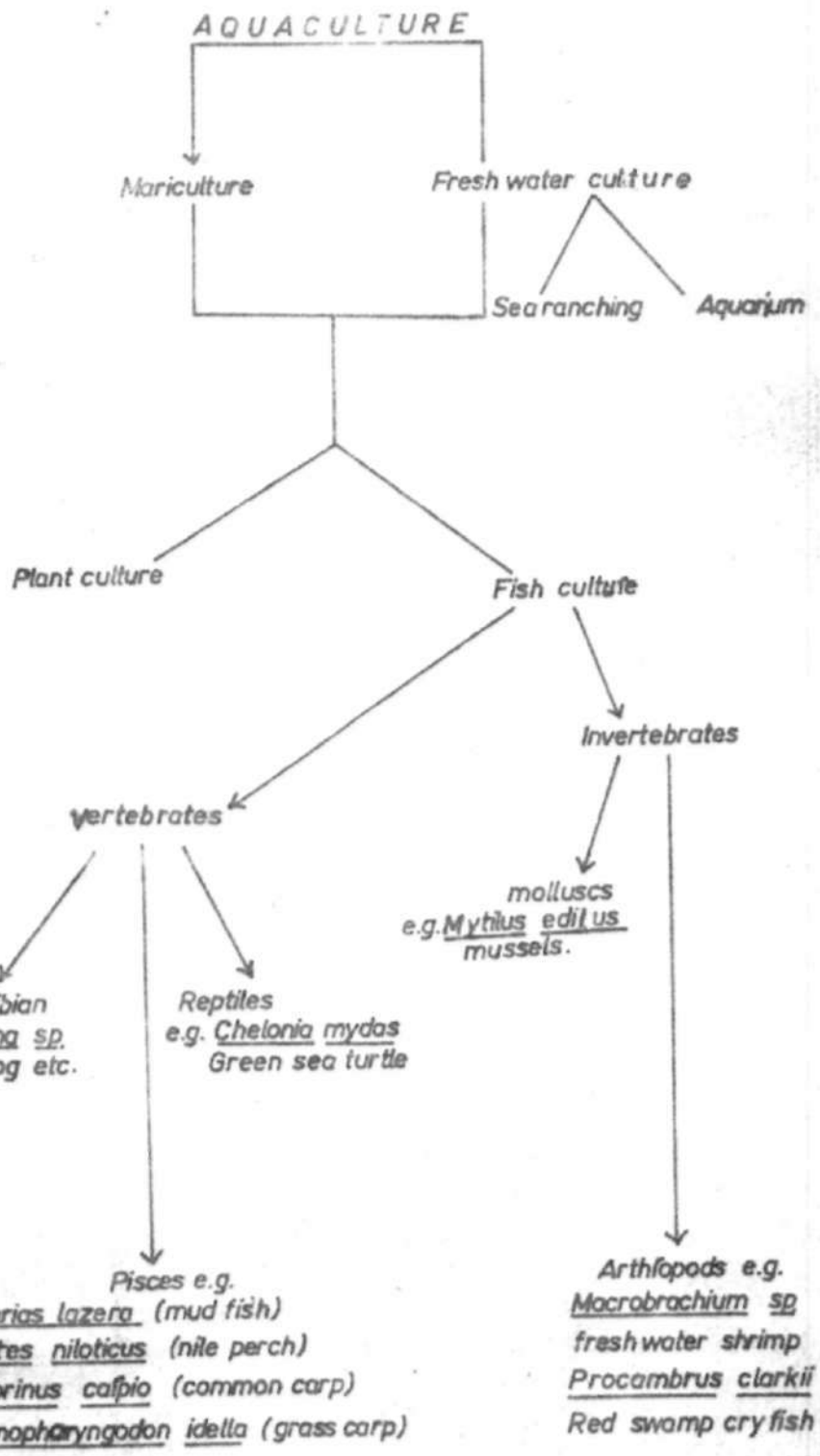
Aquaculture simply defined as the farming and husbandry of fresh water and marine organisms (Bardach et al, 1972). Aquaculture has also been defined as the rearing of aquatic organisms under controlled or semi-controlled conditions, it is thus under-water agriculture (Stickney, 1979). Reay (1979) observed that from the biological view point, aquaculture can be regarded as man's attempt, through imputs of labour and energy to improve the yield of useful aquatic organisms by deliberate manipulation of their rates of growth, mortality and reproduction. Clearly aquaculture is the aquatic counterpart of agriculture, the principles and many of the problems are the same, though there are unique characteristics associated with the aquatic medium, and with the entirely different set of organisms involved.

The practice of aquaculture in the marine environment is called mariculture; but however, there is no technical term for the fresh water type - it is simply called fresh water aquaculture. Aquaculture is broadly divided into two categories - plant culture and fish culture. The word "fish" as used here includes all the molluscs, arthropods, echindoerms etc. and chordates that are at present cultivated in aquafarms in different parts of the world.

Animals that are biologically fish, that is they belong to the class pisces, are refered to as fin fish. Some of these are the Tilapia, Tilapia sp; milk fish Chanos chanos, Nile perch Lates niloticus, common carp Cyprinus carpio; etc. Shell fishes include such arthropods as the fresh water shrimp Macrobrachium spp; the red swamp crayfish Procambrus clarkii, procambrus acutus etc and molluscs such as the cupped oysters and mussels, Mytilus edilus.

Sea ranching is an aspect of aquaculture too. Here the fish is bred up to a certain age and then released into the wild environment to help stop the extinction (of the species) brought about by over fishing and some other natural phenomena. Sea ranching is employed to sustain the population of the highly-priced anadromous pacific salmon Onchorynchus sp. In aquarium keeping, the fish are maintained for their decorative and aesthetic value. Figure 1 shows a diagramatic representation of the various facts of aquaculture.

A recent survey showed that 314 species of fin fish, 74 crustaceans, 69 molluscs, 43 algae, 13 angiosperms (including rice) 12 sponges, 9 amphibians, 4 reptiles, 3 rotifers, 2 annelids, 2 mammals and 1 echinoderm are the subjects of aquaculture. World production as at 1975 stood at over 6 million tons made up mainly of fish, oysters, shrimps, mussels and marine algae. Table 1 below shows the breakdown of the figure.



Facets of Aquaculture

(Modified from several authors)

Fig. 1

TABLE 1:- World Aquacultural Production.

Fish	-	4 million tons
Oysters	-	6000,000 "
Shrimps	-	150,000 "
Mussels	-	370,000 "
Marine algae	-	1 million "

(Nagel, 1979)

TABLE 2:- Fin fish production by aquaculture as at 1975.
First twenty nations (Nagel, 1979).

COUNTRY	PRODUCTION IN TONS
China	2,200,000
India	490,000
USSR	210,000
Japan	147,291
Indonesia	139,840
Philippines	124,000
Taiwan	18,236
Bangladesh	76,485
Nigeria	75,000
Poland	48,400
Vietnam	30,000
Yugoslavia	27,000
Romania	25,000
Hungary	23,515
U.S.A.	22,333
Itlay	20,500
Madagascar	17,392
German Dem. Rep.	16,000
France	15,000
Czechoslovakia	12,222

The World aquacultural production is gradually on the increase. Reay (1979) is of the view that the exact potential for aquaculture is of cause not known, but the FAO estimate of a five-fold increase over the next thirty years is reasonable provided that certain constraints to development can be removed.
Some of such constraints are administrative, legal and manpower problems, finance, feed, fertilizers and site availability. Nagel (1979) appears more optimistic, he believes that by the year 2,000, yields from aquaculture could be as much as 60 million tons and more of the increase is expected to come from tropical and sub-tropical zones. The Asian and Indo-pacific countries dominate this field and account for over half of the current world production as can be seen from Table 2 below.

2.2. FISH CULTURE.

2.2.1. Definition and Scope.

Fish culture is the rational rearing of fish including notably the control of growth and breeding (Huet, 1972). Fish farming is best regarded as a colloquial alternative to aquaculture though it woild not cover the culture of plants (Reay, 1979. Fish culture and fish farming are interchangeable synonyms. The subject of fish farming or fish culture is broadly divided into two categories - fin fish culture and shell fish culture. Fin fish culture involves the rearing of animals that are biologically refered to as fish. Fin fish makes up 66% of total world aquacultural production (Nagel, 1979), Shell fish is an all embracing term which includes molluscs and crustaceans amongst other minor groups. Crustaceans are the candidates for culture in Lousiana, U.S.A., Japan, Indo-China etc.

Fish farming comes in various forms and one is monocultute. This means that only a species of fish is produced from the pond. Monoculture practice is not very common because the animal being reared usually fails to utilize all portions of the environment, for example the culture of a dermasal species leaves most of the water column under utilized (Stickney, 1979). A body of water is a three dimentional growing space and to treat it like a field by planting only one kind of crop is likely to result in wasting a majority of the space (Bardach et al, 1972). Polyculture, the rearing of two or more species in each culture unit enjoys wide popularity throughout the world since the technique allows species with different food habits

to take advantage of each of the feeding niches in a pond environment (Bardach et al, 1972). The polycultural technique is also used in the prevention of stunted growth by the rearing of a piscivore like Lates niloticus in a pond overpopulated by a prolific breeder like the Tilapia. The growing together in the same pond of fish of different feeding habits has been carried furthest by the Chinese system of traditional fish farming which is now being adapted in other countries (Hickling, 1974). In the system, the principal fish are:

Ctenopharyngodon idella (Grass carp)	(plant eater)
Hypothalmichthys molitrix (Silver carp)	(Phytoplankton eater)
Aristichthys nobilis (Silver carp)	(Z00 plankton eater)
Cyprinus carpio (common carp)	bottom feeder.

Hickling, 1974

There are several other combinations designed to suit various local conditions.

Mixed farming is also within the scope of fish farming. In this process, fish is grown with some other animals like pigs, cattle, geese, chicken or with rice. Mixed farming gives the farmer a chance of marketing more than one product. It also cut down the cost of purchase and application of fertilizers. Cows and pig manure are by far the

most frequent manure used, indeed the pig sties may be built over the ponds so that the dung and urine drop straight into the water (Hickling, 1974). Pig and duck farming is often carried out in conjunction with a fish pond and here the fish benefit directly or indirectly from the feaces and the uneaten food of other animals (Reay, 1979).

Pen and cage culture are also becoming important. The cages may be made of strong wood or metal frame with a wire gauze netting. It should also be noted that stocking in most well managed farms is intensive. Extensive culture is nearest to what obtains in nature; it requires little or no management at all and the fish get all their nutritional requirements from nature. There is no supplementary or artificial feeding.

Sea ranching is another form of fish culture. Ranching is the release of hatchery - bred and reared juveniles into the natural environment. In north America for example, an income of seven dollars could be obtained from every dollar that it costs to rear salmon spawn, Onchoryn chus kisutch (Nagel, 1979).

2.2.2. Site and cultivar selection.

Over 75% of fish production by culture is done in ponds. For maximum yield, a number of factors are usually taken into account when choosing the culture species and siting the ponds. Both factors are important in the development of any fish culture project. Depending on

how carefully both are manipulated, they may spell doom or boom for the culturist and the farm.

2.2.2.1. Site selection.

Water is the most important aspect to be considered before siting a fish farm since the whole operation must of necessity be carried out in water. Hickling, (1974) insists that the water must be of the right quality and that while it must contain enough oxygen to support active life, it must not contain harmful substances. Water is the medium surrounding the fish and the resulting interfare includes the site of gaseous exchange, ionic balance removal of wastes and the determination of body temperature (Reay, 1979). There must be sufficient good water to replace water lost by evaporation and water lost during management operations like cropping and sampling. An adequate site will therefore have amongst other things, constant supply of water all year round. Spring or stream water can be used but where the cost of sinking a well is not too much, well water is better especially in hatchery. Well water is prefered because it assures more dependable flow, and it is usually free of disease organisms, parasites, trash fish, pesticides, predators and other contaminants and pollutants (Bardach et al, 1972). The pH of the water must also be within the tolerance limit of the fish.

The soil is important too and it should have a good water holding capacity or dry ponds will soon be left as

a manifestation of an unwise choice of site. A pond soil must be impermeable to water, that is, it must be water logged for if it were porous and contained air, it would not hold water (Hickling, 1974). As long as other conditions are satisfied, it does not matter if the soil is not fertile since the situation can be corrected with fertilizers at low cost. A mixture of about 1/3 clay and 2/3 sand is acceptable. Out cropping of rocks, termiteria, and gravel deposits should be avoided as they do not permit a tight seal. Also in selecting a site, areas suspected to contain buried logs of wood, long tap roots and plenty of decaying vegetation should be excluded as there is a chance of severe leakage when the plant materials decay and leave holes in their former places.

The topography should be such that water can be fed into the ponds by gravitational force only without involving the extra cost of pumping. It should also be such that will allow the placing of the longer strip (length not width) of the pond parallel to the wind so that the wind helps to stir the water thus preventing deoxygenation. The farm must be located in an area that must be accessible at all times of the year. This point might not sound important but when it is realized that no personnel or equipment can be moved to the farm or can any product be moved out of the farm on an inaccessible road, the seriousness of the point becomes obvious. A farm that can be reached only after a strenous journey

or one that is accessible only for a part of the year is not likely to be well managed and may attract only few customers.

When a proposed site has been certified suitable for a fish farm, it generally will cost between ₦6,000.00 and ₦7,000.00 to construct a one hectare fish pond including the inlet and outlet mons. About 60% of this amount will go into making of the bund walls while the excavation of the pond bottom and others will take 40%. However, the construction cost does not exactly double with the doubling of the number of ponds. Thus the bill for a two hectare farm (with 2 ponds) lying side by side will be slightly less than the cost above. The price will again be much lower if the prospective farmer hires machinery from the Federal Government at 50% subsidy.

2.2.2.2. Cultivar selection.

A number of features are desirable in a culture fish but it does not mean that the absence of any of the factors automatically disqualifies a species. Out of the 25,000 known species of fish, only 314 species have qualities that make them potential candidates for culture (Reay, 1979). But in actual practice none of these potential candidates can be said to embody all the positive attributes (Nagel, 1979) but a combination of some of these positive characteristics will make a species a star amongst other cultivars. Although the initial choice may seem wide, it is restricted in actual practice by the

biological, technological, economic and marketing criteria that determine commercial ability (Weber and Riordan, 1976).

Any fish intended for culture must be able to grow out quickly. A species that reaches table size in 6 - 12 months is more likely to enrich the farmer quickly. For this reason, fish such as many species of Haplochromis in Africa which do not even grow to 10cm in length are not suitable for cultivation despite the fact that they produce well in the ponds (Huet, 1972). For the same reason, the Nile or Niger perch, Lates noliticus, the common carp, Cyprinus carpio; and the cat fish, Heterobranchus bidorsalis and H. longifilis which can weigh as much as two kilograms in 12 months, are very desirable culture species. In order to determine the species of fish best suited for a particular area, it will be necessary to take pond temperatures at given intervals over a long period before stocking. It will be a great mistake to plant warm water species in cold water (except wintering facilities are provided) since they will fail to grow and produce catchable fish. Thus in virtually all the continental U.S,A., except South Florida and Texas, Tilapia will be unable to over winter except during unusually warm years unless they are provided with artificially heated or geothermal water (Stickney, 1979). This is effect means that only species whose body temperatures naturally correspond to waters in a given area must be stocked for economical production. But both local and acclimatized foreign species which have proved successful in this country

will be used (Awachie, 1975).

It is desirable that a culture fish should be able to produce (on its own or when induced) in captivity. This ensures a continuous source of fry whose disease or genetic history are known. Bardach et al, (1972), believe that culture systems based on capture of wild stock are of course-ultimately limited by the success of the natural population in reproducing itself. Also the ability to reproduce naturally when well managed, may well be an additional source of fish feed. This is examplified in the stocking of the prolific breeder Tilapia sp and some highly priced piscivores like Gymnarchus niloticus and Lates niloticus in the same pond. In such a polyspecific system the piscivores do not require any additional feeding. Also the fry from the hyper breeding can be sexed and stocked in monosex cultures where growth is rapidly achieved. Some African Barbus sp and Citharinus sp grow easily in ponds but they do not reproduce in captivity and for that reason are only reared occasionally (Huet, 1972). On the other hand some fishes like the grass carp Ctenopharyngodon idella and the milk fish Chanos chanos which do not breed in captivity remain popular culture fishes because of their other desirable characteristics, For such species, the culturist depends on natural reproduction in the wild to maintain his stock.

Another criterion for the selection of a culture fish is its resistence to disease. The hardiness of the larvae

and ease of handling are important too. The hardier the eggs and larvae the easier the culturists task (Bardach et al, 1972). If the fish is delicate and susceptible to disease, then just one epidemic will be required and the farm will be no more. The unfastidious food requirements of a fish is also of immense advantage to the farmer. To obtain a high yield, it is necessary that reared fish accept an abundance of cheap artificial food (Huet, 1972). Since most fish farms are of the intensive and semi intensive type the culture fish should be able to withstand and thrive as usual in a crowded pond. The best species are those which are social and gregarious. Some off shoots of a dense population include cannibalism, concentration of waste materials, high competition for food and the ease of disease transmission.

Finally the cultivar must have good taste, appeal to the people and be free of any socio-cultural stigma. Nagel (1979) feels that the demand for the product should come from as wide a section of the population as possible. No matter how successful a species is in terms of growth, reproductive capabilities and hardiness, the whole effort invested in its production will be valueless if the people hate the fish. Despite the success of the milk fish Chanos chanos in Kenya, the whole project almost ground to a halt simply because Kenyans do not like milk fish (Bardach et al, 1972). Generally desirable as shell fish are, they are unacceptable to the orthodox Jew; and while Tilapia sp are

popular in many lands, in South Vietnam it was difficult to make them a food item because of the rmours that Tilapia have health-impairing and disease - producing qualities (Bardach, 1976). According to the same author, the Japanese hate cat fishes simply because there is a myth that earthquakes in Japan were caused by a giant catfish moving and arching its back below the Nipponese island chain.

2.2.3. Historical perspective.

Fish farming has a very old history. It must have envolved in man's life at about the same time as animal keeping and farming of the land. Hitherto, man had to chase game about but at a certain point, it occured to him that if he put the uninjured captured animals in captivity and bred them, they will be an assurance against starvation on days (which were quite often) he cannot make a kill. So must have begun the association of man with sheep, cattle, goats, pigs and horses (Hickling, 1974). Furthermore, such animals (in contrast to those roaming about in the wild) he could rightly call his own, and this arrangement offered the opportunity of feeding and caring for them in a better way. This practice is also assumed to have to some extent persuaded man to abandon a nomadic pattern of life for a more profitable settled life.

Bardach et al (1972) reported that there is an Egyptian tomb frieze dated 2,500 BC and that it illustrated the harvest of Tilapia which were supposedly cultured. Various

authors presume that the culture of carp in China goes back to 2,000 BC (Nagel, 1979). The earliest record came from China where it is thought that carp culture was being practised 4,000 years ago (Reay, 1977). Hickling (1974) reports that in China, by 1,100 BC, fish culture in ponds formed by ox-bow lakes were in use and so fish culture can claim an antiquity nearly as respectable as that of rearing land animals. The legendary Fan-Lai of the Chinese carp culture fame is said to have reared carps in the fifth century BC and the modern view is that he wrote a book on the culture of common carp Cyprinus carpio in 430 B.C. (Bardach et al, 1972). Huet (1972) reports the presence in Italy of ponds dating back to the Roman times and by 618 AD, the cultivation of various other species had been made popular in most Asian countries. Edminster (1947) further describes how Romans used the flesh of slaves to feed their cultured fish purporting that it impacted a special delicacy to the fish. Markham (1613) was reported by Hickling (1974) to have encouraged fish farming since according to him, all the fishes in the rivers and the seas belong to the Lords and Kings while only those in the fish ponds belong to private persons. By the middle ages, the introduction of carp in Europe from the Asian countries gave a further boost to fish farming. Trial culture of milk fish and Tilapia in the early 1920's in Kenya is the earliest recorded account of fish culture in Africa (Bardach et al, 1972). Later in 1942-43, it was

simultaneously introduced into Congo, Zambia and some other Central African countries (Hickling, 1974). At about the same time a rather unsuccessful attempt was made at establishing a brackish water fish farm in Onikan near Lagos. In 1951 at Panyam near Jos, a Hungarian fish farmer, K.K. Zwelling, supervised the construction of the first organized and successful fish farm in the country (Essien, 1982). Since then a number of state governments, the Federal Department of Fisheries and some private businessmen have made inroads in this field.

2.2.4. Contributions of fish culture.

Fish farming no doubt plays an important role on the nutritional and economic well being of a good segment of the world. As a major and dependable source of food in the world, fish farming provides 4 million tons of fish 150,000 tons of shrimps, 600,000 tons of oysters and 370,000 of mussels per year for human consumption (Nagel, 1979). 75,000 tons of fish are produced in Nigeria per annum (Dada, 1975) and with the development of more fish farms, the figure is expected to rise. Fish culture plays the important role of supplying food when there is a scarcity of naturally caught fish (Hickling, 1974). Reay (1979) insists that most aquaculture take place to provide food for direct human consumption and this must be seen as a dominant future function in an increasingly hungry and greedy world.

Fish culture provides recreational and sporting activities for anglers. In Panyam, a long pond is speciffically marked out for sports. During the week ends and public holidays, hundreds of people convenge on the place with their angling rods, baits and picnic baskets. Judging from the turn out always, it can therefore without doubt be said that fish farm entertains and provides good times for its several callers. So it in several other fish farms in the country and else where in the world.

Several of the most valuable aquacultural products such as pearls and ornamental fish are not for food at all, and some cultured fish are used for biological control. Fish culture provides most of the beautiful and rare species of aquarium fish that liven up our sitting rooms. Gold fish, Carassius auratus are reared not only for baits but also for use as ornamentals and pets (Stickney, 1979). Also the mosquito fish Gambusia affinis because of its food and feeding habits, is used for the biological control of mosquitoes. The fingerlings used for the replenishing of the natural stock (that is, sea ranching) come from fish farms and hatcheries.

Fish farms in some aspects act as scavengers by taking up our waste products and converting them to beneficial use. Wastes from night soil to plant refuse are turned into readily available and much needed protein in the pond and it is only an extension of this to consider growing fish in the waste water from sewage treatment plants

(Reay, 1979). Deteriorated groundnuts which otherwise would have posed some disposal problems, is choice food culture fishes in this country. So also are brewery waste and rice bran. Blood too from abattoirs is profitably used in providing nutritious meals to culture fish. So on the long run, we and up exchaning waste products for fish flesh. Fish farms are of additional value in utilizing waste and providing employment (Reay, 1979).

Fish culture reduces unemployment by providing jobs of various categories. If sited in the rural area it helps to control the village to city drift. As more labour intensive methods are used in aquaculture than in sea-fishing, or in the production of land animals, it provides job opportunities for skilled and unskilled workers. This no doubt improves the living standard of the village dweller and that of the farmer too. (If the farm is privately owned).

Finally the exportation of some of the fish farm products is a foreign exchange earner for the exporting country. The Republic of Benin makes money from the exportation of shrimps to several countries including regretably, Nigeria. China, Philippines and some East Asian countries have found this trade profitable.

CHAPTER THREE

MATERIALS AND METHODS.

3.1. ICHTHYOGEOGRAPHY.

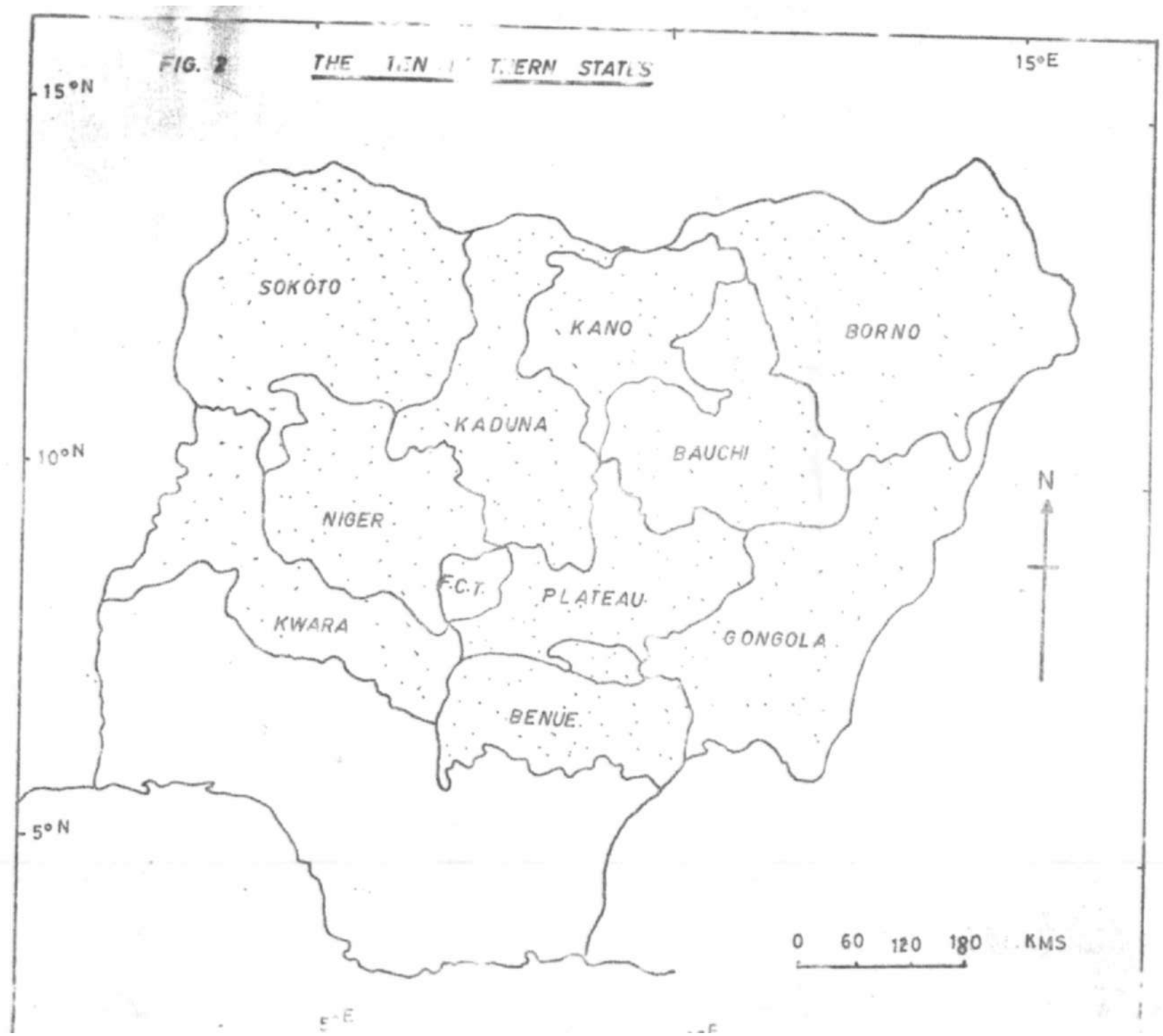
The area under review is the former Northern Nigeria comprising the following ten states of the Federal Republic of Nigeria. The states are Bauchi, Benue, Borno, Gongola, Kaduna, Kano, Kwara, Niger, Plateau and Sokoto states. These states lie in the Sudan/Sahel savannah belts with some desert encroachment in the northern tips of the area. Some parts of the states towards the southern portions of the area fall in the rain forst zone. Rainfall is high in comparison with the southern parts of the country and the total cm/year of rainfall increases towards the south. The states are transversed by many rivers the most important of which include rivers Niger, Benue, Kaduna, Sokoto, Hadejia etc.

Lake Chad is situated on the north eastern tip and there are a few man made lakes the largest of which are Kainji and Tiga. The population and land areas of the various states are shown on Table 3 below. The location of the various northern states with respect to the other Nigerian states is also shown in figure 2. And the whole area is bounded on the north and south by latitude $14^{O}N$ and latitude $6^{O}N$. On the east and west, it lies between longitude $3^{O}E$ and longitude $15^{O}E$.

TABLE 3:- Area and population of the states (Nigeria Year Book, 1980).

STATE	AREA IN SQ. KM.	POP.	CAPITAL
Bauchi	61,814	2,193,674	Bauchi
Benue	69,814	3,041,194	Makurdi
Borno	116,589	2,990,526	Maiduguri
Gongola	102,671	3,000,280	Yola
Kaduna	70,293	4,098,305	Kaduna
Kano	42,123	5,774,842	Kano
Kwara	73,404	2,309,228	Ilorin
Niger	73,555	1,271,767	Minna
Plateau	56,245	2,026,657	Jos
Sokoto	94,588	4,538,808	Sokoto

FIG. 2 THE [illegible] STATES



3.2. VISITATION.

Most of the offices of the fisheries division of the states Ministry of Agriculture were visited. Similarly visits were also paid to the Federal Department of Fisheries Office in the same area. Some of the known fish farms and proposed sites where construction work is currently going on were also visited. Interviews were held with the officers met in the various farms. A major advantage of visiting the fish farms is that it gave a chance of seeing and evaluating the level of work done personally. However, the vastness of the area and the inaccessible nature of some of the roads militated against this. The financial involvement is staggering too. Measuring boards, spring balances and a magnifying glass were taken along and these facilitated closer examination of some samples of the fishes.

3.3. QUESTIONAIRES.

Questionaires were sent to some known fish farm, all fisheries divisions of the state Ministry of Agriculture and all the offices of the Federal Department of Fisheries in the area under review. The questionaire is made up of three sections. Section One dealt with such information as the name of the fish farm, location, source of water, area of the farm and the number of ponds. Section Two sought to discuss the managerial aspects of the farm. It asked detailed questions on the species available on

the farm, the method of procurement of fry and stocking rate, the type of culture method used, feeding and fertilizing. This section also attempted to gather statistics on yield per hectare per year, price of fish per kilogram per species, and the disease history of the fish on the farm.

The last section wanted to know of any co-operation with other farms or institutions and the quality and number of the personnel working at each farm. (see Appendix I).

In most cases the questionaires proved very useful in that when completed and returned they obtained information from very distant areas. On the other hand, many were neither completed nor returned. Another disadvatage of questionaires is that the officer completing it may give an exaggerated or underestimated account of his project. The fish farmer is more often the case. In some cases where the fish farm is privately owned, the fish simply refuses to give any information. He feels that the details required will be used in computing his tax returns or that whatever operation he carries out on his fish farm is not for public consumption.

CHAPTER FOUR

RESULTS.

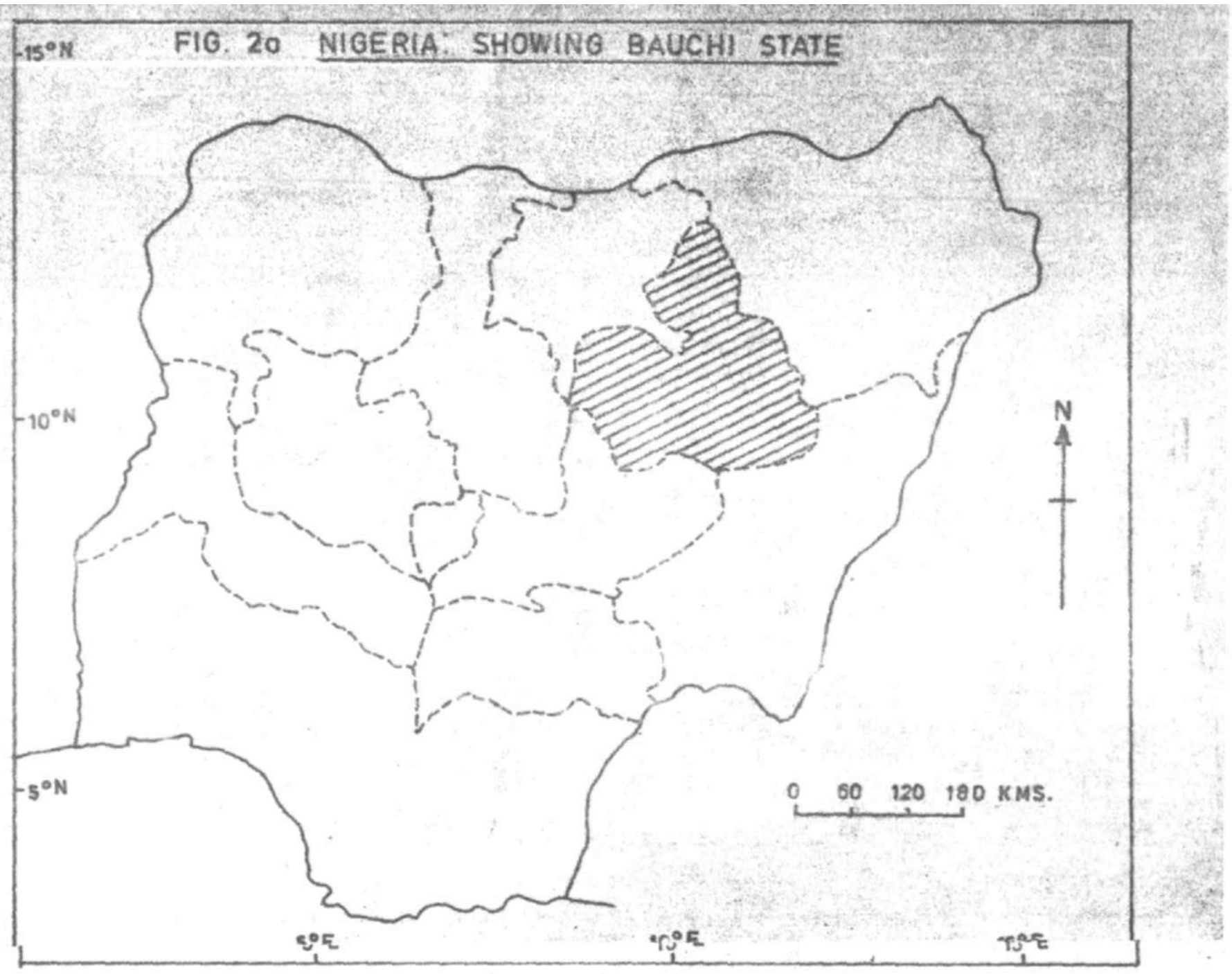
With the completion of the tour of the states under review and with the return of most of the questionaires, data for the fish farms were assembled state by state. The most important aspect of each farm were selected and have been arranged for easy reference. For farms located in apparently obscure sites, attempts were made to give its direction or proximity to a nearby prominent town. The names and status of officials that granted interviews to me, completed the questionaires and allowed me the use of their facilities have been deliberately ommitted in this chapter. They however received my gratitude elsewhere.

Some ponds which cannot be regarded as fish farms did not receive full documentation. So a community or private fish pond that contains a few wild fish and receives no technical or managerial care and was not in the first place constructed (just formed by a pool of stagnant water) will just be mentioned or left out since this work deals with fish farms.

4.1. BAUCHI STATE.

There is nothing as at now that can be regarded or called a fish farm in the whole of Bauchi state. However there is a proposal for the construction of a Gubi fish farm. The plans are now at an advanced stage and in no distant future the first fish farm will take off.

FIG. 2a NIGERIA. SHOWING BAUCHI STATE



4.2. BENUE STATE.

There are two proposed fish farms in Benue State. The proposals have actually left the planning table and are as at now being translated to reality on land. The first is the Makurdi fish farm and the second is the Fisheries Division fish farm also in Makurdi. Construction and expansion work are still going on in both of them but no stocking has taken place in any. Figure 3 shows Benue State and the location of the fish farm.

4.2.1. Makurdi Fish Farm.

As the name implies, the farm is located in Makurdi and only fish is produced from it. That is, mixed fish farming (fish plus say cattle or poultry or pigs) is not practised here. The farm was established in 1980 and water comes from a steam that is constant through out the year. The farm has a total area of eight hectares consisting of 20 ponds which are between 5 and 1 hectares in size. There is a proposal to stock common carp C. carpio, L. niloticus, G. niloticus and the Tilapia spp and the greater perecentage of the fry will be procured through induced and wild breeding in the ponds. There will also be both mono and polyculture and the use of fertilizers if the need arises. There is a good understanding between the farm and the Federal Department of Fisheries/ Benue State Government but there is also a shortage of skilled intermediate and senior staff. The farm is owned by the Benue State Ministry of Agriculture.

FIG. 3 NIGERIA: SHOWING BENUE STATE (FISH FARMS)

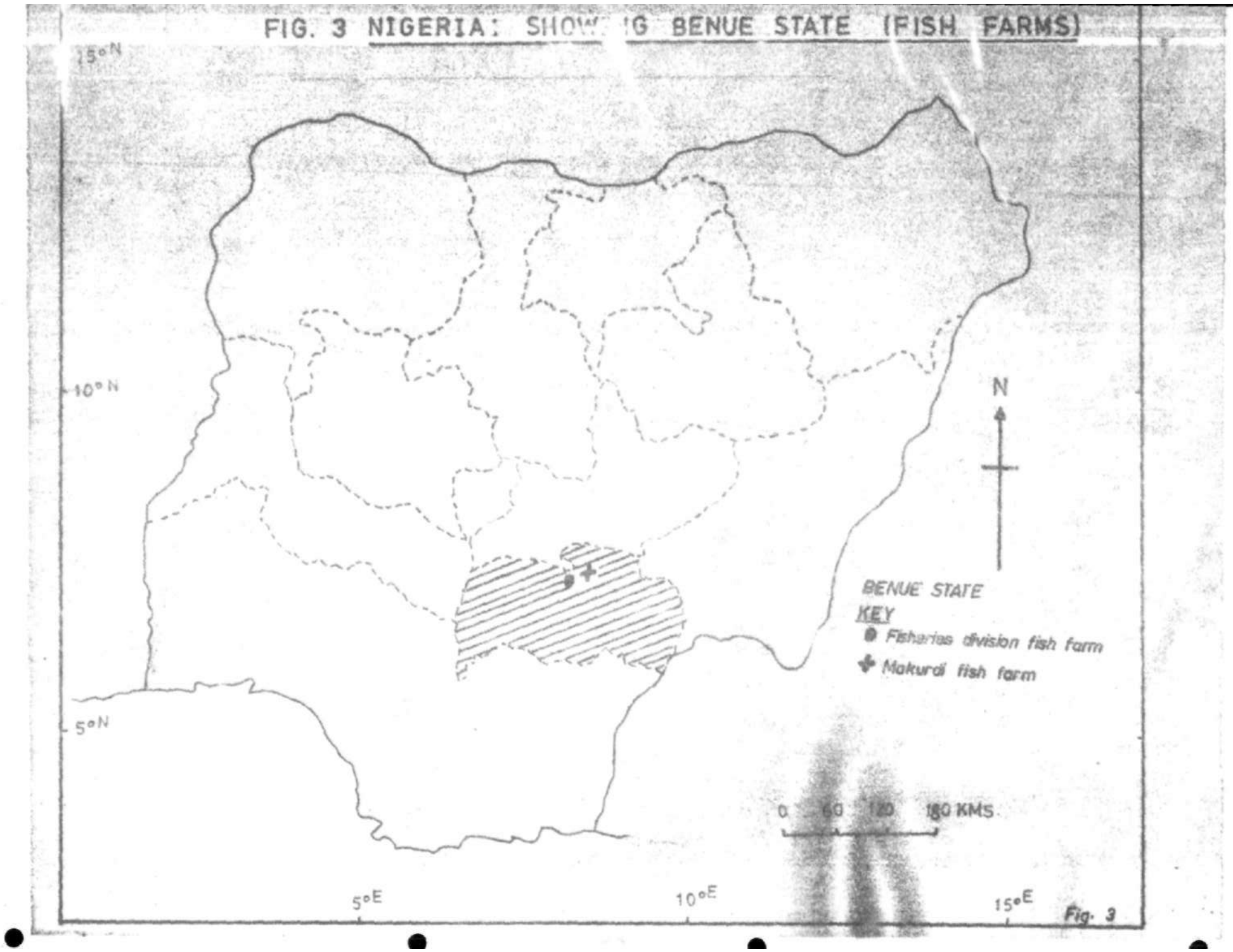


Fig. 3

4.2.2. Fisheries Division Fish Farm.

Full construction work on this farm started in January 1982 and the source of water is the River Benue. The present area is about 5 hectares made up five ponds that are between 0.2 and 0.5 hectares.

Fry will be obtained from wild breeding in the ponds and from the Panyam Fish Farm. Only polyculture will be practised here. All the artificial or supplementary feed will be compounded from local materials and super phosphates will be the fertilizers to be used. The fish farm is funded by the Benue State Government.

Also, the Benue State Government is presently discussing the possibility of establishing a big fish farm at Beragbum. An American firm will undertake the construction and management if the negotiations come through.

4.3. BORNO STATE.

In general, there has been a remarkable progress in fish culture in Borno State over the past six years. There are now three fish farms - Ali Gambori fish farm, the Wesley Dam farm, and the Auno Fish farm. As at 1977, there was not even one fish farm in the whole state. Figure 4 shows Borno State and the location of the fish farms.

4.3.1. The Ali Gambori fish farm.

The farm was established in September 1978 and gets a constant supply of water from a borehole.. Fish alone is farmed here and there are two ponds of approximately one hectare each. It is located in Maiduguri.

FIG. 4 NIGERIA; SHOWING BORNO STATE (FISH FARMS)

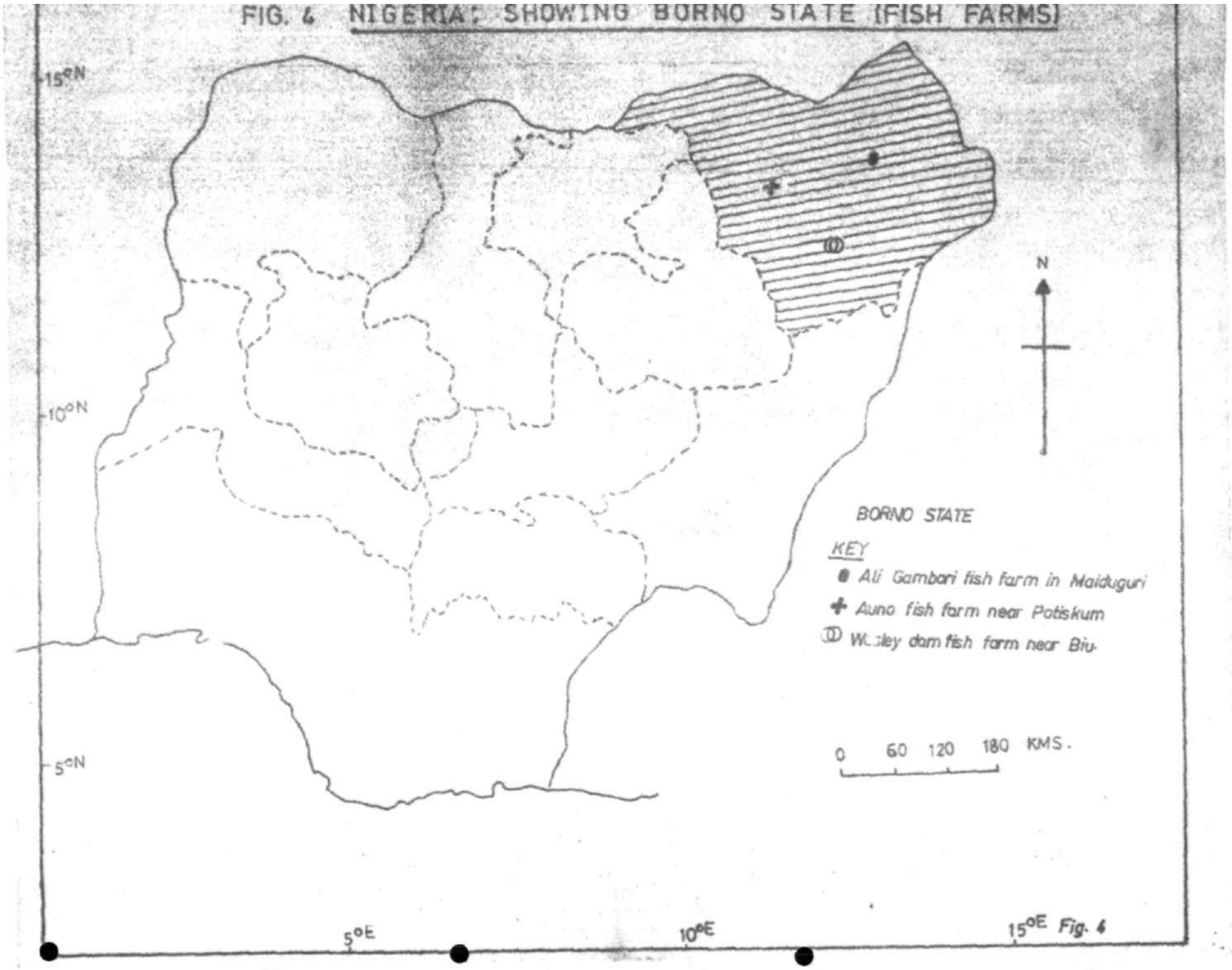


Fig. 4

Common carp, C. carpio, Clarias spp and Tilapia spp are cultured here, the carp fry were obtained from Panyam fish farm while the Clarias and Tilapia fry were captured from nearby streams, and of course since the initial stocking the Tilapia has continued with its prolific breeding. Only polyculture is practised here and the supplementary feed used include wheat and corn bran. Cow dung dropped by grazing cattle that come to drink is the fertilizer used. Carp grows to 500 grams in 6 months here and there has not been any disease outbreak. There is a shortage of manpower here.

4.3.2. Auno Fish farm.

This farm is located near Potiskum. It was established in 1981 and it gets a constant supply of water from underground streams and rain water. The total area of the farm is 2.5 hectares and there are three ponds; the first two are 1 hectare each while the third is 0.5 hectare. Clarias sp and Tilapia spp are the only two cultivars and they were obtained as fry from the River Yobe and Panyam fish farm. Mono and Polyculture are practised and intensive artificial feeding with wheat and rice bran takes place with no kind of fertilizer being used. No disease outbreak has been recorded. The farm is in close co-operation with the Panyam fish farm but there is still a shortage of skilled personnel both in the Senior and Intermediate levels.

4.3.3. Wesley Dam Fish Farm.

This farm was established in 1981 and it is near Biu. The farm consists of only one large pond which is a little over 2 hectares though there are plans for the construction of more ponds. C. carpio, T. nilotica and Clarias spp were among the species that were introduced as fry from the Ali Gambori fish farm in 1981. No fertilizers are used at the moment and there has not been any disease outbreak. There is however the problem of recruiting and retaining qualified officers and fisheries attendant assistants.

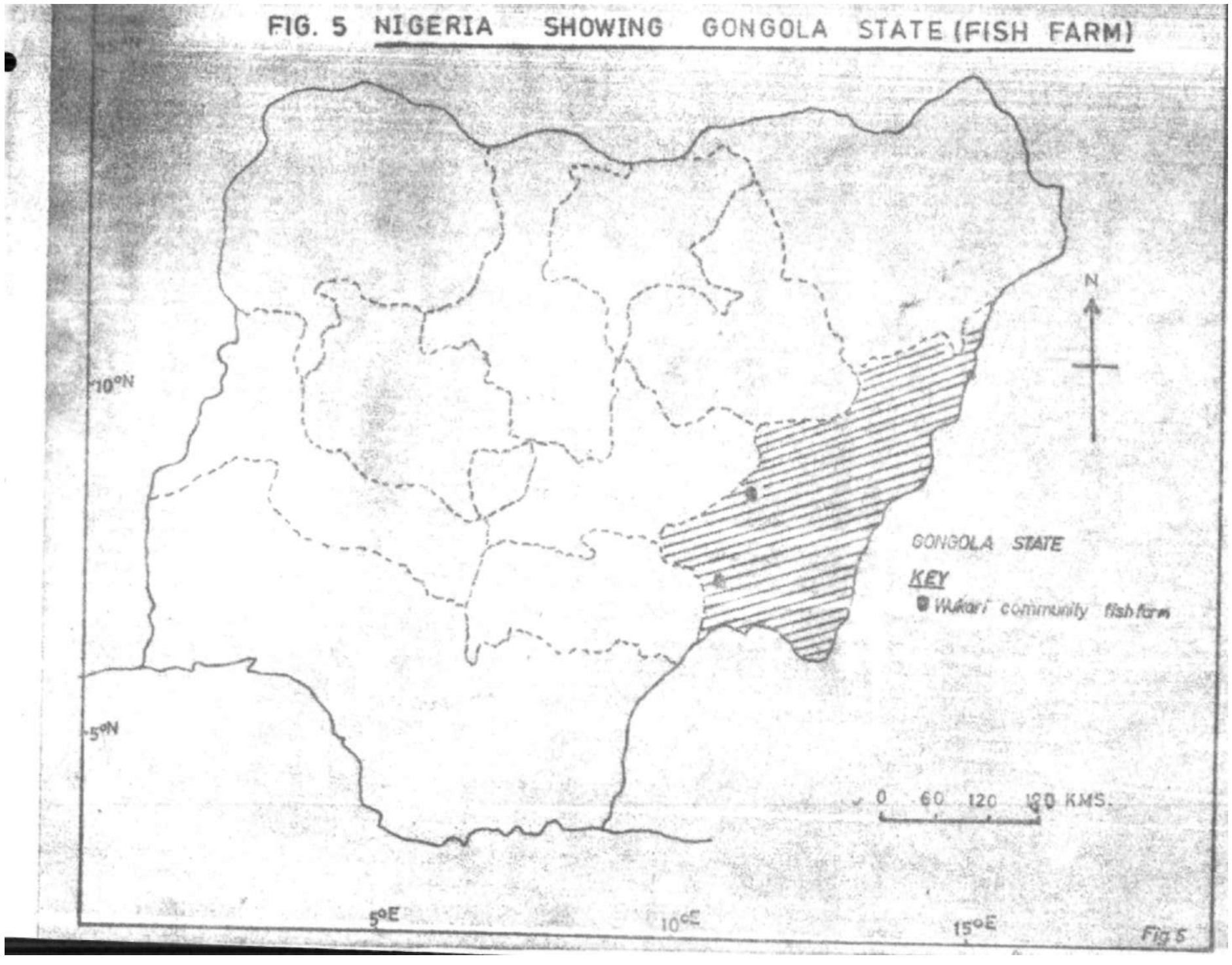
4.4. GONGOLA STATE.

Much progress has not been recorded in this field in Gongola State. The State government appears to be concentrating more on capture fisheries but it is hoped that with the successful take off of its first step in fish culture (Wukari Community Fish Farm) government and the private sector will be sufficiently attracted to invest in this field. Figure 5 shows Gongola State and the location of the fish farm.

4.4.1. Wukari Community Fish Farm.

As the name implies, the farm is located in Wukari and it was constructed in 1981. The farm is supplied with water from a seasonal stream, that is, water is not available throughout the year. The farm therefore is a seasonal one and it will be producing common carp and tilapia. The farm has a total area of four hectares and there are 4 ponds of about a hectare each.

FIG. 5 NIGERIA SHOWING GONGOLA STATE (FISH FARM)



Polyculture is planned for all the ponds and fry will be ontained frominduced breeding and from Panyam Fish Farm. It is envisaged that fertilizers will be used if the need arises and there is the need for skilled manpower.

4.5. KADUNA STATE.

The second fish farm to be constructed in the former Northern Nigeria is located in Kaduna State and that was in 1954. Since then, only two more farms have been added (making a total of three) and even then finishing touches are still being added to the last one. The three farms are the Maska fish farm, Maigana fish farm and the Mando fish farm. Figure 6 below shows the position of Kaduna State and the location of the three farms.

4.5.1. Maska Fish Farm.

The farm is located in Maska about seven kilometree to Funtua. It was established in 1954 and in gets its water supply from a nearby stream and the rain. Water is however not constant throughout the year but this is supposed to have been rectified by blocking the spilling during the rainy season to store as much water as possible for the dry parts of the year.

The farm is about 70 hectares in total area and is made up of 48 ponds that range in size from .10 hectares to 2 hectares. Tilapia spp, C. carpio, L. niloticus and C. lazera are among the species cultured. The fry for this farm are obtained from induced and wild breeding. Polyculture is practised in all the ponds and the natural

FIG. 6 NIGERIA: SHOWING KADUNA STATE (FISH FARMS)

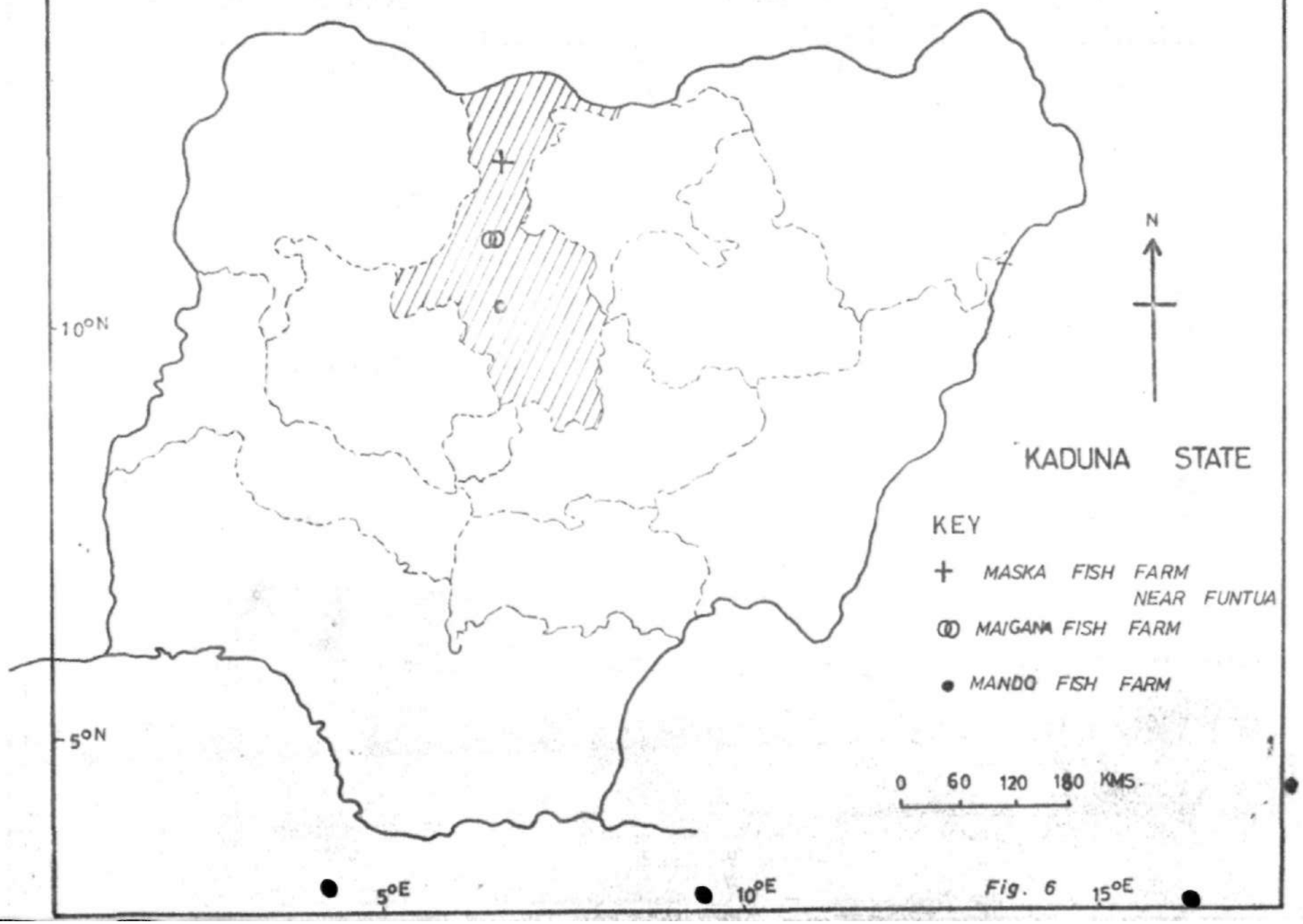


Fig. 6



PLATE 1: A section of the spillway at Maska Fish Farm.



PLATE 2: The reservior area of the spillway at the Maska Fish Farm.



PLATE 3: The Hatchery at the Maska Fish Farm.



PLATE 4: The reservior at Maska Fish Farm.



PLATE 5: A view of some of the production ponds in Maska Fish Farm.

4.5.2. Maigana Fish Farm.

Maigana Fish Farm is located on the outskirts of Zaria and it was established in 1970. Its source of water is a damned seasonal stream and this limits the operation of the farm to only 6 - 8 months in a year. The farm is about 8 hectares and has 10 ponds that range between 0.2 - 1 hectare in size. L. niloticus, T. zilli, T. galilea and C. carpio are among the cultivars on this farm.

Fry are obtained from induced and wild breeding and both mono and polyspecific methods of culture are employed with a supplementaty feed of cotton seed cake, maize and guinea corn. Fertilizers are used and cropping is of course done once in a year. No disease has been encountered and the farm co-operates with the Ahmadu Bello University and the Federal Department of Fisheries. The farm requires qualified personnel to man the different aspects of fish culture on the farm.

4.5.3. Mando Fish Farm.

The Mando Fish Farm is located off Mando Road; a short distance behind the Ahmadu Bello University College of Agriculture and Animal Sciences in Kaduna. Construction work started in June 1981 and the farm is expected to go into production in mid 1982. The farm gets a copious and constant supply of water from a stream dammed by the College of Agriculture and Animal Sciences. When in operation the farm will produce only fish. It

has an area of 11.7 hectares and as at now there are 10 existing ponds (there are plans for more ponds) that are between 5 and 1 hectare in size. There will be mono and polyspecific methods of culture and the natural feeds in the ponds will be supplemented with any available artificial feeds. Both inorganic and organic fertilizers will be used and the rate of cropping will depend on the growth rate of the cultivars. The farm co-operates with the Ahmad Bello University and it anticipates the lack of qualified personnel to man the farm. It is owned and funded by the Federal Department of Fisheries.

Plate 6 shows the ABU reservior from which the Mando Fish Farm receives its water supply. Plates 7 and 8 are views of the farms production ponds.



PLATE 6: A view of the reservior which supplies water to the Mando Fish Farm.



PLATE 7: One of the production ponds in the Mando Fish Farm.



PLATE 8: Production ponds in Mando Fish Farm.

4.6. KANO STATE.

There are two fish farms in Kano State and those are the Bagauda and Tiga Fish Farms. Construction work is still going on in the Tiga Fish Farm and when completed it will be the second largest in the area under review. The Panyam fish farm in Plateau will still be the largest. Figure 7 shows Kano State and the location of the fish farms.

4.6.1. Bagauda Fish Farm.

The farm is located in Bagauda which is some kilometres to Kano on the Zaria - Kano road. The farm was established in 1969 and it gets a constant supply of water from the Bagauda Dam. The farm has 21 ponds and the largest is about 1 hectare while the smallest is 0.5 hectare.

C. carpio, Tilapia spp, H. niloticus, C. lazera, L. niloticus and Bagrus bayad are among the species grown on this farm. Fry are produced from induced and wild breeding. Mono and polyculture practices are used and the supplementary feed include groundnut cake, poultry feed, maize, blood meal and deteriorated groundnuts. Production is boosted with organic and inorganic fertilizers and cropping is done yearly. The farm has not recorded any epidemic but there is an acute shortage of qualified personnel. Plate 9 is a representation of some nursery ponds in the farm. Plate 10 shows the hatchery ponds from which the farms fish fingerlings are derived, and plate 11 is a picture of some the production ponds.

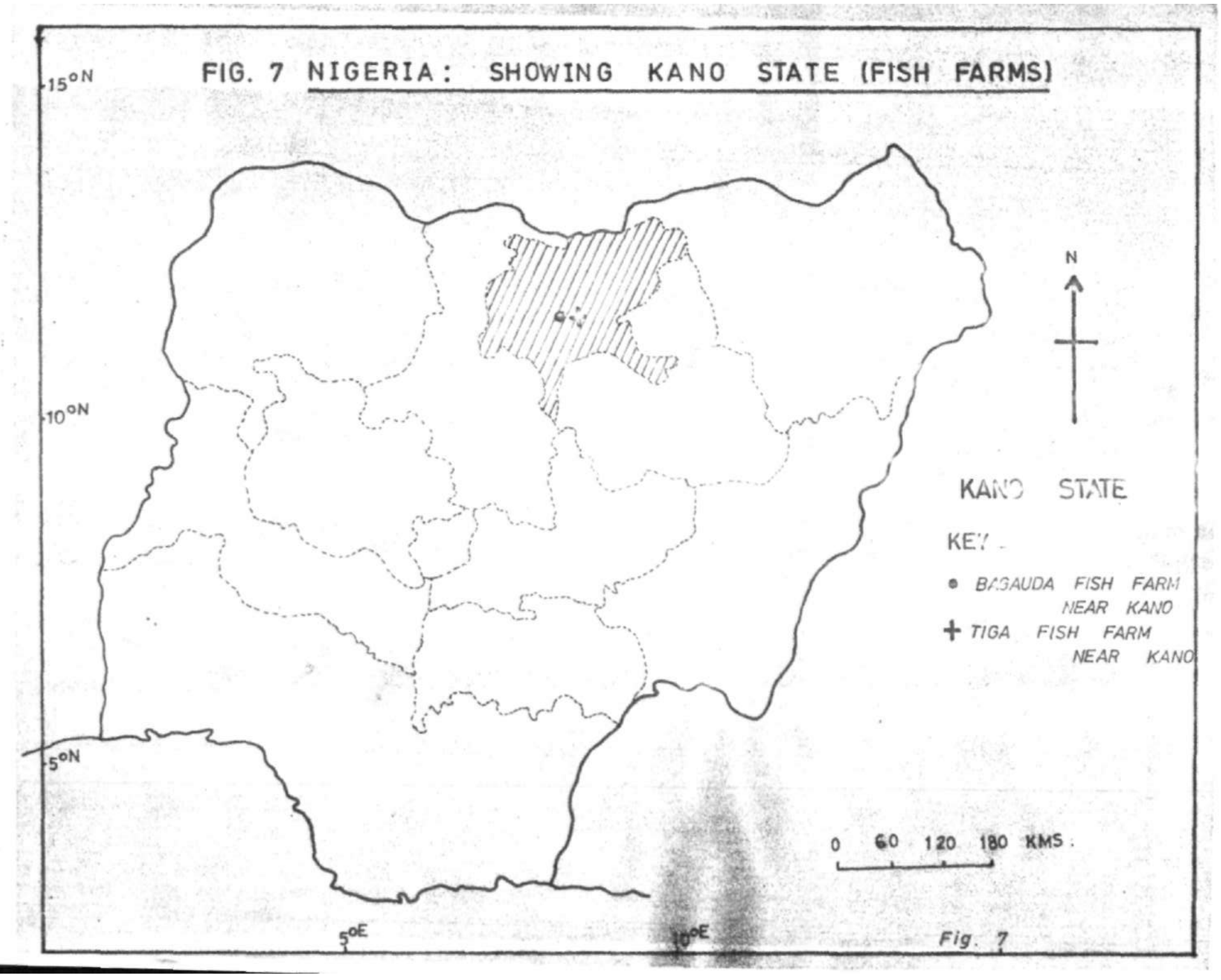

FIG. 7 NIGERIA: SHOWING KANO STATE (FISH FARMS)
15°N
10°N
5°N
5°E
10°E
N
KANO STATE
KEY :
BAGAUDA FISH FARM NEAR KANO
TIGA FISH FARM NEAR KANO
0 60 120 180 KMS.
Fig. 7



PLATE 9: Nursery ponds in Bagauda Fish Farm.



PLATE 10: Hatcheries in Bagauda Fish Farm.



PLATE 11: Some production ponds in Bagnuda Fish Farm.

4.6.2. Tiga Fish Farm.

The Tiga Fish Farm is in Tiga near Kano and it was established in 1979. The farm receives a constant supply of water from the Tiga Dam and only fish is produced here. When completed the farm will occupy a total area of about 150 hectares but as at now less than a third of that area has been developed. There are presently 12 ponds that are between .25 and 3 hectares in size but 30 more ponds are planned for the farm.

L. niloticus, T. niloticus, H. niloticus, C. carpio and C. lazera are among the cultivars grown on this farm. Fry are obtained from induced and wild breeding. The polyspecific culture that is practised in all the ponds is boosted with a lot of supplementary feed made up of fish meal, blood meal, groundnut cake, maize and left over food. Urea NPK and super phosphates are the fertilizers used and cropping is carried out as often as desired. There has not been any epidemic and the farm has no man-power problems. It is operated by the Federal Department of Fisheries. Plate 12 shows some personnel of the farm stocking a pond. Plates 13 and 14 shows a view of some of the production ponds and the mending of a damaged monk respectively.



PLATE 12: Stocking common carp Cyprinus carpio in the Tiga Fish Farm.



PLATE 13: A view of some of the production ponds in the Tiga Fish Farm.



PLATE 14: Mending a damaged monk in Tiga Fish Farm.

4.7. KWARA STATE.

Kwara State has three Fish Farms and they are the Ajase-Ipo High School Farm, Alhaji Rami Fish Farm and Omobolu Fish Farm. There are of course the demonstration fish ponds at the Kainji Lake Fresh water Fisheries School, and also a rather small undocumented one belonging to the Ministry of Agriculture at Ilorin. It would appear that the Kwara State Government by virtue of the location of the state, tends to concentrate more on capture fisheries. Figure 8 shows Kwara State and the sites of the fish farms.

4.7.1. Ajase-Ipo High School Fish Farm.

The pond was constructed in 1978 and it receives a constant source of water from a nearby river. At present it has just one pond of about 2 hectares.

Clarias spp, Heterobranchus spp, Channa Obscura are among the cultivars grown on this farm. The initial fry for stocking was obtained from the Ministry of Agriculture and Natural Resources in Ilorin. The poly specific culture practised here is boosted with supplementary feeding and fertilizers. The fertilizers are made up of poultry droppings, cowdung, piggery waste and super phosphates. No disease has been recorded and the farm is in close co-operation with the State Fisheries Division and the Ministry of Agriculture Ibadan. The farm is owned and operated by the staff and students of the school and so there is no manpower needed. The fish farms major problem is the excavation and construction of ponds which they have found

FIG. 8 NIGERIA: SHOWING KWARA STATE (FISH FARMS)

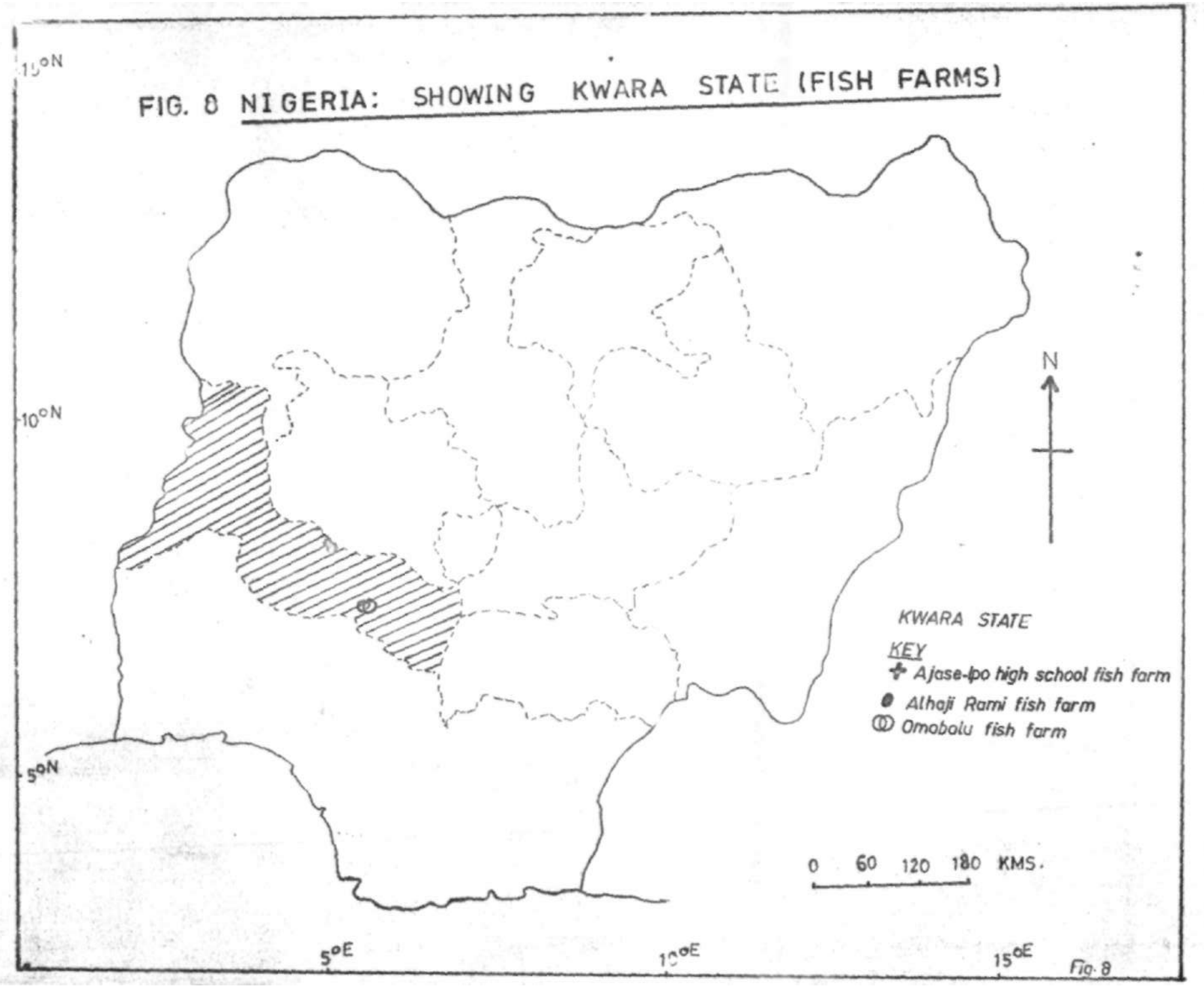


Fig. 8

very difficult and expensive.

4.7.2. Alhaji Rami Fish Farm.

The farm is located in Pategi and it was founded in 1979. The fish farm receives water through out the year from River Yauri. The total area of the farm is 5 hectares and there are 10 ponds that are 0.5 hectares each.

Cyprinus carpio, H. niloticus, T. nilotica and C. lazera are grown on this farm. Wild breeding and fry harvest from the wild supply the fingerlings for stocking; the farm receives assistance from the Ode-Irele Fish Farm in Ondo State and the Oyo Fish Farm. Polyculture is practised in some ponds only with an application of supplementary feed and fertilizers. The feed include growers mash, minerals and blood meal while the fertilizer is urea. There is a shortage of trained manpower and the high cost of feed and excavation is still to be rectified.

4.7.3. Omobolu Fish Farm.

The farm is in Iyah-egbede near Kabba and it was established in 1981. It receives water from a nearby seasonal river but when the river dries up, water is supplied from a deep well. The farm is 3 hectares and there are 4 ponds of about 7.5 hectares each.

T. nilotica, H. niloticus, C. lazera and C. carpio are amongst the cultivars here. The fingerlings were obtained from the Oyo State Ministry of Agricultute and Natural Resources, though a few were harvested from the

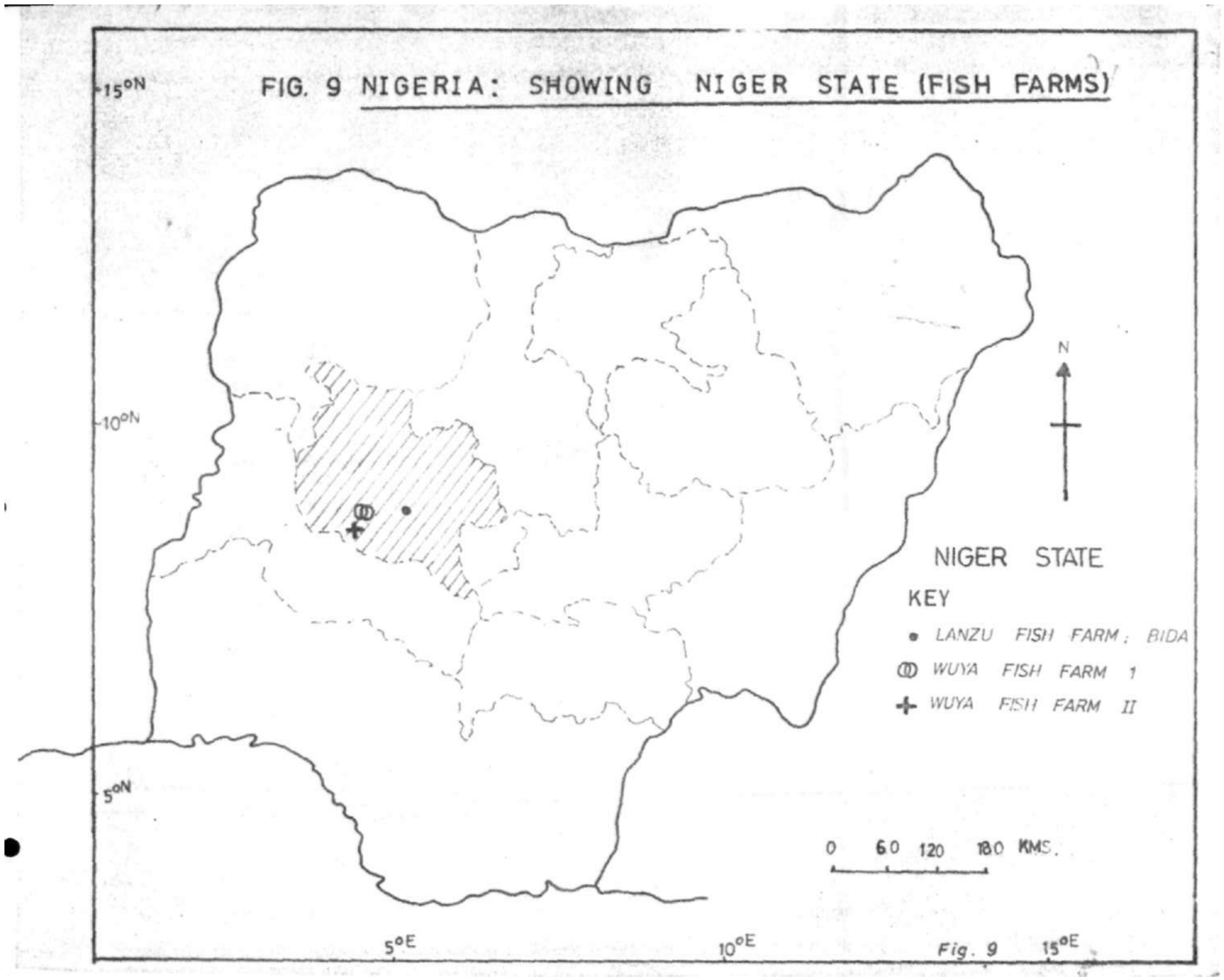
wild. The polyculture in vogue here is supported with an artificial feed of blood meal, growers mash, pellets of wheat bran and vitamins. Super phosphate is used to induce natural growth in the ponds. The farm co-operates with the Kwara State Ministry of Agriculture but there are still no qualified staff to man the farm. There is also the problem of funds for expansion work.

4.8. NIGER STATE.

Niger State has in the past ten years recorded substantial progress in the development of its fisheries especially in the fish culture sector. As at now, there are 3 fish farms in the State and plans are at an advanced state for the construction of two more farms to be located one each in Agaie and Edozigi. The present level of development sharply contrasts with the existence of not even one farm as at 1970. The three farms in the State ate Wuya Fish Farm I, Wuya Fish Farm II, and the Lanzu Fish Farm. Figure 9 shows the position of Niger State and the fish farms.

4.8.1. Wuya Fish Farm I.

For the purposes of this research work and because there are essentially two fish farms in Wuya, the first farm in the state is refered to here as Wuya Fish Farm I. It is located in Wuya on the Bida - Mokwa Road and it was established in 1971. Its source of water is a steam that is constant throughout the year. Fish alone is cultured in all the 5 ponds that are between .5 - 1


FIG. 9 NIGERIA: SHOWING NIGER STATE (FISH FARMS)
15°N
10°N
5°N
5°E
10°E
15°E
N
NIGER STATE
KEY
LANZU FISH FARM; BIDA
WUYA FISH FARM 1
WUYA FISH FARM II
0 60 120 180 KMS.
Fig. 9

The farm is made up of 2 ponds that are about 2 hectares each. All the fish which include Tilapia spp, G. niloticus C. lazera are dumped together to form a polyspecific system. Cattle manure is used as fertilizer and the natural feed is supplemented with rice/corn bran and deteriorated groundnut. No epidemic has been recorded.

Furthermore, about 3 kilometres after the Wuya Fish Farm II on the Bida - Mokwa road, there is an expense of about 50 hectares that has been certified adequate for fish culture but as at now, no agency or individual is interested in putting the place into use.

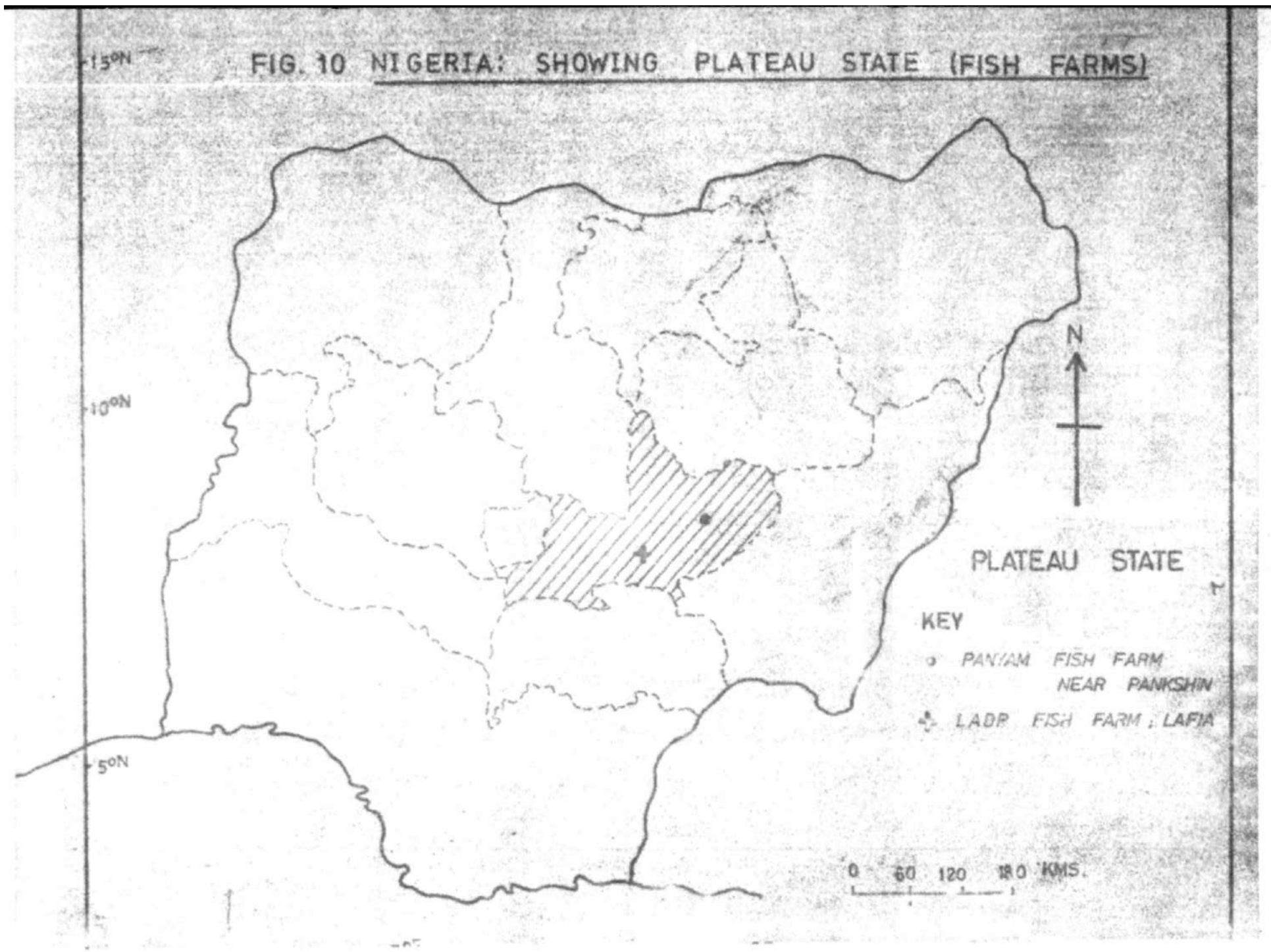
4.9. PLATEAU STATE.

The oldest fish farm is located in Plateau State. The Panyam Fish Farm and the Lafia Agricultural Development Project Fish Farm are the only two fish farms in the state. For some technical reasons, data was not available on the later and so it is not documented here. There are however some fish ponds in Sabongida, Loko, Tung and Maisha. Plans are being finalized for their upgradement and they are now in various developmental stages. Figure 10 shows the location of Plateau State and the site of the Panyam Fish Farm.

4.9.1. Panyam Fish Farm.

As can be deduced from the name, the farm is located in Panyam which is a few kilometres to Pankshin on the

FIG. 10 NIGERIA: SHOWING PLATEAU STATE (FISH FARMS)



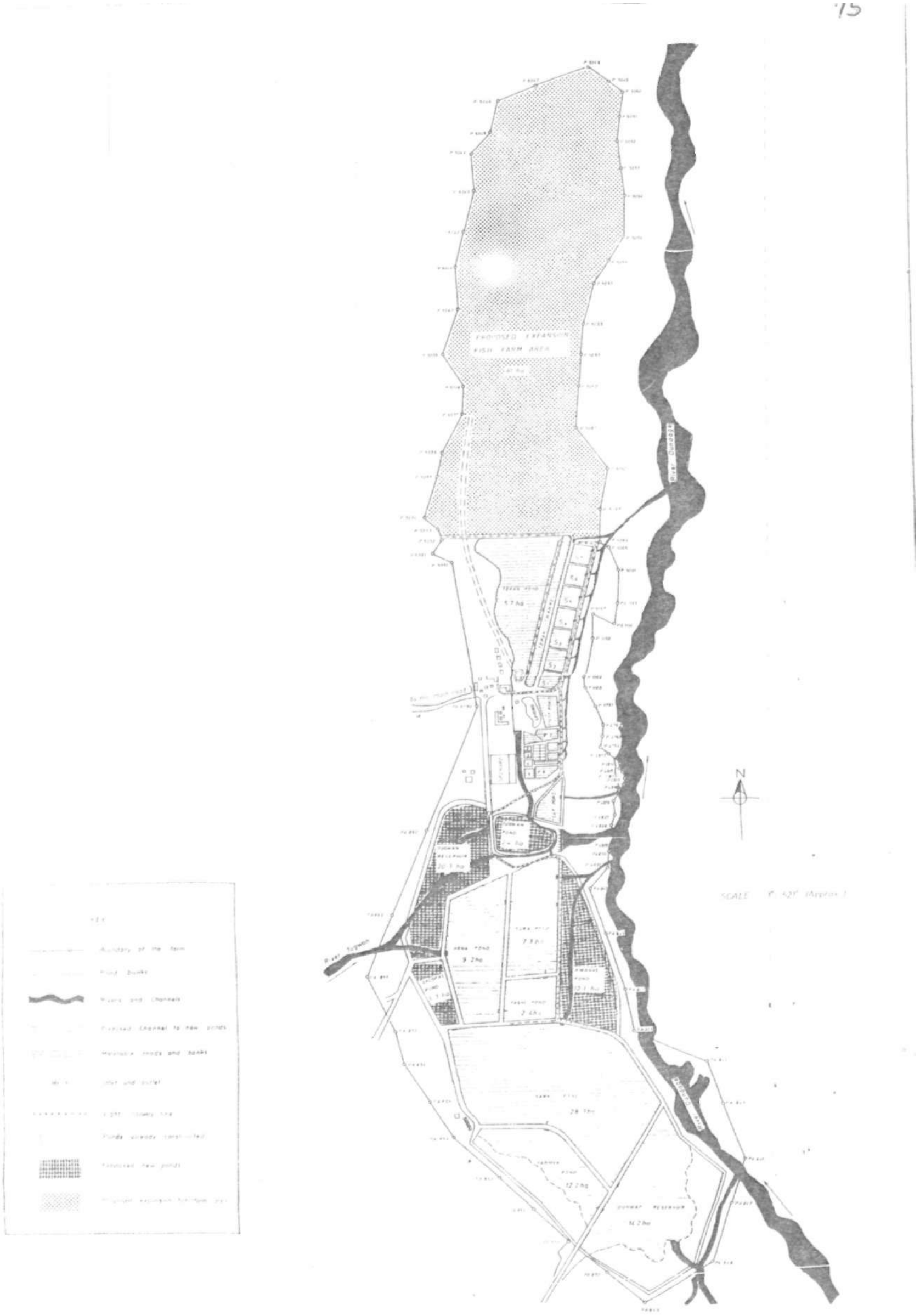


Fig 1 PANYAM FISH FARM SHOWING CONSTRUCTED AND PROPOSED PONDS

the P.F.F.). There is an experimental rice/fish culture but it is still in its infancy. Construction work started in 1951 and the farm went into operation in 1952 thus making it the oldest fish farm in the country. Water is supplied from a seasonal river and a ground spring but the seasonal scarcity of water has been checked by the construction of three reservior ponds that are 10, 15 and 20 hectares.

The farm has a total area of 200 hectares out of which 120 hecatares have been converted to 21 nursery/ experimental ponds, 7 storage ponds, 9 production ponds and three reservior/production ponds, that is a total of 40 ponds that are between 0.1 - 30 hectares in size. C. carpio, C. lazera, Sarotherodon niloticus, Sarotherodon galileus, T. Zilli and Ophiocephalus obscura are some of the cultivars found in this farm. The initial stock for the farm was imported but since then, induced and wild breeding methods have been adequately supplying the fry but Clarias sp fry are still obtained from the wild. Polyculture takes place in all the ponds and the supplementary feed include groundnut cake, maize, spoilt groundnuts, blood and fish meal, brewers waste and cotton-seed cake. Both organic and inorganic fertilizers are used, the former constituting mainly of chicken and cattle manure. Each pond is totally cropped once a year though some of the fish are returned. There was a low level attack of Clinostomium sp on T. zilli. There is no manpower

problem here as many of the staff are already in different institution for training. The farm is in close co-operation with the University of Jos. Plate 15 is a picture of the Long Channel used for sports fishing while plate 16 is the hatchery complex. A section of the ponds is shown in plate 17.



PLATE 15: The Long Channel at Panyam Fish Farm. Sport fishing is allowed only in this pond.



PLATE 16: The Hatchery complex in Panyam Fish Farm.



PLATE 17: Some production ponds in Panyam Fish Farm. In the fore ground is a fish cage.

3.10. SOKOTO STATE.

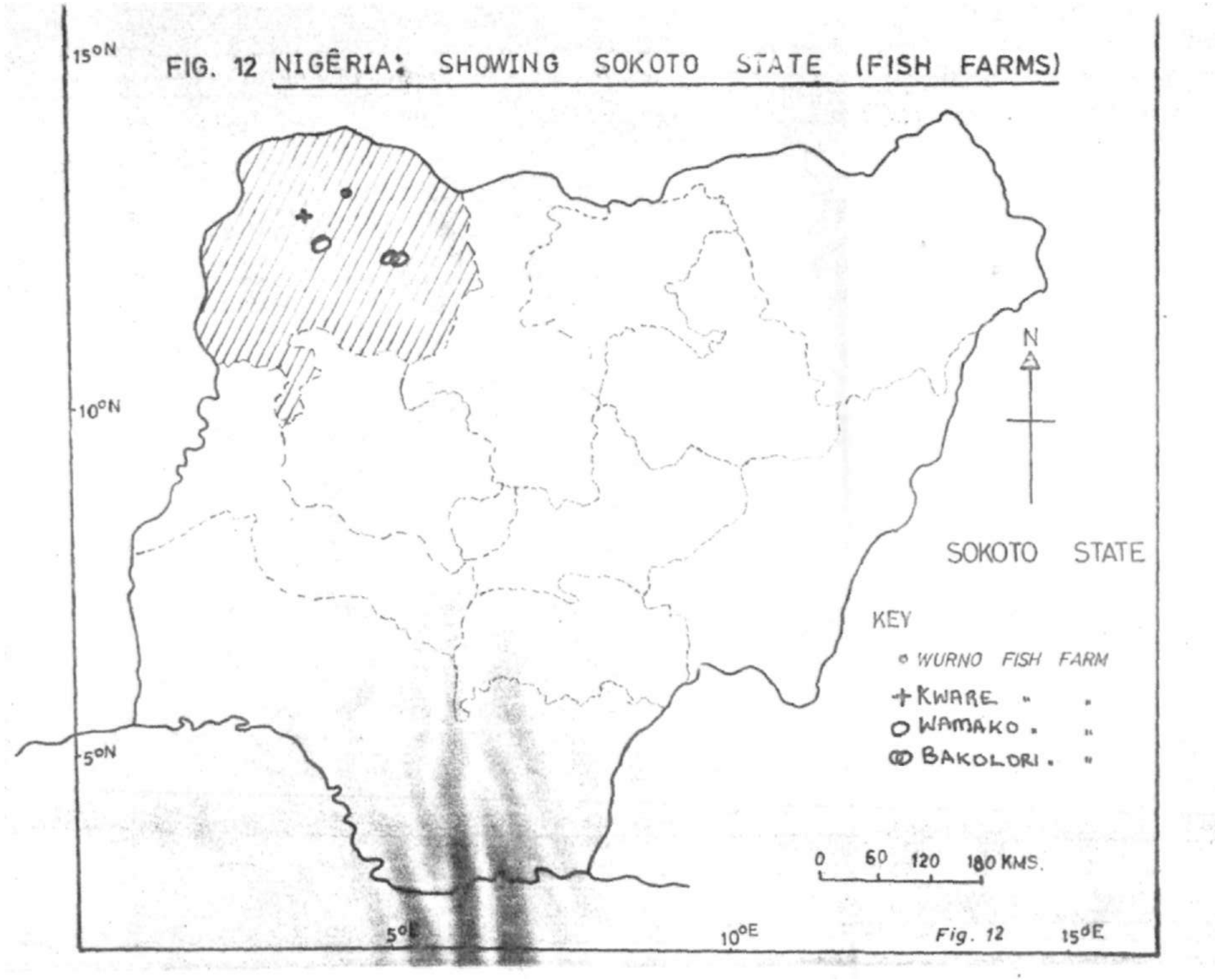
Sokoto State has also recorded significant progress in its fisheries sector in the last ten years. Gradually, the state governments attention is being focused not only on the ceremonial capture fisheries but also on culture fisheries. There are as at now, four fish farms in the State. These are the Wurno fish farm, Wamako fish farm, Kware fish farm and the Bakolori fish farm. Figure 12 shows the position of Sokoto State in respect of other States and the sites of the four fish farms.

3.10.1. Wurno fish farm.

The farm is in Wurno, some kilometres north of Sokoto. The farm which was established in 1979 gets a constant supply of water from the Lugu Dam. The farm has a total area of 3 hectares that are divided into 4 ponds which are between .75 - 1 hectares in size. L. niloticus, T. niloticus, T. galilea, C. lazera, L. senegalensis, H. niloticus and S. membranaceus are cultured here. Fry were obtained from other fish ponds and from wild breeding in the ponds. Polyculture is practised in all the ponds and this is boosted with a supplementary feed of groundnut cake, maize and cotton seed cake. Cow dung and goat droppings are the fertilizers used here.

4.10.2. Wamako fish farm

The Wammako fish farm which established in 1972 gets a constant supply of water throughout the year from streams and springs. Fish alone is produced here. The


FIG. 12 NIGÊRIA: SHOWING SOKOTO STATE (FISH FARMS)
15°N
10°N
5°N
5°E
10°E
15°E
N
SOKOTO STATE
KEY
WURNO FISH FARM
KWARE " "
WAMAKO " "
BAKOLORI " "
0 60 120 180 KMS.
Fig. 12

farm has an area of 8 hectares; there are 9 ponds the largest of which is 2 hectares while the smallest is .5 hectares. T. nilotica, T. galilea, C. lazera, L. senegalensis, L. coubie and S. membranceus are the cultivars found on this farm. The fish fry were obtained from Bagauda, and Wurno Fish Farms and from wild breeding. Polyspecific culture is practised in all the ponds and the artificial feed used include groundnut cake, maize and cottonseed cake. No fertilizers are used and cropping is done twice a year. No disease outbreak has been recorded but the farm urgently requires the services of an aquaculturist and some fisheries assistants. The farm receives some assistance from the Federal Department of Fisheries.

4.10.3. Kware Fish Farm.

The farm is sited in Kware and it produces only fish. It gets its water supply from a bore hole that dries up at certain times of the year but the water board is working to correct the situation. The farm is 10 hectares in size and has seven ponds that are between 1.5 and .5 hectares.

The species under cultivation include T. niloticus, C. carpio, C. lazera and L. niloticus. Fry are obtained from Wamako and Bagauda Fish Farms and from wild breeding in the ponds. Mono and polyspecific culture methods are employed and supplementary feed used are maize, cottonseed cake and deteriorated groundnuts. Fertilizers are used and cropping is done twice a year. No disease has been

recorded and the farm requires aquaculturists and fisheries assistants.

4.10.4. Bakolori Fish Farm.

The farm is located in Bakolori near Talata Mafara which is about 90 kilometres south of Sokoto. Construction work started in June 1981 and the farm will produce only fish. It gets a constant supply of water from the Bakolori Dam. The total area of the farm is 20.5 hectares and there are 44 ponds that measure between 2.3 and .5 hectares.

T. nilotica, C. lazera, C. carpio, H. niloticus and L. niloticus will be grown here and they will be obtained as fry from other fish farms and induced breeding. Polyculture will be practised in all the ponds and any available feed will be used. Fertilizers will be both organic and inorganic depending on availability and it will require the services of fisheries biologists and superintendents. Plate 18 shows the entrance to the Bakolori Fish Farm, while plates 19 and 20 shows construction work at various developmental stages. Plates 21 and 22 shows some of the machinery on the farm site.



PLATE 18: Entrance to the Bakolori Fish Farm.



PLATE 19: A pond under construction in Bakolori Fish Farm.



PLATE 20: Another pond under construction in the Bakolori Fish Farm.



PLATE 21: A compactor at work at the Bakolori Fish Farm.



PLATE 22: Heavy machinery employed in construction work at the Bakolori Fish Farm.

CHAPTER FIVE

5.1. DISCUSSION

The names and all the relevant information of all the fish farms in the area under review have been outlined in the preceeding Chapter. Some were flaws committed as a result of lack of basic equipment while others were as a result of limited knowledge of some aspects of fisheries; this is traceable directly to inadequate manpower. The fish produced in all the farms are utilized in a number of ways. A large percentage is used for food and they are consumed either fresh, dried, smoked or fired. A small percentage of the farms' production (fry and fingerlings in particular) is used for stocking fish farms and dams. The breeding stock for hatcheries are also partly from the farms. And lastly to some extent, the farms provide aquarium and laboratory specimen.

The peculiar problems of each state will be touched upon here but a more detailed discussion on fish culture practices in general will feature later in this chapter. There will also be a general discussion/recommendation on the overall improvement of fish culture in the country. A few tips on how some aspects of fish culture have been successfully carried out elsewhere in the world will be added as and when appropriate.

5.1.1. Bauchi State.

As shown in Chapter Four, there is no fish farm in Bauchi State except for the proposed Gubi farm. This total

absence may be due to the fact that there is another source of cheap animal protein. This may come from cattle, goats, chicken or fish (imported frozen fish and capture fish). The former seems more likely. There is no available data to show the quantity of animal protein available in the state. However, there are about 10.7 million cattle in the country and 70% of this figure is estimated to be in the ten northern states. Even then, others sources of animal protein like chicken (both imported and locally produced ones) goats, sheep, turkeys, guinea fowls etc which are not adequately documented will not permit a scientific guess of what is the average animal protein available per person per day in the state. However, it is envisaged that with the recommendations made in this work Bauchi state may be tempted enough to embark on fish culture.

5.1.2. Benue State.

The two fish farms in Benue State are still undergoing finishing touches prior to prodution and so there is not much to be discussed separately but the farms will benefit from the general discussion and recommendations later in this chapter. The apparently late exploration of this field here may be attributed to a number of factors. Benue State is transversed by the River Benue and this has caused a part of the population to take to the fishing profession, some doing it part time. Since old habits die hard and because of the capital outlay (land and money)

required for the establishment of a fish farm, the fishermen prefer the capture fisheries that sustained their ancestors.

Also being a part of the north, there are other sources of animal protein that can be depended upon. However it is hoped that with proper management of the water and ponds, the farms will in no time prove to be a useful and heart warming venture. However, the two farms have a combined area of area 10 hectares at present. When construction work is completed, and with good management, the farms should be able to produce at least two tonnes per hectare per year. This means that when functional, a production capability less than 20 tonnes per year will be below expectation if computed by the average yield of 2 tonnes/hectare/year in the tropics.

5.1.3. Borno State.

Despite the tremendous progress that has been recorded here, there are still a few flaws that are yet to be corrected. Adequate statistics should be kept on the production per pond per year. There should also be a record of stocking, feeding and application of fertilizers. In some of the farms, fertilizers are still not used at all; this is a very bad habit that should be discontinued. Both organic and inorganic fertilizers are known to cause increase in production.

But then, Borno State deserves a special part on the back for its inroad in fish culture practices. With

13% of the 524,123 tonnes of fish landed in Nigeria by the coastal and inland states coming from Lake Chad, (Sagua, 1982) and with over 2.1 million cattle 341,000 sheep and 510,000 goats amongs other things, Bornor State can hardly be said to be in serious need of animal protein. There could therefore have been alternative sources of animal protein should the state decide against fish culture. Generally there are about 6 hectares of land currently being used for fish culture in the state, a conservative estimate of twelve tonnes per year is expected from the farms. If it fails below this level, then the management - most importantly the stocking rate, feeding and fertilizations - of the ponds should be improved.

5.1.4. Gongola State.

Gongola is just its first step in fish farming. The farm already started on the wrong food. It was sited in a place where water is not available throughout the year. It would appear that the fisheries policy makers in the state were aware of this deficiency and yet went ahead with the construction of the farm on this site. For a fish farm to begin production as a seasonal one is the heigh of ignorance of the basic requirements of site selection. As much as possible, such technical issues should not be influenced by political inclinations but rather the decision should squarely be on the recommendations of experts. To make the farm productive, water must by all means be available to the farm. The cheapest of and yet costly option among all the

alternatives is that to sink a bore hole for the farm. But if the cost of the bore hole is much, and taking cognizance of the fact that the farm is still under construction, the farm should be closed down. The Government should search for a more suitable site (see Chapter2). However if the present size of the farm is to be reckoned with, and the water deficiency rectified the farm is expected to take off with an initial production of about 12 tonnes per annum.

5.1.5. Kaduna State.

There are three fish farms in the State. Construction work and finishing touches are still being added to the third one at Mando, Kaduna. The other two fish farms; Maska and Maigana have problems. Maigana Fish Farm is totally dry about 4 - 6 months in a year. That is, for about half the year, no growing of fish takes place and all the staff are on semi-holidays and yet receiving full pay. By virtue of the duration of operation, it will be almost impossible to harvest any fish of more than one kilogram from this farm. The government has two alternatives; either to dig a bore hole or to close down the farm since it is not likely to make any profit (or break even) in this present state.

Maska fish farm is much bigger and has taken more financial investments. Its problem stems from water shortage and management. The main reservior should be desilted so as to store more water and despite the cost,

a deep bore hole equiped with an electric pump and hose should be provided for the farm. Experienced and dedicated officers will also help revive the farm from its present slumber. If this calibre of staff is not available from Kaduna State, the government should consider finding some outside its boarders of seeking the help of the FAO through the Federal Government.

It was also noticed that it took about 16 years for Maigana Farm to be established after the construction of the fish farm in Maska. The reason for this long lapse was because the government was concentrating on capture fisheries in the many rivers in the state. And after the initial disappointment from Maska, the government took its time to fully evaluated the benefits derivable from such ventures. The later view is of more importance because since the construction of Maigana Fish Farm in 1970, (the farm brought its own disappointments too) the government has fully folded its arms as far as culture fisheries is concerned. The farms do not even have any data on its production per hectare per year. Despite all the discrepancies, about 47 hectares of land are used for fish culture in the state. And going by the tropical estimate of at least 2 tonnes per hectare per year, approximately 100 tonnes of culture fish should be produced in Kaduna State annually. This is of course assuming that there are good management techniques and qualified personnel.

5.1.6. Kano State.

Bagauda Fish Farm was established in 1969 and ten years after that, Tiga came into being. Both farms are blessed with good management. Because of the adequate feasibility studies carried out before their construction, good clear water is always available for all management operations.

However, with the success of the two farms, it is hoped that the government should consider the possibility of setting up some more fish farms. No doubt the presence of these farms is being felt in the area. The fish ponds in both Tiga and Bagauda fish farms (about 20 hectares) are being well managed. Like all other farms, there are no figures to confirm the level of production. When the Tiga Fish Farm is fully developed, and with the present management, both farms will be producing up to 150 tonnes of fish per annum.

5.1.7. Kwara State.

There does not appear to be a serious effort by the Kwara State government to develop fish culture in the State. This is not surprising too because of the geographical location of the State. The River Niger passes almost through the State and with the damming of the river to form the Kainji Lake, the resultant fish boom attracted a good part of the inhabitants to the fishing profession. Having benefitted that much from capture fisheries, the people most probably are finding

it difficult to understand the need for fish culture.

The Omobolu Fish Farm in Iyah-Gbede near Kabba is fed with water from a seasonal river and later from a well. The sinking of the well must have been expensive. It is more acceptable for a farm to operate for some years and then, due to sudden geographical or climatic changes, it starts facing water shortage; than for a farm to be short of water right from the on set. The later is a clear manifestation of bad planning. On the whole, the farms recorded in Kwara State have a combined area of 11 hectares. But for the fact that some of the farms are manned by unqualified personnel (even school children), Kwara State should be expected to produce at least 22 tones of culture fish annually.

5.1.8. Niger State.

Progress has been fairly rapid here. Also plans for future development are commendable. It only means that the policy makers are fully convinced of the value of such a venture. In order to sustain the development, the Niger State government should as a matter of urgency initiate training programmes for its fisheries staff. Shortage of manpower is acute in the senior category. The State has an option of carrying out a recruitment drive both locally and abroad or seeking the assistance of the United Nations through the Federal Government. Surely, one of these measures will certainly produce the desired result, and this will ensure the production

of at least fourty tonnes of culture fish per annum from the three farms whose area is estimated at 20 hectares at present.

5.1.9. Plateau State.

Panyam Fish Farm set the pace for fish culture in the country. In the past few years, the profitable post-independence status of the farm is being gradually revived especially with the assistance of the Federal Department of Fisheries and the FAO. The farm is very big and should the three newly constructed reservior ponds fail to provide water all the year round, money spent on the provision of a well will be well spent. The farm should also be commended for being the first (and only fish farm as at now) to attempt the mixed farming of rice and fish; the provision of recreational facilities is also laudable.

But it is surprising that despite the initial success of Panyam, efforts were not made to establish similar ventures in other parts of the State. There are several streams and springs that should have been put to use. After the establishment of the Panyam Fish Farm, about 30 years elapsed before the recent LADP farm. The Plateau State Government should therefore be able to initiate and encourage plans for the construction of new farms. However, with the recent increase in the number of ponds in the Panyam Fish Farm, the production level is expected to rise. This unfortunately has not been the case.

With about 120 hectares of ponds, Panyam Fish Farm alone should produce close on 240 tonnes of fish per annum.

5.1.10. Sokoto State.

The Sokoto State government is gradually beginning to put attention on culture fisheries instead of concentrating all resources on capture fisheries which to a large extent is ceremonial in the state. Kwaré Fish Farm is badly sited and this is manifested by the water shortage it experiences for some months in a year. Again, it should be emphasized that locating such technical ventures should be based strictly on professional advice and not on a political manifesto.

Serious and immediate efforts should be made to improve the fisheries staff position in the state. With one fisheries overseer shuttling between Kwaré, Wurno and Womako Fish Farms, the farms will most probably produce below expectation. The state government should embark on training programmes for the staff. There should alo be a recruitment drive for experienced officers both locally and abroad. These measures should go a long way in alleviating the present condition. And with the staffing condition improved, Sokoto State will produce close on 100 tonnes of culture fish annually. The Bakolori Fish Farm is still being constructed and when completed it will alone produce about half of the projected figure for the State.

5.2. GENERAL DISCUSSION AND RECOMMENDATIONS.

A number of points need to be generally taken into consideration in the running of a fish farm. These points if properly taken note of will to a long way in enhancing the efficiency and consequently the production of the farm. This will also improve production to the more acceptable figure of at least two tonnes per hectares per year. Based on the total hectarage and improved management techniques, it is therefore projected that from end of the year 1983, the ten states in the north should be producing at least 1,000 tonnes of culture fish per annum. The breakdown of the projected production state by state is as follows:

TABLE 4: Estimated production by fish culture.

STATE	TONNES OF FISH/YEAR
Bauchi	40 Tonnes
Benue	20 "
Borno	12 "
Gongola	12 "
Kaduna	100 "
Kano	250 "
Kwara	22 "
Niger	40 "
Plateau	400 "
Sokoto	100 "
	996 Tonnes

It is then clear that compared with the Western and Eastern states, the ten Northern states can be said to be uninterested in fish culture at the present. The greater bulk of the country's production will come from the Southern parts of the country. In the course of the discussion, examples will be drawn from fish farms in the area under review while some literature concerning the management of fish farms in foreign countries will be cited. The discussion and recommendations will be made under some sub-heading which include feasibility studies, management of the fish pond, research and publicity, statistics and personnel.

5.2.1. Feasibility Studies.

Before embarking on any project, it is necessary to first find out the possibility of carrying out the project. It will be a disaster to go half way before discovering mistakes in costing, siting or even viability. So it is with fish culture, a few of the fish farms were found to be without water during some months of the year. (Maigana in Kaduna State, Omobolu in Kwara State, and Kware in Sokoto are examples) It is hereby recommended that before a fish farm project starts there should be a feasibility study. The study should reveal amongst other things, the availability of water all year round, the texture of the soil to ensure good water retention capability, the acceptance of the farms products by the populace and the availability of qualified personnel to do the job.

5.2.2. Management of the Fish Pond.

Since all the major activities in a fish farm take place inside the pond, utmost care should be taken to determine what materials or which fish go into any pond. Kware fish farm, Auno fish farm and Naska fish farm amongst others practices monoculture, the animal being reared usually fails to utilize all portions of the environment, for example, the culture of a demarsal species leaves most of the water column unoccupied (Stickney, 1979). Therefore for a higher yield from any particular pond, polyculture is hereby recommended. In a polycultural system, different species with different feeding habits are raised without one interfering with the development of the other. Such a system will contain more fish and consequently more yield because a pond of say three hectares when stocked with four such species becomes in effect a much larger pond. A body of water is a three - dimensional growing space and to treat it like a field by planting one kind of crop is likely to result in wasting a majority of that space (Bardach et al, 1972).

Several combinations of species to be stocked in a pond can be formulated as long as they have different feeding niches and do not prey upon one another to the detriment of the fish farmer. However, as will be seen later in this chapter, the preying of one species upon

another may not only be advantageous to the fish culturist, but will in actual fact be encouraged. In the Chinese carp culture, the grass carp C. idella; big head Aristhychtys nobilis, silver carp Hypophthalamichtys molitrix mud carp Cirrhinus molitorella the black carp Mylopharygodon piceus and the common carp C. carpio are all introduced into one system. But since all the species are not locally available picking at least one species from each of the group will form an ideal combination for polyculture.

TABLE 5: Groups of species suitable for polyculture.

Macrophyte feeder	Benthic Feeder/Omnivores
C. idella (grass carp)	Cyprinus carpio
Citharinus citharus	Heterobranchus sp
Distichodus rostratus	Synodontis sp
D. brevipenmis	Clasrias sp
etc.	etc.
Piscivores	**Zoo/Phytoplankton feeders**
Gymnarchus niloticus	Tilapia galilea
Lates niloticus	Tilapia nilotica
Hydrocynus sp	Hypophthalamichytys
etc.	molitrix

Piscivores are specially recommeded for culture with prolific breeders like Tilapia sp especially when the later tend to overpopulate the pond. This not only reduces the unwanted stunted fish population but also provides feed for the often more desirable piscivores. Fast breeding tilapias can be reared as trash fish either in mixed or polyspecific culture with highly priced carnivorous fish such as L. niloticus or G. niloticus or in monospecific cultures and then used in feeding the later (Awachie, 1975).

In a situation where the piscivores are unavailable and it is envisaged that the species about to be stocked will over populate the pond through breeding, sexing and consequently stocking the males and females in different ponds is advised. The total volume of water available in the pond should be taken into consideration so that while ensuring that minimum space is wasted, overcrowding is also avoided. Unwanted breeding can also be controlled by the used of floating cages. As long as the cage does not touch the substratum, the tendency to breed will be reduced.

It was also observed that the artificial feed dispensed in some of the farms is made up of mostly carbohydrare materials. This does not only deprive the fish of a balanced diet but it also contributes to its ill health. Too much starch in the feed causes fish constipation and fishes having this disorder are seen

trailing a chain of faces from the anus. Twenty to thirty percent protein in the feed is advisable. The method of dispensation of the feed needs modification too. Automatic feed dispenser which deliver a pre-set quantity of feed to the fish upon activation is suitable. In the absence of that, feed can be dumped manually into the pond but care should be taken to determine the appropriate quantity required. Too much feed not only depletes the purse of the farmer but also pollutes the water. It is better to feed several times a day but using small quantities of feed. Depending on the size of the pond, it is recommended that a number of spots where the feed should always be dumped should be chosen in the pond. With time, the fish will get used to going to particular spots for feeding.

The cropping technique employed in some farms will need to be modified too. Some officers harvest ponds as often as they want to or as often as there are people who want fish. Most fish will thrive better when not frequently disturbed by the draining of the pond, also in doing that, breeding cycles are disturbed. A fish that has its carefully prepared nest destroyed by a cropping operation is likely to withhold spawning for some time. Fry and alevins are more susceptible to death at this time since the cropping methods take no step to ensure their safety. Generally, most fishes that get injured but still escape the net die a few hours later. Their decay contribute in the depletion of oxygen - a situation which compells

most of the fish to come to the surface and gasp for air. Spraying water into the pond corrects this. The pH of the water should be checked occasionally to ensure that it does not get too alkaline or too acidic.

Some fish farms were observed not to be using fertilizers of any type. Two major groups of fertilizers are available for use in fish farms. They are the organic and inorganic fertilizers; both are equally productive and it is advisable to use both in the same pond. Fertilizers not only increase the nutrient level in the pond (and consequently increasing production) but some in addition control parasitic infections. Hickling (1968) notes that the application of fertilizers to fish ponds in Germany increased the fish crop by 80% and was profitable since the value of the extra weight of fish got was 8 - 10 times the cost of the fertilizer and the cost of spreading it. In fact the use of fertilizers in most cases doubles the production of most fish farms as can be seen from table below.

TABLE 6: Production in various culture systems

Type of Culture	Natural Production	With Fertilizers	With Supplementary feed and Fertilizers
Monoculture			
Kg/ha	550	1120	2240
Polyculture			
Kg/ha	670	1350	2690

(Dada, 1975).

A corrollary from the table is that the level of production in kilogrammes per hectare further emphasizes that superiority of the polyculture over monoculture. Though slaked lime is a good fertilizer, care should be taken when using it because an overdose is toxic to the fish.

A number of fish farms (almost all of them) are stocked with fry got from rivers and streams; this is not good practice. An ideal fish farm should be independent of wild fish but it is likely that the exotic species that have rejected all inducements to breed force fish farmers into this habit. The possibility of collecting infected fry, the unpredicable supply and the inability of the farmer to choose the parent stock are some of the disadvantages of the procuring fry from the wild.

Finally, it should be noted that the ability to breed and grow does not ensure the acceptability of the fish as a food item. Therefore, the fish culturist should remember that an important aspect of fish farm management is the stocking of the species that are acceptable to the people.

5.2.3. Statistics.

It was observed that a large number of the fish farms in the area under review do not keep records of the farms activities. Wurno, Wamako, Kware, Ali Gambori, Maska, Maigana, Bagauda Fish Farms amongst others could not produce any record of their production per pond per year. Some could not say for sure, the various species that

were planted in the various ponds. It is recommended that a file be opened for each pond. Details of stocking including the size of fry, weight, number, species and date of stocking should be entered in the file. Also all cropping operations together with the weight per species, date of cropping and revenue derived per species should be found in the file. All these are necessary because at a glance, the fisheries officer can say for sure which is the most productive pond or which species grew fastest or yielded more revenue. Agricultural planners will also require these details to be able to carry out their duty effectively. Such clean and easily presentable data will no doubt attract better funding for fish cultural activities.

5.2.4. Mixed Farming.

All the fish farms (except Panyam Fish Farm which is experimenting on mixed farming with the angiosperm, rice) deal with fish only in their farms. Also in most of the farms visited large expanse of uncultivated land belonging to the farms were found unutilized. With the rising cost of supplementary feed, it is necessary that cheaper ways of feed procurement should be devised. It is hereby recommended that all the fish farms should as a matter of urgency start growing their own guinea-corn, groundnuts, maize, cotton and rice for use in feed formulation. The excess after feed manufacture can yield revenue for the farm.

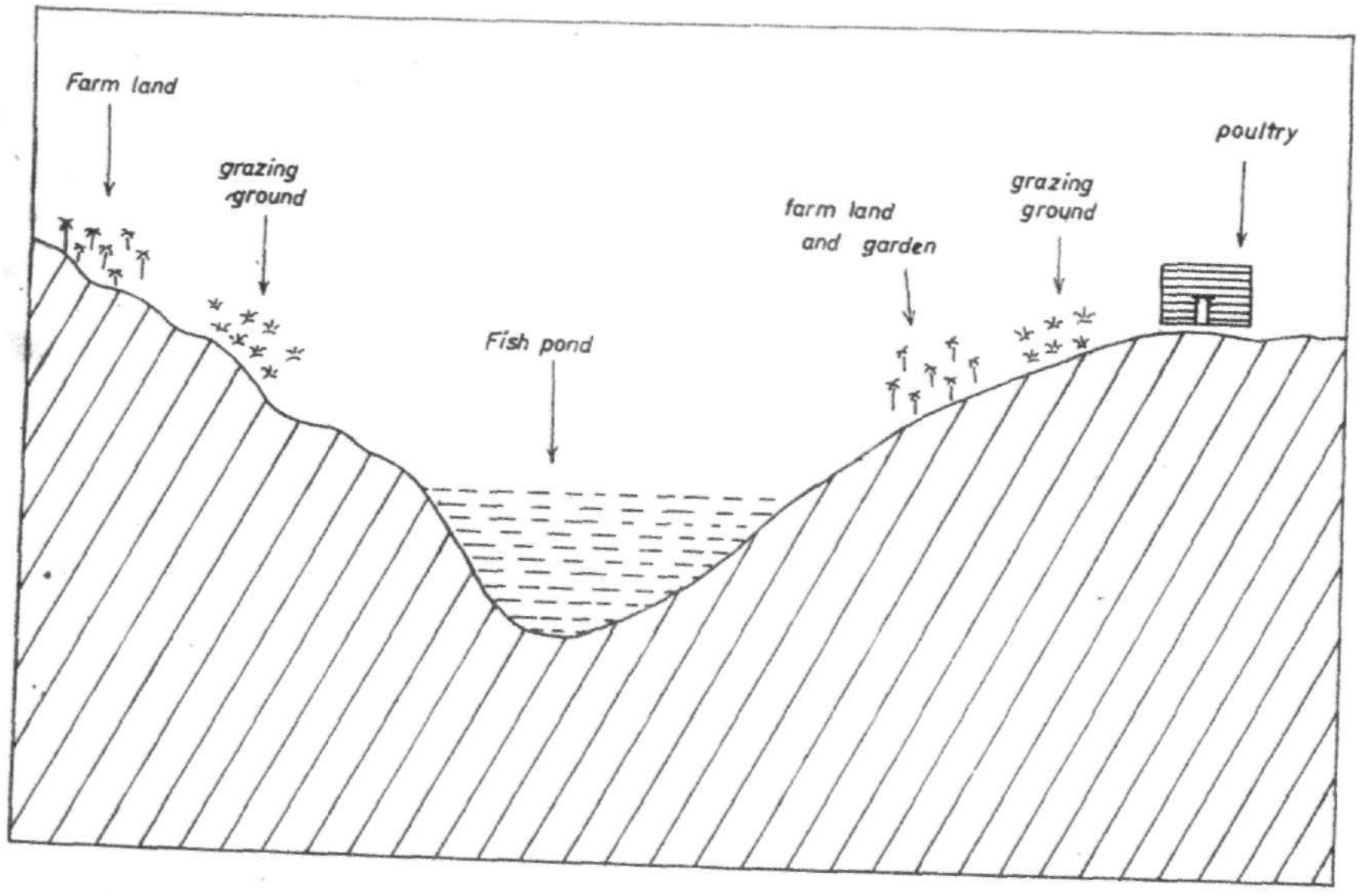
Another aspect of fish farming which was found to be totally absent is growing of fish and some other animals like pigs, cattle, ducks, and chickens. The advantages are many but the practice is recommended for two major reasons. First, the farmer will have a wider variety of products to market. A farm that has beef, chicken, pork and fish to offer is likely to attract more people than a farm that sells only fish. This no doubt will increase the earning of the farm. The second and perhaps the more important reason is the effective fertilizer derivable from the animals at no cost. The most interesting and thorough use of organic fertilizers in the Chines carp culture occurs in Singapore where fish grown for profit by the Chinese or as a subsistence crop by the Malays, are an integral part of an operation which also includes fish, vegetable, livestock as well as such cash crops as rubber and tobacco (Bardach et al, 1972). Such an arrangement can very easily be introduced into our fish culture practice and there are a number of ways in which the system can be organised. Cow and pig manure are by far the most frequent fertilizers used, indeed the pig sties may be built over the pond so that the dung and urine drop straight into the water (Hickling, 1971). Since most of the states hate pigs, it is recommended that poultry units in place of pig sties be built over the ponds so that the chicken manure goes directly into the pond.

Alternatively, the farm land, grazing ground and poultry pens can be located on a higher ground so that when it rains all the excess fertilizers on the farm land, cattle/ chicken droppings find their way into the pond. Bardach et al (1972) maintain that human inhabitants contribute their own fertilizers too. The farmer therefore ends up fertilizing his ponds without really going out to buy fertilizers. The cost of application of the fertilizer is minimal too. See figure 13 please.

Also conspiciously absent is the culture of any shrimp or crayfish. The fresh water shrimp and crayfish fetch good revenue and are at present being imported from neighbouring West African countries. Efforts should be made to resume the culture of the pink shrimps which was under culture experimentally until the civil war ground the project to a halt.

5.2.5. Personnel and manpower development.

Of all the fish farms surveyed, it was found that only Panyam and Tiga fish farms have the required manpower to carry out their work. In some states, the situation is so bad that one cannot reasonably expect any fish production at all. One fisheries overseer is in charge of all the activities in Wurno, Kware and Wamako Fish Farms. Under such a tight schedule none of the farms can be properly managed. It is therefore recommended as short term measure, to recruit capable staff from Asia, Europe and the U.S.A.



A MIXED FARM LAYOUT

modified from Bardach etal. (1972)

Fig 13.

The people so employed will not only man the farms but should also transfer their knowledge to the Nigerian staff working with them. An appeal can be made to the United Nations to send some of its FAO fisheries experts to help correct the situation. As long term measure, government should initiate the training of Nigerian staff at all levels. The training of the fisheries assistant is equally as important as that of the fisheries officer. The training should be in form of short course, seminars and work shops both locally and abroad where there are even better facilities. Motivation to work harder can be achieved through these and adequate reward for hard work.

Furthermore, the universities should examine ways of broadening their fisheries curriculum so that a fresh graduate will not have only an abstract theoretical orientation of the subject. Also in drawing up the syllabus, the universities should consult the fisheries sector so that the later can provide all they will expect of a new graduate for inclusion in the syllabus. This will save time and money in retraining the fisheries officers. As at now it takes between two and three years for a new officer to get a proper grasp of what goes on in the field. Recommended areas of emphasis include naming and identification of popular cultivars, their food and feeding habits, sexing, breeding techniques, functions of the major body organs, common diseases/parasites and their

control. Others are water quality control, processing, fisheries, economics, and mode of function/repair of some common harvesting gears. Also equally important is the provision of the necessary infrastructure for the correct management of a fish farm. These include oxygen tanks, vehicles and all the facilities that will be required for the propagation and stocking of fry. Smoking kilns, refrigerators and distribution vans are also recommended because if the harvested fish cannot be properly preserved and transported to the market centre in good condition, the whole exercise will be worthless.

5.2.6. Research and Publicity.

But for the Panyam Fish Farm that co-operates with the University of Jos and the Maska Fish Farm that co-operates with Ahmadu Bello University, no other fish farm has any connection with any university or research institute. The communication gap ensures that the result of fruitful research carried out in the Universities never get to the production centres (fish farms) for implementation. Closer co-operation with Universities, the distance not withstanding is advocated. Furthermore, efforts should be made to establish mini-labs in all the farms. This will not only stimulate the workers but will also ensure that the principles of fundamentals of any research information passed onto the fish farm will be well interpreted and implemented.

Research institutes and the relevant departments in the Universities should be given the financial encouragement to engage in as many research areas as possible. Research on breeding, growth, nutrition, preservation and marketing will go a long way in enchancing the status of fish culture. Hybridization of some tilapias has produced 100% or near 100% male populations. When the off springs of such a cross are stocked, the danger of over population is not only eliminated but the fish farmer is rewarded with bigger fish since most reporoductive capabilities are now channelled towards growth. Some highly priced species like G. niloticus and most mochokid and clarid fishes have as at now not been bred in captivity and this is an area waiting for serious research work. Deligent trials with variations in the percentages of protein, fat carbohydrate, vitamin and mineral levels in the feed is likely to give a balanced optimum feed for any cultivar. Once this has been established for one fish at various age grades, the requirements of others can be simulated. Very few species have had their feed optimally tailored for them and much research goes on and is still needed to achieve a cost effective feed - lot feeding (Bardach, 1976).

Also efforts should be made to publicise fish culture and what it stands for. People should be made to understand that fish culture can be run (and is being run in several parts of the world) as a full-time money-yielding business.

5.2.7. Government encouragement.

Since fish culture is new in the country, and it is also an effective method of producing cheap protein, government should encourage efforts in the establishment of fish farms in any available suitable piece of land. It is disappointing to note that since the establishment of the Panyam fish farm in 1951, the then Northern Nigeria government (and lately the Plateau State government) shut off fish culture development project until the recent Lafia Agric. Development Project fish farm. In Kaduna State, it took fifteen years after the construction of the Maska farm for another (Maigana fish farm) to be established. Another ten years elapsed before the construction of the third. This is despite the fact that there are numerous rivers/streams and adequate plains for siting fish farms. Government should renew its interest in this subsector (Olatunde, 1982). Also during the actual construction, government can come in with a 50% subsidy in the hiring of machinery. On fish fry, the current vogue in Ondo State is worthy of emulation. The State Fisheries Division supplies prospective fish farms with healthy fish fry straight from their hatcheries and ponds - at little or no cost. In fact, the encouragement given to the prospective fish farmer is such that anybody who owns a piece of swampy area will be eager to own a fish farm. The fisheries division surveys the site at no cost and even provide:

personnel and nets to assist the farmer in harvesting. (Ojo, O.O. personal conversation). The individuals who have the financial strength can be encouraged to go into fish farming business. The necessary moral support in form of advice should be given free (Olatunde, 1982).

Commercial and agricultural banks should also be made by legislation to reserve a small percent of their agricultural loans for fish farmers. This is necessary because some really interested prospective fish farmers who acquire suitable sites by inheritance find themselves handicapped by finance. And since fish culture is a relatively new field, government can acquire (after adequate compensation) any piece of land that otherwise could have been useless for any other type of agriculture. Huet (1972) suggests that the ability of a fish culture enterprise to utilize an apparently useless piece of land makes it even more advantageous and less expensive than other forms of agriculture.

Cage culture, a new aspect of fish culture may yet prove to be very profitable. This practice has not been very widely experimented upon and government can set up a specific programme for its development. And lastly it is recommended that during agricultural shows, the government should set prizes aside for the biggest culture fishes just in the same manner as the biggest bulls, chickens and pigs attract prizes.

CHAPTER SIX.

SUMMARY AND CONCLUSION.

Fish culture has been defined as the rational rearing of aquatic animals in controlled or semi-controlled conditions. Such controlled conditions offer the opportunity of infuencing the growth, feeding, breeding and general well being of the fish to the advantage of the fish farmer. Aquaculture is close in meaning to fish culture only that aquaculture is an all embracing term covering the husbandry of both aquatic animals and plants. The necessary qualities desirable in a culture fish and that of a proposed fish culture site were reviewed.

An average Nigerian is supposed to consume about 27 grams of animal protein per day but this daily intake was found to be between 5 and 8 grams. It therefore means that a source for supplementing this deficiency cheaply is necessary. Fish was found to be a cheaper source of animal protein than livestock. Also because of the better care in a fish farm, culture fish grow faster than their counterparts in the wild. Amongst other reasons, the fish farming business presents a less hazadous venture when compared with an ocean fishing vessel.

The first fish farm in Nigeria was established in 1951 and since then there has been some effort by the various state governments and Federal agencies to develop more fish culture centres. The research work reviewed and

appraised fish culture practices in the ten northern states. By using questionaires and by visiting some of the states, information on all the fish farm, total area, number and size of ponds, pond management, manpower problems and marketing of the produced fish. It was also estimated that the toal aquaculture production is just about 1,000 kilograms per annum. Clearly this means that this sector is yet to be fully exploited in the area under review. Some of the problems of the farms were discussed (and appropriate recommendations offered) state by state but a later section touched on general procedures which can be applied to any fish farm. It is hoped that this thesis will be an interesting piece to read, it is also hoped that the fisheries policy makers and officers in the field who come across it will find the discussions and recommendations useful. If carefully implemented, they are bound to bear some fruits in no distant future.

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AHMADU BELLO UNIVERSITY, ZARIA
DEPARTMENT OF BIOLOGICAL SCIENCES
POST GRADUATE FRESHWATER FISHERIES SECTION

_____

_____

_____

_____

Dear Sir,

AN APPRAISAL OF FISH CULTURE PRACTICES IN NIGERIA

1. Requests:- The post graduate section of this department is currently engaged in some research on fin and shell fish. An aspect of this research is "An Appraisal of Fish Culture Practices in Nigeria" and on this we solicit your help in the completion of this questionaire. Kindly answer the questions as best as you can.

2. Rationale:- We would like to state that one of the reasons for this study is to throw more light on the level of development of fish culture practices in the Northern parts of Nigeria and consequently to recommend ways of improvement of this source of cheap animal protein. We further will like to assure you that this study has absolutely nothing to do with taxation or other similar investigations by the Government. Instead, the recommendations that will be based on this study will as a matter

of fact, draw Government attention to the neglect and lack of training facilities which have been the sad lot of Fisheries and Fisheries personnel for a long time. To avoid a strangulation of the fish industry in the country, a research of this sort we feel, is a step in the right direction. Help us to keep FISHERIES alvie in this country.

Thank you.

Yours faithfully,

Post Graduate Student,
Fisheries Section.

AHMADU BELLO UNIVERSITY, ZARIA

DEPARTMENT OF BIOLOGICAL SCIENCES

POST GRADUATE FRESHWATER FISHERIES SECTION

AN APPRAISAL OF FISH CULTURE PRACTICES IN NIGERIA

SECTION 1

1. NAME AND ADDRESS OF FISH FARM: _____

_____

2. WHEN ESTABLISHED: _____

3. SOURCE OF WATER _____

a) Is water constant throughout the year? _____

b) If water is seasonal, How do you cope: _____

_____

4. TYPE OF FISH FARMING: (Is it mixed or just fish alone) _____

5. TOTAL AREA OF FARM _____

6. SIZE OF INDIVIDUAL PONDS: (e.g. ½h, 1h etc) _____

7. TOTAL NUMBER OF PONDS: _____

SECTION TWO

8. PLEASE LIST ALL THE SPECIES IN YOUR FARM: _____

_____

_____

9. WHAT IS THE APPROXIMATE STOCKING RATE PER POND:

_____

10. HOW ARE FINGERLINGS OR FRY OBTAINED; MARK "X" AS APPLICABLE.

a) IMPORTED _____ FROM WHERE _____

b) FROM BREEDING (i) INDUCED BREEDING: _____

(ii) WILD BREEDING: _____

(iii) FROM OTHER FISH FARMS: _____

NAME OF FARM: _____

(iv) FROM RIVERS OF STREAMS:

_____

11. DO YOU PRACTICE MONOCULTURE IN ANY POND: _____

12. DO YOU PRACTICE MONOSEX CULTURE IN ANY POND: _____

13. OR IS IT POLCULTURE IN ALL PONDS: _____

14. ANY ARTIFICIAL/SUPPLEMENTARY FEEDING: _____

15. WHICH TYPE OF FEED AND DOSAGE: _____

_____

16. DO YOU USE FERTILIZERS: _____

17. WHICH TYPE AND WHAT IS THE DOSAGE: _____

18. ABOUT HOW LONG DOES IT TAKE EACH FISH TO REACH TABLE SIZE: _____

19. HOW OFTEN DO YOU CROP: _____

20. WHAT IS THE APPROKIMATE YIELD PER HECTARE/YEAR:

	1975	76	77	78	79	80

21. HAS THE PUBLIC DEMAND FOR FISH CHANGED WITH TIME:

_____

22. YAS THE PRICE OF FISH CHANGED WITH DEMAND: _____

	1975	76	77	78	79	80
PRICE OF DRY FISH/KG						
PRICE OF FRESH FISH/KG						

23. HOW DO YOU PRESERVE YOUR UNSOLD FISH: _____

24. ANY DISEASE OUTBREAK _____ IF YES, WHICH DISEASE _____

25. HOW DID YOU COPE WITH IT: _____

SECTION THREE

26. ANY CO-OPERATION WITH ANY STATES, RESEARCH INSITUTES OR UNIVERSITY: _____ IF YES PLEASE NAME THEM:

_____

27. PERSONNEL: PLEASE STATE AS REQUIRED BELOW:

	SENIOR STAFF ON THIS FARM	NO. OF YEARS IN SERVICE	QUALIFICATION
a)	(number of staff and rank not name)		
b)	INTERMEDIATE STAFF		

28. DO YOU HAVE ANY MANPOWER PROBLEM, IF YES BRIEFLY STATE IN THE SPACE BELOW: _____

_____

29. NAME OF OFFICER COMPLETING THIS FORM: _____

(THIS IS OPTIONAL, YOU MAY IGNORE IT IF YOU WANT TO).

APPENDIX II

SOME CULTIVARS IN THE AREA REVIEWED

	SCIENTIFIC NAME	ENGLISH NAME	HAUSA NAME	FAMILY
1.	Tilapia nilotica	Tilapia	Gar gaza	Cichlidae
2.	Tilapia galilea	Tilapia	Gargaza	Cichlidae
3.	Gymnarchus niloticus	----------	Dan Sarki	Gymnarchidae
4.	Lates niloticus	Nile or Niger perch	Giwan ruwa	Centropomidae
5.	Clarias lazera	Catfish/mudfish	Tarwada	Claridae
6.	Heterobranchus bidorsalis	Catfish/mudfish	Ramboshi	Claridae
7.	Cyprinus carpio	Common carp	----------	Cyprinidae

SCIENTIFIC NAME	ENGLISH NAME	HAUSA NAME	FAMILY
8. Distichodus rostratus	River cow	Chichiyawa	Distichodontidae
9. Heterotis niloticus	----------	Balli	Osteoglossidae
10. Synodontis membranaceus	Catfish/Back swimmer	Kurungu	Mochokidae
11. Synodontis schall	Catfish	Kurungu	Mochokidae
12. Ctenopharyngodon idella	Grass carp	---------	Citharinidae
13. Ctharinus citarus	Moon fish	Faliya	Citharinidae