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FISH-POND SITE SELECTION
MID-WESTERN STATE NIGERIA*

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*Survey carried out from
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FISH POND SITE SELECTION
MID-WESTERN STATE NIGERIA

Malcolm C. Johnson

The areas visited by either all of the party or only certain members of the party are well known. Each technician certainly measured each site by his own yardstick keeping in mind however, that the program is a unified program of rice, soybean, corn peanuts, and fish production.

Fish ponds must be in an area of impervious, or relatively impervious soils. Fish ponds must have an adequate supply of suitable water. To be very effective, fish ponds should be at such an elevation that they may be completely drained in order to effect total harvest, regulate the numbers and species of fish, control of diseases and predators, and some other more minor factors. The units of measurement of a suitable fish production site were topography, soil type, water supply in respect to quantity and water supply in respect to quality and accessibility.

From the stand point of fish production, there is no need to discuss those areas found not to be suitable for this use. It can be said however, that except in the areas of more or less pure deep sands, fish ponds could be developed to a greater or lesser degree in many others.

For instance, the soils in a wide area surrounding Benin City are rather coarse, sandy soils with a small content of red clay. These soils, although not truly desirable as pond soils, would hold water to some extent. Water use would be wasteful prohibiting the use of underground water for

any substantial acreage. Perhaps instead in localized area, large catchments could be built to catch surface water for later use. Percolation test will be necessary to determine the feasibility of this.

Hatchery and Production Ponds

The initial fish hatchery is to contain 30 acres at water level. This would require approximately 50 to 60 acres of land. In addition, an area large enough to accommodate a feed mill, an enclosed hatchery, a holding shed, equipment sheds, etc. must adjoin.

Water for the hatchery must be free from all unwanted species of fish. Wells are the only dependable source of water in this respect.

The initial area of grow-out or production ponds is to be 100 acres at water level. This should require around 125 to 150 acres of land in order to accommodate the levees, outside drain channels, etc. These ponds can use surface water. However, every effort must be made to reduce the numbers of wild organisms to a minimum.

Two areas were visited by the survey party that would be entirely suitable physically for the entire initial fish unit. This is not to exclude other large areas of the Niger delta and perhaps some other areas that have not yet been explored.

These two suitable areas are: 1) near the village of Aviara which is ten miles southeast of Oleh, and 2) an area from about ten miles south of Illushi to just south of Agenebode along the Niger River.

In both areas, heavy clay soils were found close to or at the surface. Some of the land in both areas appeared to be subject to seasonal flooding.

However, in the Aviara area, more than adequate acreages are above the flood stage, and the Illushi lands could be protected by a system of levees as outlined in the 1963-1964 FAO feasibility report made available to the Tiffany Team by the Ministry of Agriculture. Drainage could be effected in both areas by a system of drainage canals connecting with the natural run-off channels. Surface water from rivers or smaller streams is available in both places should it be necessary to rely on this source.

According to Geologic Map No. , 350 gpm of sub-surface water per minute is available at ten feet at Aviara, and 150-175 gpm at 276 feet at Ugboha near Illushi. Bore hole logs were not available any nearer to Illush

The topography of Aviara is such that the land rises gently from areas of surface clays to flat, sandier surface soils that would be suitable for row crops affording a contiguous farming area for row crops, rice and fish. Clay sub-soils were found to underlie these sandy top soils at least to elevations safely above seasonal floods. This mixture of fine sand and clay should make excellent pond levees. A soil probe of only about six feet in length was all that was available. This probe did not reach beneath the clays.

At Illushi, flat land extends from the escarpment of the highlands east to a small river forming an ox-bow from the Niger River (Alika Creek). The western two-thirds of this strip appears to be uniformly wet grass or scrub savannah. The eastern one-third, more or less, was a heavy dark clay to a depth of at least five feet. This strip was about two miles wide, and from an aerial view seems to extend from about ten miles south of Illushi to just south of Agenebode. Approaching the river bank, the soil

again becomes quite sandy.

Between Illushi and Alegbette, near the village of Amalu, soil borings exposed sandy loams to a depth of about five feet. Between Amalu and Alegbette the clays again appear near the surface.

Sub-surface water in the Illushi area is not as abundant as farther south in the Aviara area. The construction of protective levees to prevent inundation of the ponds would also add considerably to construction costs at the Illushi site.

The most apparent draw-back to the Aviara area is its remoteness. Aviara is some four hours by car from Benin City and after leaving Warri or Sappele, the roads and bridges are rough and narrow although they can be travelled in all weather.

Both sections discussed above can be used for the production of commercial fish only, if desired. Seed stock, in that event, would be transported from the hatchery located in some other area.

The desirability of locating the general headquarters near Agbor has been discussed by the Tiffany Team. The reasons for this are apparent. It is my opinion that the soil in this area, although somewhat sandy, will accommodate fish ponds. Geologic Chart No. indicates that the soil will give up about 250 gpm at 375 feet. This is not considered an economical supply for large areas but should be adequate for the central fish hatchery. Several wells would have to be co-joined to furnish approximately 1000 gpm. The small yield of water at a relatively great depth plus pond water loss through the fairly pervious soils would increase the costs of producing fingerling fish.

Soil samples from all of the areas visited were taken and pH measurements made by the soil chemist at the Ministry of Agriculture using the glass electrode method.

In addition, water samples were collected at certain places and the tests run by the use of a field-type water analysis kit are recorded below. These tests are the ones considered most pertinent to fish production. Soil and water determinations are appended.

An aerial survey of the Niger delta from Warri to Agenebode was made Friday, July 5. In addition to confirming the on-surface findings of the two areas previously discussed, this flight exposed a relatively wide area between Alegbette and Agenebode that contained many natural lakes. It appeared that these lakes were well above the water level of the Niger, and therefore, were in impervious soils.

This area was later entered on foot and good clay soils close to the surface were encountered in the area visited. There are no roads at present, but local villagers say the area is extensive and rarely floods. Sub-surface water is reported to be at about 700 feet in very small amounts. At least two small rivers transect the general area.

Recommendations

Request the Ministry of Agriculture to construct a small pond by forming levees into a rectangle above ground level at the site of the new Fisheries Station at Benin, and also one in the vicinity of Agbor. Flood these areas for water-holding capabilities.

Request the Ministry to map out the soils in all areas described above

in order to pinpoint dimensions of the impervious soils formation.

Locate the initial fish farming units, hatchery, and grow-out areas in the most favorable places available for that purpose, in order to build a demonstration and pilot facility that would give impetus to future fisheries development.

As a footnote, it should be stated that the fisheries component is fairly flexible and probably could be adapted to many areas chosen for row crops but with any sacrifice of the pre-requisites outlined above, production and/or economy would suffer.

Summary

I. The entire deltaic plain for a greater or lesser width east to west and from Aviara north to Agenebode is suitable for fish production.

The area south of Agenebode to Alegbette is high, only slightly subject to flooding, contains natural permanent lakes, fertile soil, and covers many acres. Surface water deep and in small amounts.

From Alegbette south to Aviara, land is lower, somewhat heavier, adjoins wide expanses of loamy areas. Water close to the surface. More likely to flood. This area is bisected by the Ase River about 1/2 way to Alegbette from its confluence with the Forcados River.

II. The Benin coastal plains sands are just that. They do contain some clay, however. It was observed that within a radius of thirty to forty miles around Benin City, the soils were badly eroded and absorbed the somewhat heavy rainfall readily. The Water Resource Commission technicians verified that these soils were highly pervious. At least some of the small river valleys

are formed by good clay bearing hills.

As this distance from Benin is exceeded, at least to the west and south, the sand becomes finer in texture and has enough red clay so that it can be compacted into a ball when wet. These soils could be compacted into dikes, but permeability would vary between localized spots.

Underground water yield at Agbor is reported at 300 gpm at 720 feet (potable) or 600 gpm at 360 feet with a high iron content.

III. The water quality at all points tested is suitable for fish production although somewhat soft (low in salts of Ca-Mg). pH about neutral, some bicarbonates.

IV. The rolling terrain away from the delta would obviate large contiguous acreages of ponds for grow-out purposes.

V. The hatchery could be located in some of these areas. Low volume of underground water would mean drilling a field of small wells in order to furnish 1000-1500 gpm water in the upland areas.

In the southern delta areas, underground water available within 10 feet of the surface would be more economical. Also soil type is much more suitable.

VI. Grow-out ponds should be built in extensive areas of flat lands with abundant surface water from rivers, streams or lakes. At Aviara, underground water is ample at 10 feet and could be pumped at only a slightly greater cost than surface water.

VII. Recommend fish and rice farms be located co-jointly. In the event it is believed to be highly desirable to have the hatchery at upland head-

quarters, then split the Fisheries component with the grow-out ponds being located at the closest suitable rice farm or vice versa.

Tide-Water Delta

The fisheries specialist accompanied by several staff members of the Ministry of Agriculture visited the fresh-water mangrove swamp area across the Warri River and south from the town of Warri.

This is a very extensive region of low delta extending from the Warri River south to the Atlantic Ocean. In its upper reaches where it is influenced by the discharge from the Nun, Forcados, Warri, Benin, Ethiope and many smaller rivers, the water is apparently fresh. Moving towards the sea, the waters are reported to become more and more brackish until they become saline at the coast.

The entire area except for some high "islands", is subject to inundation to a depth of two to three feet at each high tide. It was my impression that flooding occurred for about six hours, and the land was exposed for about six hours during each cycle.

Along the creek and river margins, mangrove trees grow to a large size and height. However, this strip of large trees is probably not over fifty feet wide. The general surface of the delta in the fresh-water swamps supports dense stands of the same mangrove species that grow only to about head height.

These mangroves have many tentacle like roots that form a fibrous mat to a depth of three or more feet into the soil. In addition, the delta floor supports the litter from mangrove accumulated for thousands of years.

The surface does not remain exposed long enough to dry to the extent that heavy machinery could be used to construct ponds. Perhaps, drag-lines could work from mats.

At Lagos, Nigeria and in other similar areas of the world, ponds have been constructed in tidal mangrove swamps. This is usually done by hand labor using cutting tools to cut through the roots and other organic material and piling excavated "pieces" of the peaty soils into levees.

Water is allowed to enter the ponds at high tides, the gates are then closed and the pond water retained as the tide recedes. Techniques are then employed to improve the natural yield of wild fish entering with the water, and in some areas desired species are stocked in addition.

Control of the numbers and kinds of fish and other organisms is difficult if not impossible resulting in rather unpredictable and variable yields except in some very special world areas. However, in Nigeria, villagers who are not fully occupied and who sustain themselves mostly by subsistence farming could produce badly needed protein supplements by building tidal ponds.

The introduction of exotic species such as the American Red Swamp Crayfish is also a possibility.

It is recommended that at such time as the proto-type fish farm has been built and put into well-organized operation that some small-scale trials be conducted in these tidal marshes in an effort to learn to fully utilize their potential for aquaculture.

Aviara Area - Probable Initial Pond Site

This area is gently rolling country probably due to channels and natural levees of old water courses. In the low swamp areas, ground water in July was about 6" below the surface. Surface soil was sandy, peaty clay. At about one foot, it became heavy gray clay to at least six feet.

Moving from one low swamp between Aviara and Ase (at about Ayara) to Aviara, the land appeared to rise at about 5 feet per mile. At a point on this slope said never to flood, there is an area about 2 miles wide and several miles long in both direction that is sandy to a depth of about 18" becoming good clay at least to depth of probe. Ground water is about 5 feet more or less. Water table chart indicates 350 gpm at 7-12 feet.

The pH of the soil is 4.8.

The pH of the water from a dug well about 6 miles aways is 6.5. About two miles down slope a small stream flows for all but the dry season. It is muddy and appears to contain a fair amount of tannic acid. Many small fish were seen alive at the surface.

About three miles crow flight, there is a fairly large lake that is fed all year by back water from the Ase River. The water is turbid and stained, but for many years has been the main source of fish fo the Ayara fishermen.

The Ase River is about four miles away.

Inspite of remoteness from cities and shipping point, it is my opinion that the Aviara area is the only single site visited that would accommodate all of the agricultural components in a more or less contiguous unit. The heavy rainfall and short dry season is a major consideration relative to two

row crops per annum.

One other possibility is an area bisected by the Benin-Sapele highway and between the Government's Rubber Research farm and the Koko run-off. The soils though somewhat sandy, do have about 35% red clay. A small, clear river runs through this area to discharge into the Benin River some twenty miles to the west. This area was only cursorily examined.

As the selection of possible fish-pond and general farming and aquaculture sites narrows, more frequent and specific water and soil samples should be taken. The water samples tabulated below are expected to reflect only a very generalized picture of available waters.

Water Analysis

Sample Area	pH	phenol Alk.	MO Alk.	Total
Dug well in low delta Heavy Leafmold	6.0	0	17.1	17.1
ppm OH^-	ppm $CaCO_3$	ppm $Ca(H_2CO_3)$	Cl^-	
0	0	17.1	0	
Niger River at Ilusshi	6.7	0	34.2	34.2
ppm OH^-	ppm $CaCO_3$	ppm $Ca_2(H_2CO_3)$	Cl^- 0	
0	0	34.2	0	
River water in pond 12 miles N.E. Benin	6.5	0	27.3	27.3
ppm OH^-	ppm $CaCO_3$	ppm $Ca_2(H_2CO_3)$	Cl^- 0	
0	0	27.3	0	
Sample 3 - Benin City Water	6.5	0	102.6	102.6
ppm OH^-	ppm $CaCO_3$	ppm $Ca_2(H_2CO_3)$	Cl^-	
0	0	102.6	T	102.6

Water Resource Commission indicates city water is treated with Cl^- and lime.

pH of Soils
(pH in water, 1:2 Soil: Water Ratio)

Sample Number	pH Value	Remarks
1	4.3	Ughelli Clay
2	5.0	Ughelli Top Soil
3	5.0	(Oleh) Irri-Aviara
4	4.5	Aviara at low swamp
5	4.8	Aviara on Upland Ridge
6a	5.0	Kwale grass-riceland
6b	4.5	Black top-soil areas are ex River from Kwale
7	5.1	Gumbo east of Kwale
8	4.7	Aviara oil-well site top soi
9	4.6	Aviara oil-well site clay sub-soil
10	5.0	Sandy area near Amalu
11	5.0	Agbor
12	4.5	Alegbette rice farm
13	4.6	Illushi black top soil
14	4.7	Illushi clay at 5'