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**FISHCULTURE PROJECT  
REPORT FOR EAST PAKISTAN**

**Phase I**

**FINAL REPORT**

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Agricultural Experiment Station  
Auburn, Alabama**

**Project: AID/csd-1581**

**Title: Increasing Fish Production  
by Improved Fishcultures**

**Date: February 1, 1969**

**SUMMARY OF ESTIMATED COSTS OF FISH CULTURE PROJECT  
FOR EAST PAKISTAN**

**I. Construction of New Fisheries Research Station at Dacca (Joydepur)**

	<u>Dollars</u>	<u>Rupees</u>
Land required 75 acres, minimum 50 acres (cost not included)		
Construction of 111 excavated earthen ponds and water storage moat	11,000	640,000
Labor		45,000
Pumps, wells and electrical generating system	11,500	30,000
Fencing		20,000
Laboratory equipment	15,000	
Laboratory building		440,000
Residences and guest house	<u>          </u>	<u>400,000</u>
Totals	\$37,500	1,575,000

**II. Improvement of Research Facilities for Fisheries Research Station at Chandpur**

Construction of 30 excavated earthen ponds	3,000	125,000
1 dewatering and 2 tube irrigation pumps	1,200	
Construction of 48 concrete ponds (1/100-acre)		145,200
50 plastic-lined pools	1,400	
4 wells and pumps for supplemental water supply	2,500	20,000
Sealing existing ponds to reduce seepage	3,000	10,000
Laboratory equipment	15,000	
Supervision of research at Fish Seed Farms	<u>3,000</u>	<u>12,000</u>
Totals	\$29,100	312,200

## **SUMMARY OF FISHCULTURE PROPOSAL FOR EAST PAKISTAN**

The present Fisheries Research Station is located at Chandpur, 40 miles south of Dacca on the Dakatia River, where very effective research could be carried out on the management of riverine-estuarine areas. However, the Station is located on soils with a high seepage rate and there is no permanent source of water. Several of the limited number of experimental ponds are without water during the dry period. Also, the area available for construction of new ponds is so limited that this Station can never become an effective pondcultural research station to develop the highly productive fishcultures that are needed to provide the large quantities of high quality protein required in East Pakistan.

It is recommended therefore that:

1. A new pondcultural research station be established at Dacca near Joydepur Fish Seed Farm.

The advantages of this location are:

- a. The soils consist of excellent quality clay in which ponds with minimum seepage can be constructed.
- b. A water supply moat can be constructed at this location to provide a primary source of water for experimental ponds throughout the year.
- c. The area is readily accessible by paved road and is conveniently located to the Central Offices of the Directorate of Fisheries and a major university in Dacca.

**d. Space can be made available at the site for future expansion.**

**A land area of 50 acres will be required for the proposed 111 experimental ponds and research buildings. However, a minimum of 75 acres should be purchased to provide for future expansion. The land is presently in rice paddies.**

**2. Facilities for research at the Chandpur Fisheries Station should be improved so that effective research on increasing fish production may begin promptly while negotiations for the land and construction of the new station at Dacca are in progress. These facilities are needed now at Chandpur and will find intensive usage for research on improved management in the riverine-estuarine areas. At Chandpur, it is proposed to construct 30 small earthen ponds and 50 concrete ponds and to test methods for reducing seepage of existing ponds. Ponds at selected Fish Seed Farms would also be used for experimental purposes. This would make possible sufficient research space so that Auburn University participation under the USAID project AID/csd-1581 could be effected as soon as contracts can be finalized.**

**3. Auburn University proposes under this contract to:**

**a. Send to East Pakistan a team of 2 experts once yearly to assist the Directorate of Fisheries in planning research, management, and extension activities for increasing fish production.**

The time required within the country is estimated at 3 weeks, with prior planning, travel and follow-up work requiring a total of 6 man-months.

- b. Send approximately 6 months later a team of 3 experts to check upon the progress of the research, the problems encountered and provide training for host country personnel. This team would conduct short courses on subjects most needed to improve the competence of research and extension staff. Time required within the country is estimated at 3 weeks, with total time for travel, planning and associated work calculated at 9 man-months.
- c. If experts on pond construction are not available within East Pakistan, staff members from Auburn University trained in both pond construction and fishculture would be stationed at Dacca full-time during the period of construction, which is estimated at 2 to 3 years. If the Directorate or the Provincial Government can supply personnel trained in pond construction, it would be necessary for an expert from Auburn to make only 2 additional visits per year, estimated at 2 weeks each within the country, to check on construction progress and related problems. These visits would be spaced between the two team visits so that construction could be checked approximately every 3 months.

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## FISHCULTURE PROJECT REPORT FOR EAST PAKISTAN

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Auburn, Alabama

February 1, 1969

### INTRODUCTION

The present report summarizes the results of 3 trips made to East Pakistan. The first report<sup>1</sup> dealt with preliminary survey, November 23 to November 29, 1967, and summarized East Pakistan's present and future needs for high quality protein, the role of fisheries, the various organizations contributing to fisheries education, research and management, and the available research facilities. The second trip was June 19 to June 21, 1968, for conferences at the University of Mymensingh and with the Directorate of Fisheries at Dacca. The final trip was October 26 to November 22, 1968, when intensive investigations were made of the fish seed farms, research stations and sites proposed for establishment of fisheries research stations. The itinerary of places investigated and a map showing their location follows:

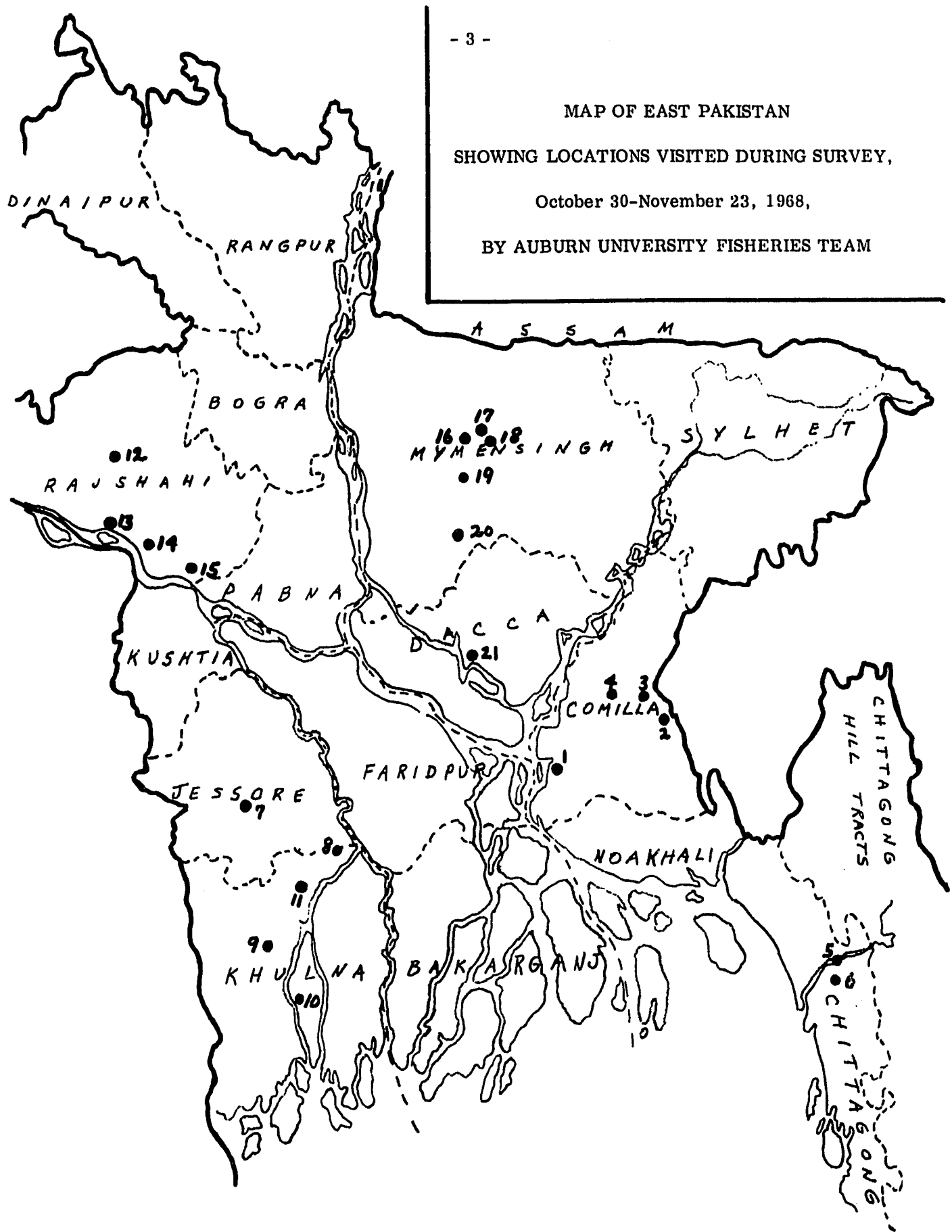
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<sup>1</sup> Fishculture Project for East Pakistan, Phase I, by H. S. Swingle and D. D. Moss, January 30, 1968. 16 pages

ITINERARY OF AUBURN UNIVERSITY FISHERIES TEAM  
DURING SURVEY OF EAST PAKISTAN, OCTOBER 30 - NOVEMBER 23, 1968

October 30-31	Chandpur Fisheries Station	(1)
November 1	Chandpur and Adjacent Areas	
November 2	Jangalia Fish Seed Farm (near Comilla)	(2)
November 2	Shangraish Fish Seed Farm (near Comilla)	(3)
November 2	Chandina Fish Seed Farm (Comilla)	(4)
November 5	Kaptai Reservoir	(5)
November 5	Patiya Fish Seed Farm (Chittagong)	(6)
November 8	Jessore Fish Seed Farm	(7)
November 8	Baluhar Baor (near Bazrupur)	(8)
November 9	Paikgacha Fish Seed Farm (Proposed)	(9)
November 9	Khalia Prsiamari (Paikgacha) Proposed Site for Brackishwater Fish-Rice Culture Research Station	(10)
November 11	Krishnanagar Fish Seed Farm (Khulna)	(11)
November 13	Amnura Fish Seed Farm	(12)
November 13	Rajshahi Fish Seed Farm	(13)
November 14	Thana Fish Seed Farm (Proposed)	(14)
November 14	Natori Fish Seed Farm	(15)
November 18	Mymensingh-Directorate of Fisheries (Proposed 16-Acre Site)	(16)
November 18	Mymensingh Fish Seed Farm	(17)
November 18	Mymensingh University (Proposed)	(18)
November 19	Hamil Beel (Madhupur Tangail Subdivision)	(19)
November 19	Tangail Fish Seed Farm (Dacca Road)	(20)
November 19	Dacca Fish Seed Farm (Joydepur)	(21)

MAP OF EAST PAKISTAN  
SHOWING LOCATIONS VISITED DURING SURVEY,  
October 30-November 23, 1968,  
BY AUBURN UNIVERSITY FISHERIES TEAM



Summarizing from the January 30, 1968, report, East Pakistan has an area of 55,126 square miles, with a population density of approximately 1300 persons per square mile. The population is increasing by 2 million people annually (3%). Average protein availability in Pakistan is 55.7 grams per person per day, just slightly below the calculated requirement of 57 grams. However, animal proteins are only half that required for good nutrition and malnutrition is prevalent in large segments of the population. Infant mortality, in considerable part due to protein deficiency, averages 160 per thousand live births. By 1985, production of protein from all sources must be increased 2.4 times the present level.

The small size of farms and annual inundation of up to 60 percent of the total land surface during the monsoon period makes increase in livestock production difficult. The most promising source for the needed protein is from improved and expanded fishcultures, and from improved management of fisheries in natural waters. Because of low productivity and frequent storms that interfere with fishing in the Bay of Bengal, only limited increase in production can be relied upon from the offshore marine waters.

The present catch in the inland waters is approximately 231,800 metric tons or 7.2 pounds of fish per capita, supplying only 6.6 percent of the animal protein requirements. Evidence from these surveys has indicated that greatly expanded catches are possible with improved management of bheels, baors, bherries, and other natural bodies of water,<sup>1</sup> from short-term intensive fishcultures in waters

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<sup>1</sup> A bheel is a water-filled natural depression, a baor is an oxbow lake, and a bherri is an enclosed tidal area.

impounded during the monsoon period, by development of procedures for impoundment and management of both brackishwater and freshwater ponds, and by development of methods for culture of various species in baskets suspended in natural waters. A vigorous research program in fisheries is necessary to supply the information needed for a successful national program for increasing production of animal proteins necessary to meet present and future needs.

While little can be done to increase production in rivers, it should be possible to double the catch with mechanized and improved fishing methods. Development of the culture of fish in baskets floating in rivers and backwaters could do much to increase the yield from these areas.

Fertilization, weed control and stocking are procedures that could increase the catch 10-fold in natural lakes and bherries.

Fish production in both brackishwater and freshwater ponds can be increased dramatically. Ponds stocked with proper numbers and species of young fish can produce, with phosphate fertilization, yields of 1000 pounds or more per acre within a period of 8 to 12 months. With addition of supplemental feeds for fish productions of 3000 pounds or more per acre can be attained. Intensive research will be required to develop fish feeds from readily available materials, and to determine the species and combinations of fishes that will produce the highest yields.

#### EAST PAKISTAN DIRECTORATE OF FISHERIES

East Pakistan is divided into 17 districts, each with a District Fisheries Officer and an Aide. Districts are further subdivided into 56 divisions with

a Fisheries Officer in each. In addition, 300 men are working in fisheries extension. The Directorate operates a research station at Chandpur and 4 centers for training fishermen in methods of fishing and use of fishing gear and equipment. Also it operates 51 fish seed farms in various parts of the country. The Director and his administrative staff have offices in Dacca.

#### Freshwater Fisheries Research Station at Chandpur

Chandpur is located approximately 40 miles south of Dacca about halfway to the Bay of Bengal. It is rather inaccessible as 4 to 6 hours are required to reach the Station by boat or automobile from Dacca. The Research Station has 43 acres of land with 24 ponds comprising 9.0 acres of water. There are 34 houses for senior staff, 30 houses for other workers and dormitories to accommodate 200 people.

Work at this Station is divided into three phases, (1) Fisheries Biology, (2) Fisheries Technology and (3) Fisheries Training. The Fisheries Training Institute is operated for the training of extension personnel employed by the Directorate of Fisheries. Extension workers are required to complete a training program of 18-months duration before they are assigned to the field. The Institute has its own building and a training staff of 6 teachers and 10 training aides.

The Fisheries Technological Division is housed in a good building with several moderately well equipped laboratories. It has a staff of 15 research officers and 15 aides.

The Fisheries Biology Division is housed in a separate building. It has a staff of 20 research biologists and 30 aides. Work in this division consists of research on pond fertilization, water chemistry, biology and life cycles of mussels and shrimp, pituitary spawning of fish, toxicity of insecticides to fish, taxonomy of fish and parasites of fish.

The research being carried out by Research Officers and biologists appeared to be of good quality, and the staff appeared eager to learn. However, many of these research personnel need additional training in fisheries. Most have B. S. or M. S. degrees in Botany and Zoology, but have had no formal work in fisheries.

#### Suitability of Chandpur as Main Research Station

Major features that reduce the suitability of Chandpur as the Main or Central Freshwater Fisheries Research Station are: (1) remoteness of location, (2) limited number of experimental ponds and (3) soil with inadequate clay to retain water. Of these, the poor quality of soil is the factor which most limits future expansion and development.

Ponds built on the Station go dry during the dry season, except for those that have a depth of approximately 12 feet. Ponds are filled entirely by rain water with some seepage through the sandy soils. The ponds can be drained only by pumping. Another undesirable feature is that during years of extremely heavy rainfall, flood waters overtop the ponds resulting in damage to dams and premature termination of experiments.

Further discussion of the Station is included under the section on recommendations.



### THE FISH SEED FARMS

At present, the Directorate operates 51 fish seed farms. An additional 15 are in process of construction and 25 more are planned. Their locations are shown on the following map.

These fish seed farms have as their main purpose production of Indian carps for stocking ponds and natural waters. The original 51 farms were built on the same plan, with 6 ponds 150 x 90 feet (0.3 acre) and 2 ponds 190 x 141 feet (0.6 acre). The new farms have 5 ponds on each station, 2 are 160 x 200 feet (0.7 acre), and 3 are 150 x 90 feet (0.3 acre). On the existing fish seed farms, approximately one-third of the ponds held water throughout the dry season, while two-thirds suffered severe draw-downs or dried up during this period.

The fish seed ponds were stocked in June with fry obtained from rivers or from induced spawning, using hormones. The fry are grown to fingerlings that are sold to fish farmers in August to November. The ponds generally were not used during the remainder of the year, except in some ponds, unsold fry were raised to commercial size and sold to add to the income of the government. It would appear that those ponds that retain sufficient water throughout the dry period might be used for research to determine optimum rates of stocking, fertilization, feeding and other management procedures during the idle 5- to 6-month period.

### EAST PAKISTAN AGRICULTURAL UNIVERSITY

The University is located at Mymensingh, approximately 100 miles north of Dacca, with daily train service and a narrow paved road connecting the two

# EAST PAKISTAN

FISH SEED FARMS

## LEGEND

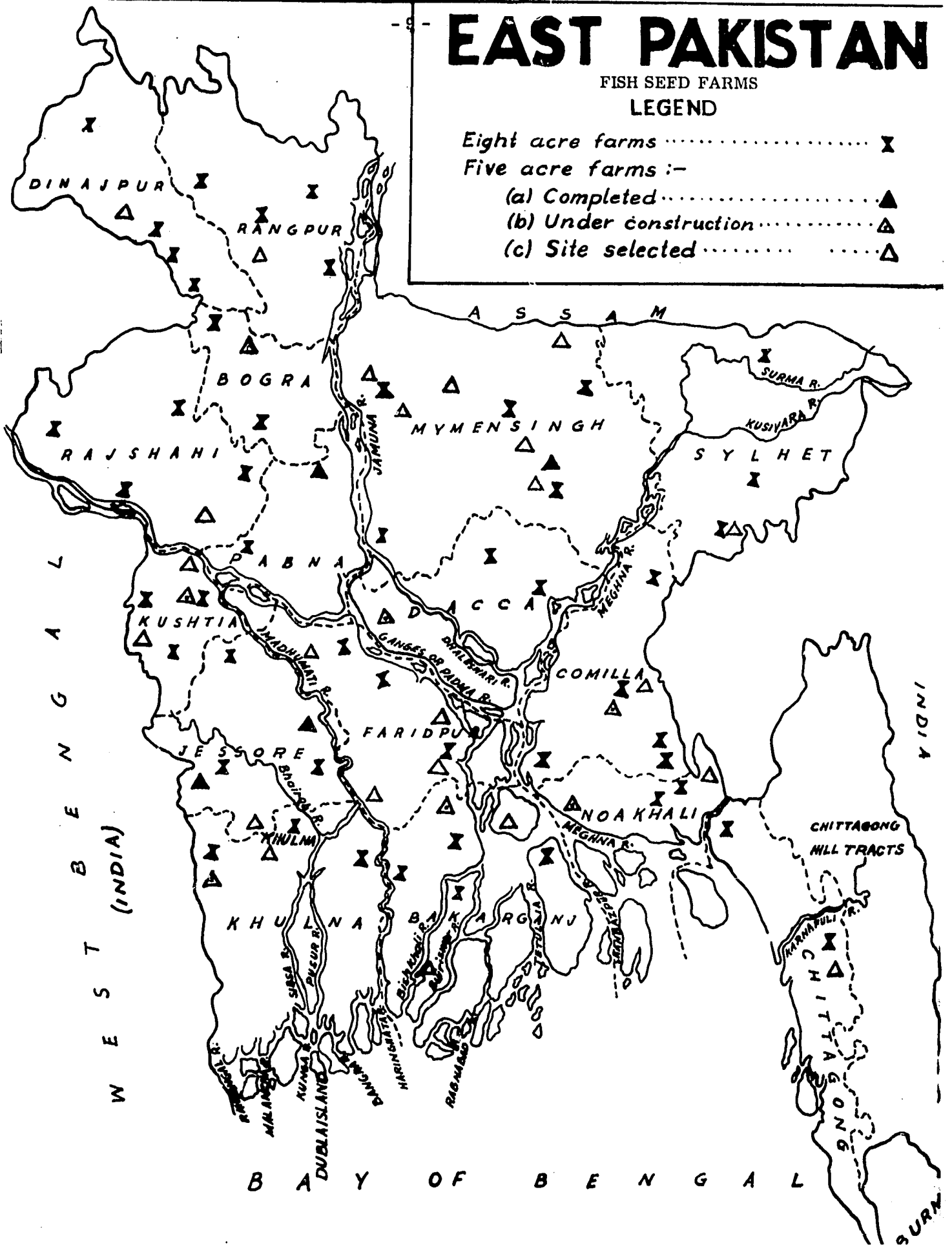
Eight acre farms ..... X

Five acre farms :-

(a) Completed ..... ▲

(b) Under construction ..... △

(c) Site selected ..... ◻



cities. Enrollment was 1300 students, with 30 in the first year fisheries course. The Texas A & M Contract Team under USAID is assisting in the development of the University, with one member as advisor to the School of Fisheries.

It was considered advisable to locate a fisheries research station at or near the University so that teachers and students could be involved in research with the Directorate of Fisheries upon problems relating to increasing fish production. The University offered to make available a 50-acre track of swampy land for the research station, but the soils proved unsuitable when examined with a soil auger. The soil profiles are included in the Appendix to this report.

Also, lands purchased nearby by the Directorate of Fisheries for erection of a research station or fish seed farm proved unsatisfactory for construction of research ponds (See soil profiles in Appendix). Since no suitable soils could be located nearby, the plan to establish the research station at or near the University was abandoned. However, it is hoped that cooperative research between the University and the Directorate of Fisheries can be established through research grants as both would benefit greatly from such an arrangement.

#### FISHERIES DEVELOPMENT CORPORATION OF EAST PAKISTAN

The Corporation is financed through investments by private individuals, businesses, FAO and Government loans. It deals principally with marine fisheries with emphasis toward expanding the fleet of mechanized fishing vessels, developing ports with more adequate facilities for processing and the preservation and distribution of catches of marine fishes.

It also operates for maximum sustained yield the freshwater Kaptai Reservoir on the Karnaphuli River in the Hill Tracts near the city of Chittagong. Fishermen pay a license fee and a royalty of 5 rupees per 82 pounds of fish that is collected by the Corporation for the government. Details of this operation are given in the Appendix.

#### REVENUE DEPARTMENT OF EAST PAKISTAN

Much of the public fishing water is under the control of the Revenue Department, who lease the fishing rights to the highest bidder. Unfortunately, this department is not equipped to manage these waters and many areas have become covered with water hyacinths and the fishery has deteriorated to a low level. To improve fishing in these areas, the Directorate of Fisheries must submit a project to the Government, requesting sufficient funds to lease the fishing rights from the Revenue Department. An example of this procedure is the operation of Baluhar Baor, a 630-acre oxbow lake. By 1958, the lake had become covered with water hyacinths and yielded a catch of 1.5 pounds fish per acre. The area was leased in 1960 by the Revenue Department to the Directorate of Fisheries for 1500 rupees. In the subsequent 5 years, by proper management, including weed control and stocking, the catch was increased to 200 pounds fish per acre. At the end of this initial period, the rent to be paid by the Directorate of Fisheries to the Revenue Department was raised to 10,000 rupees; the Directorate must then request this sum from the Government to pay the rent. Since all fees paid to the various departments go to the same government, a revision of this rather complicated system would do

much to facilitate improvement in the management of public waters for the purpose of increasing the supply of high quality protein so badly needed by the people.

#### THE BRACKISHWATER FISHERIES RESEARCH STATION

The advisability of establishing a brackishwater fisheries research station to develop methods of shrimp culture and fish culture was investigated. Officials of the Fisheries Development Corporation and FAO fisheries specialists working in the area considered this project highly desirable. The Directorate of Fisheries had proposed development of a research station at Khalia Prsiamari near Paikgacha, southwest of Khulna in the Sundarbans. In this area, an embankment project of the Government has been constructing dikes (polders) along the edge of tidal rivers to prevent intrusion of brackish-water so that the land may be used for intensive rice culture. Salinities greater than 2 ppt is considered harmful to rice production.

The embankments, or polders, are constructed on the level land a short distance back from the river, completely enclosing an area of land. At intervals along the polders, concrete structures with water outlets are provided to let out the fresh water that falls within the area. Flap-valve gates prevent the intrusion of salt water at high tide. The exact salinities occurring in this area annually were not known.

Fishermen in the area have complained that since construction of the polders, the catch of shrimp and fish has declined greatly because the fry and larval forms no longer gain entrance into the small streams now enclosed by the polders and

the flooded fields are no longer available as their pasturage. One of the declining species is the shrimp, Penaeus semisulcatus, which grows to an extremely large size in this area; its maximum weight is said to be approximately 2 pounds. These shrimp sell at a very high price on the local markets and are also exported to foreign markets. The giant prawn, Macrobrachium rosenbergi, is also present in the area and important in the fishery.

The purpose of the proposed research station at Khalia Prsiamari is to investigate to what extent the embankments, or polders, are interfering with the shrimp fishery and also with the brackishwater fishery, to determine those species suitable for use in the fresh waters now provided within the embanked area, and to work out suitable methods of shrimp culture and brackishwater fish culture to offset the losses caused by the embankments.

For research on shrimp culture, salinities in excess of 15 ppt are necessary during at least that portion of the year just before and several months after spawning of the shrimps. Larval forms of M. rosenbergi die at salinities below 10 ppt, but after reaching the juvenile stage, this species migrates upstream into fresh waters. For general brackishwater research it is desirable to have available for pond use at all times waters of salinities from 15 to 30 ppt, plus water of lower salinity (0-15 ppt) for dilution so that any desired salinity up to sea strength may be available for research on cultures of various aquatic organisms.

Areas investigated were near Chittagong, and in the Sundarbans area, south of Khulna. Little definite information was available upon the salinities in either

area over the period of a year. However, salinity measurements made in the surface waters for the embankment project by Leedshill - De Leuw Engineering Firm are shown in the Appendix. In general, they indicate that only the lower Sundarbans had adequate salinity for a research station near Khulna, but this area was remote and so isolated that a station there would not be advisable. However, inadequate records of salinities made it impossible to accurately evaluate the physical suitability of this area.

In the Chittagong area, a number of locations appeared possible near Cox's Bazar. However, lack of salinity data made selection of suitable sites impossible during this Survey Trip. Consequently, the selection and evaluation of sites for brackishwater fishculture research stations were postponed. The Directorate of Fisheries is setting up a schedule to measure at monthly intervals salinities of top and bottom waters at the above locations so that evaluations may be made at a later date.

The areas visited during these investigations, the soil profiles and other observations are given in the Appendix.

#### RECOMMENDATIONS

1. Establish adequate fisheries research facilities in East Pakistan for the development of improved fishery management procedures for natural waters and to develop advanced methods of pond fishculture and basket cultures in freshwaters. Here, two proposals are presented:
  - A. Expansion of facilities at Chandpur and use of the Fish Seed Farms as supplemental research areas until a permanent and more suitable fishcultural research station can be built near Dacca. Subsequently, work at Chandpur should deal with the management of of riverine and estuarine fisheries.

**B. Construction of a new pondcultural research station at  
Joydepur, 10 miles from Dacca.**

- 2. Send an advisory team of experts in fisheries from Auburn University approximately twice yearly to assist the Directorate of Fisheries and cooperating universities in planning research projects, and in training of research and extension personnel.**
- 3. Send a specialist at other times when requested by the host country and when this is considered advisable by the AID Mission.**
- 4. Make available fellowships for advanced training of selected research, teaching and extension personnel.**
- 5. Develop methods for reduction of seepage from ponds in various types of soils.**

**These proposals will be discussed more fully in the following sections.**

**Expansion of Research Facilities at Chandpur**

**The Chandpur Station operates under the handicap that no water is available to replace that lost in experimental ponds by evaporation plus seepage during the 6-month dry period. Evaporation records from concrete ponds from December to June, rainfall records, and evaporation and seepage estimates for two earthen ponds are given under the Chandpur Station in the Appendix. Soils here were rather permeable and the estimated loss was of the order of 5 feet by seepage plus 1.3 feet by evaporation during the dry period of November to June.**



In an attempt to partially overcome this loss, the ponds have been dug to depths of 10 feet below soil level. However, this often resulted in penetration of sand beds where seepage was increased as the ground water level receded.

Extensive soil borings were made in the area presently occupied by the larger experimental ponds, in the area where new ponds are to be constructed, in the area of the small ponds and in the recently purchased 6-acre tract across the road from the Station. The locations of the borings are shown on the map of the Chandpur Station (Figure 1), and the soil profiles are shown graphically in Figures 2 to 7.

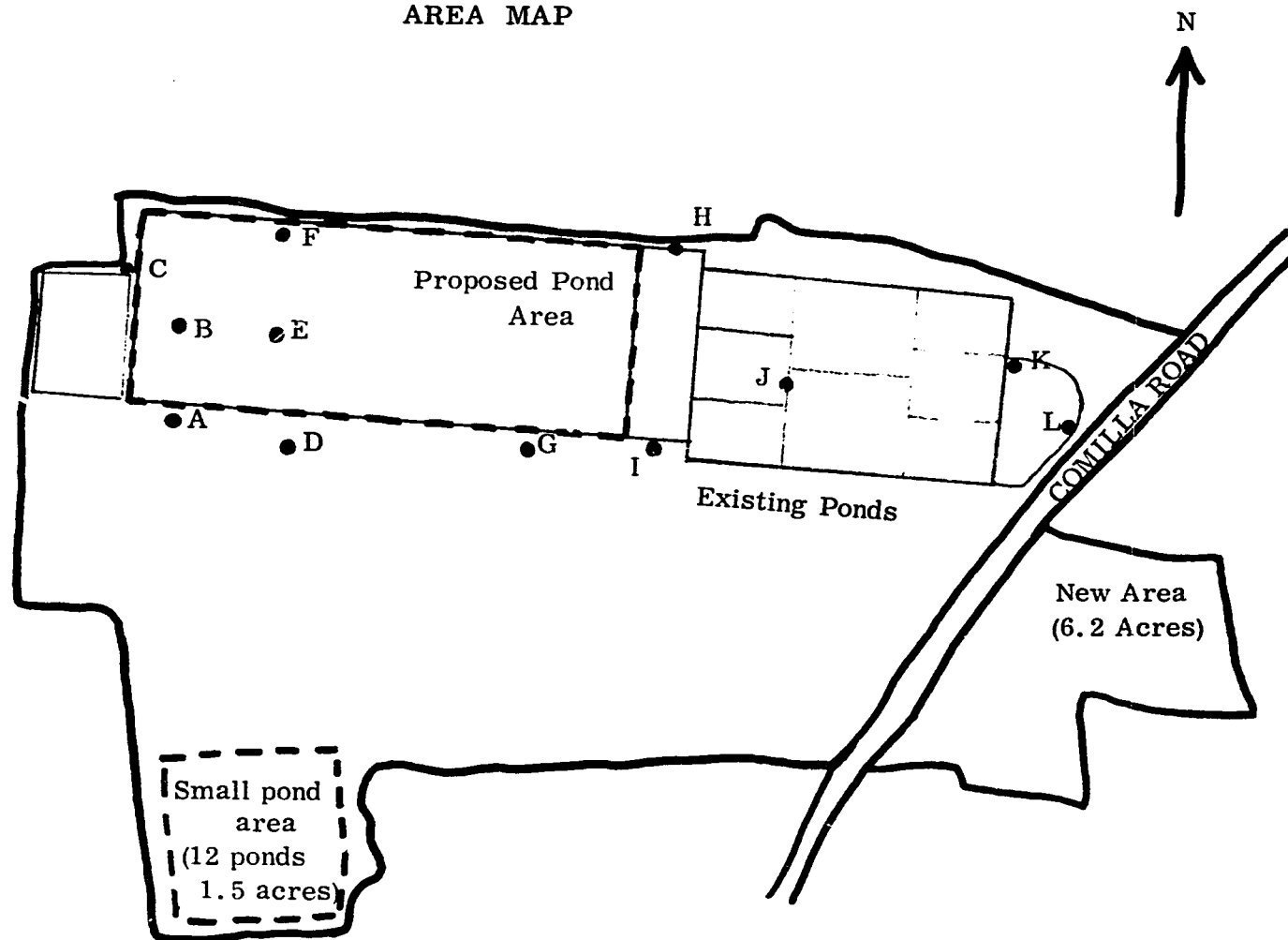
The newly acquired 6.2-acre area across the road from the Chandpur Station had layers of sand and sand-silt below depths of 8 feet on the west and 4 feet on the east. The overlying clay-silt would be satisfactory for pond construction if it were not underlain by the sand and sand-silt.

Two additional areas were investigated along the Dakatia River, about 1 and 2 miles from the Chandpur Station with the hope that a suitable area could be found at a point where the river water could be used to replace water lost by seepage and evaporation during the dry period. Sand was found at depths below 3 to 6 feet and both areas were unsuitable. The soil profiles are given in the Appendix under the section on Chandpur.

#### Construction of Excavated Ponds

It was concluded that the most suitable location available at Chandpur was in the proposed pond area described above. By taking proper precautions in construction, including excavating and repacking core trenches under dams, excavation of pond bottoms to not over 3 to 4 feet below the soil surface and compaction

Figure 1. CHANDPUR FISHERIES STATION  
AREA MAP

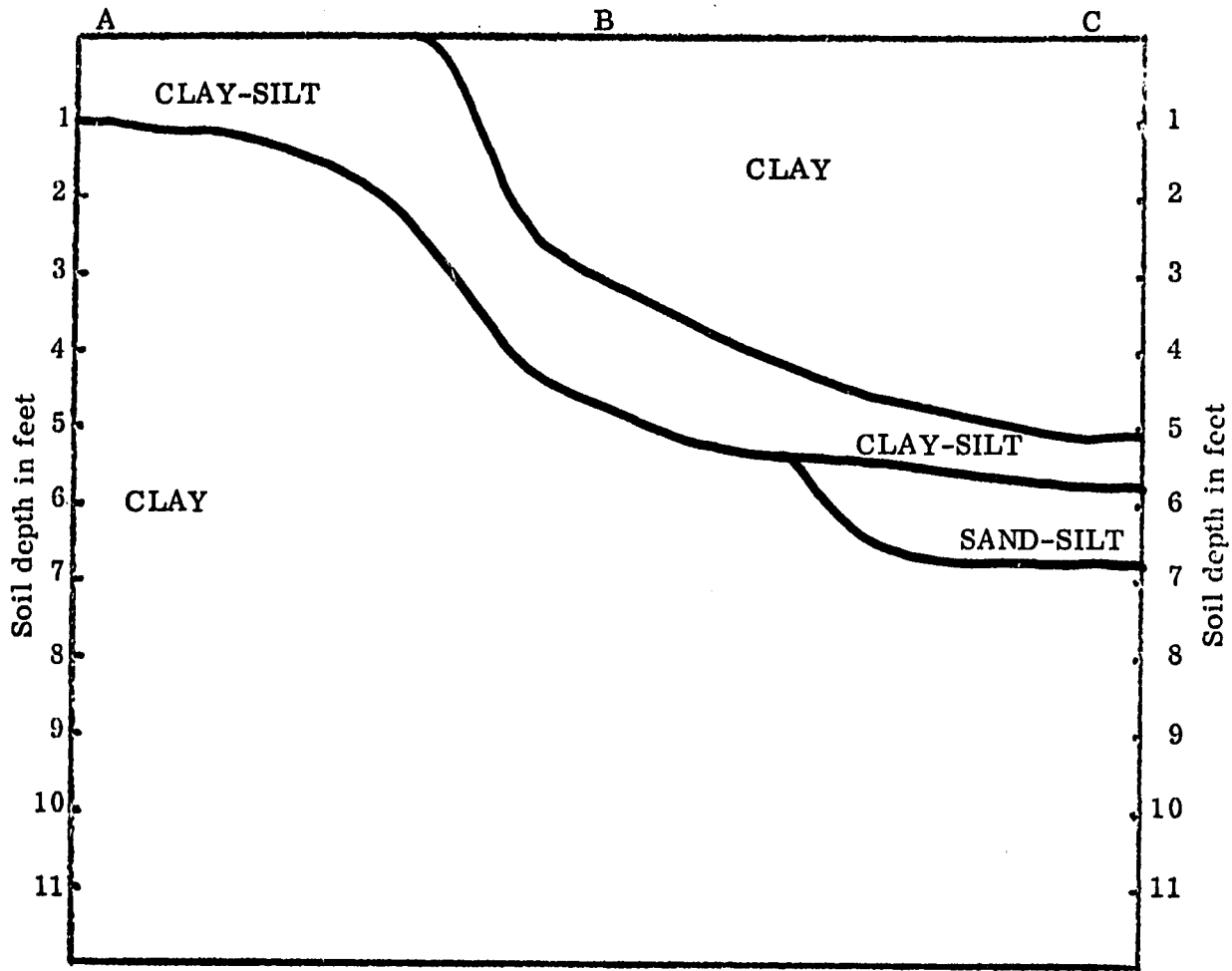


- 17 -

Map showing location of soil profiles and of pond areas. The concrete ponds will be placed south of the "Proposed Pond Area".

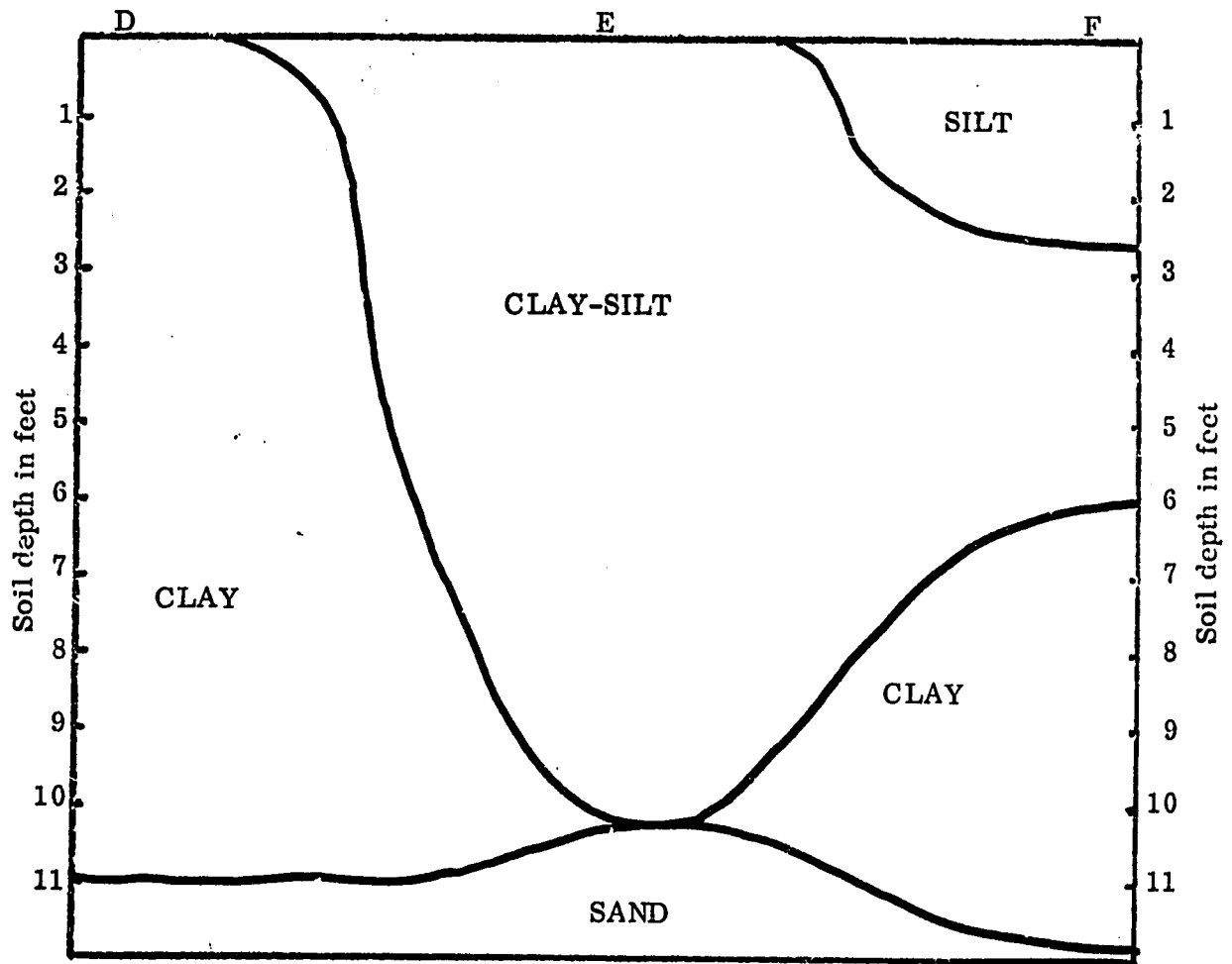
October 30-31, 1968

Figure 2. Chandpur Fisheries Station  
Proposed Pond Area  
SOIL PROFILE CHART



These soils lie in the western part of the proposed new pond area. They are satisfactory for pond construction, but excavated core trenches under dams must cut through sand-silt layers such as that between 6 and 7 feet at point C. Then clay of good quality should be tightly packed in the trenches.

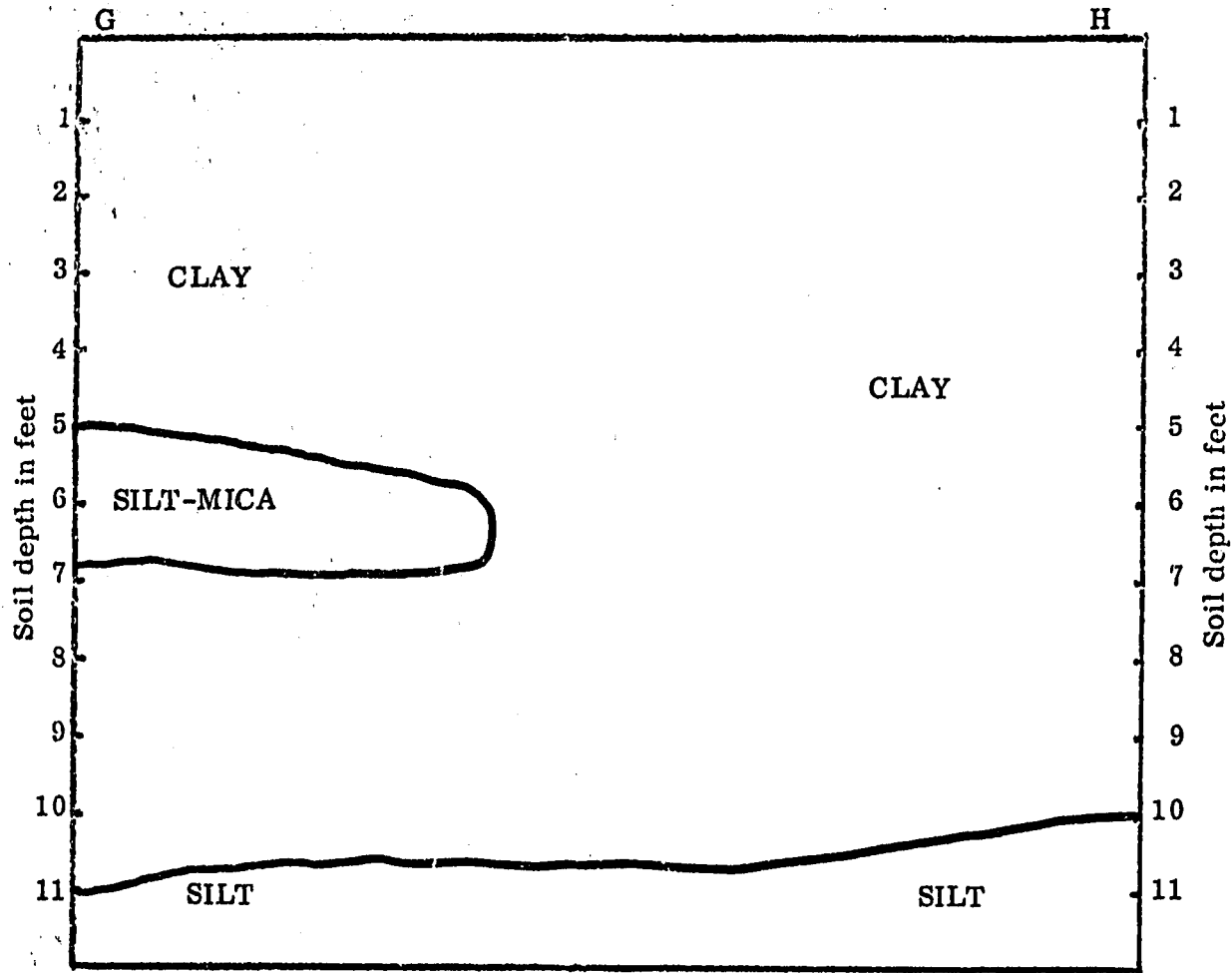
Figure 3. Chandpur Fisheries Station  
Proposed Pond Area  
SOIL PROFILE CHART



These soils lie in the west central section of the proposed new pond area. Here sands lie below 10.5 to 12 feet. There is enough clay and clay-silt to prevent excessive seepage if the bottom of the ponds do not penetrate below 4 feet from the surface, leaving 6.5 to 8 feet of clay or clay-silt above the sands. If pond bottoms are excavated to 10.5 to 11 feet, all water will be lost when the level of groundwater falls below this point.

October 30-31, 1968

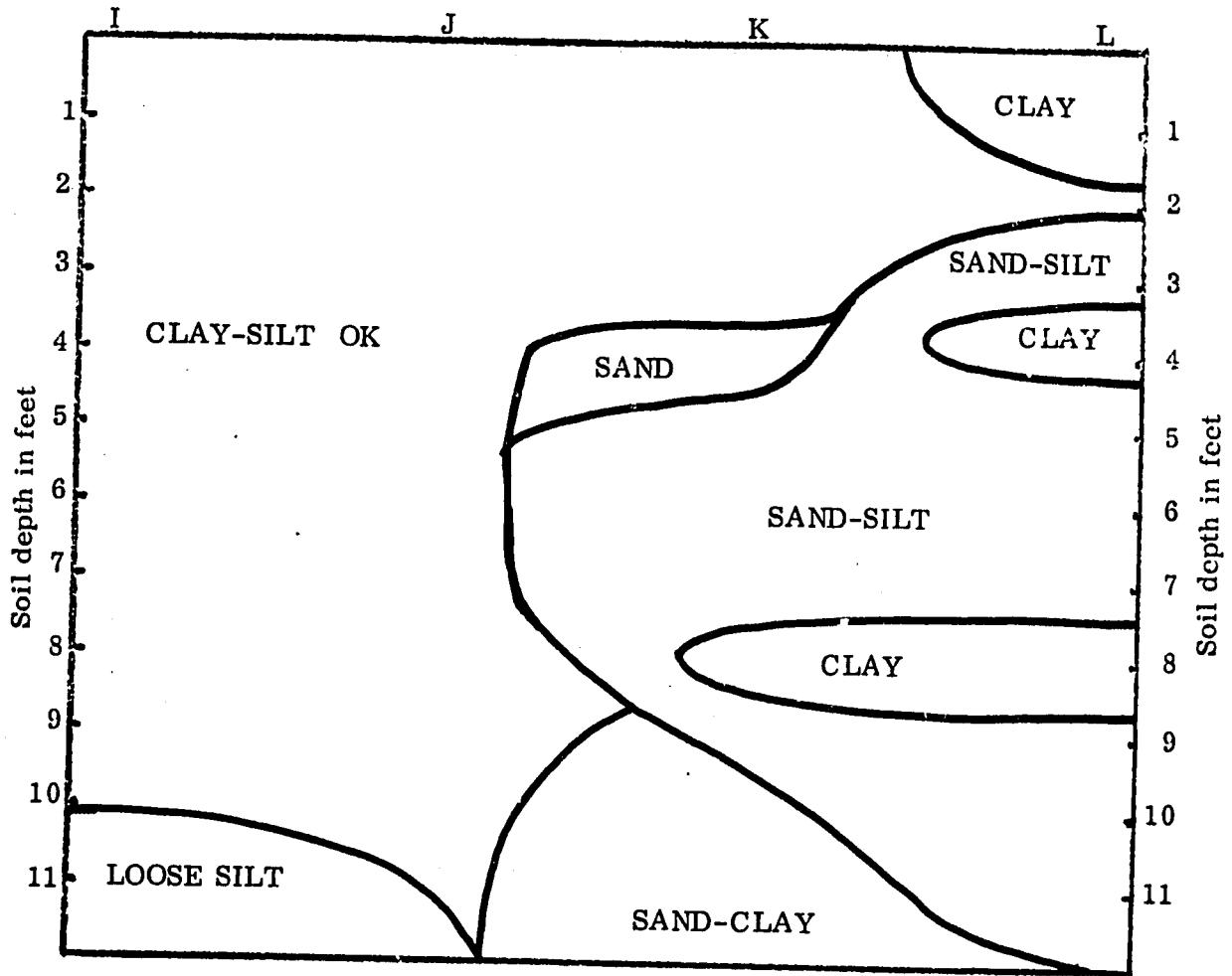
Figure 4. Chandpur Fisheries Station  
Proposed Pond Area  
SOIL PROFILE CHART



These soils lie at the east end of the proposed new pond area. They are satisfactory if a layer of 4 to 6 feet of clay is left below the pond bottom and above the layers of silt. Also core trenches under dams through layers such as that between 5 and 7 feet at point G should be excavated and refilled with clay and thoroughly tamped.

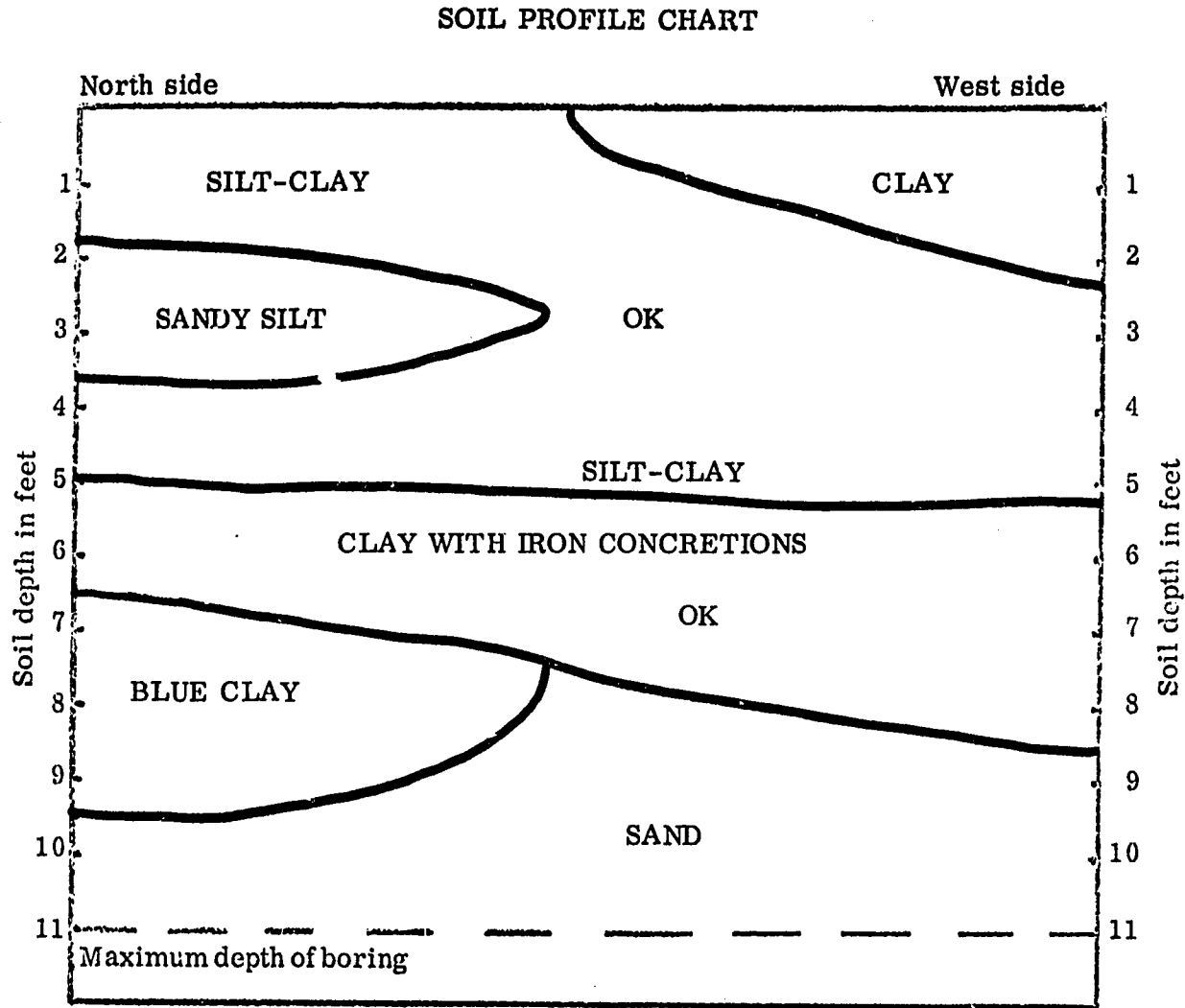
October 30-31, 1968

Figure 5. Chandpur Fisheries Station  
Existing Ponds  
SOIL PROFILE CHART



These soils are in various parts of the existing pond area and readily explain why most of the ponds do not hold water well. The bottoms of the ponds are excavated to depths of 9 to 10 feet and no core trenches were excavated and refilled with clay below the dams. Ponds in the areas I and J hold water much better than those at locations K and L as would be evident from the soil profiles. At point I, a shallow pond should hold water better than one excavated down near the area of loose silt at 10 feet.

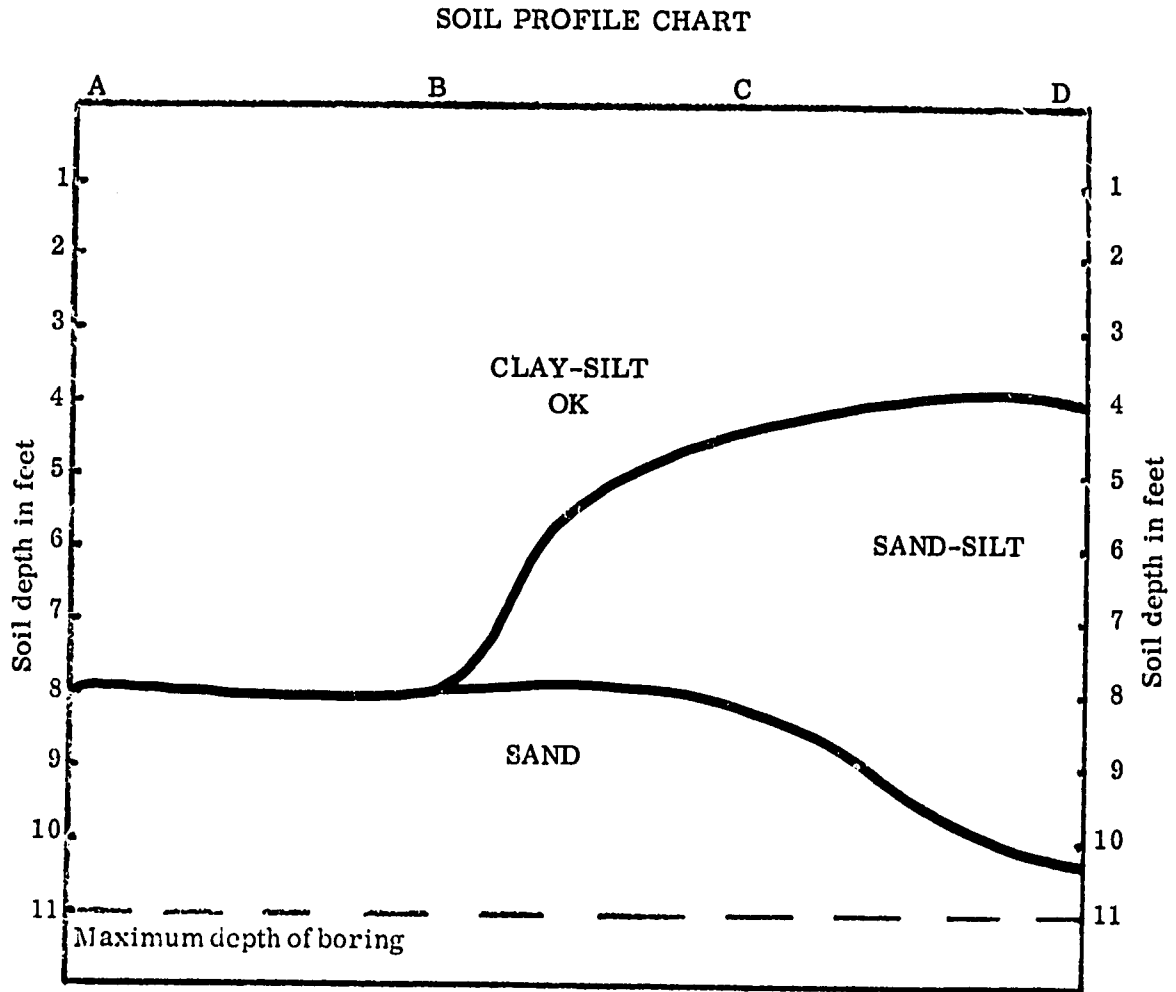
Figure 6. Chandpur Fisheries Station  
Small Pond Area



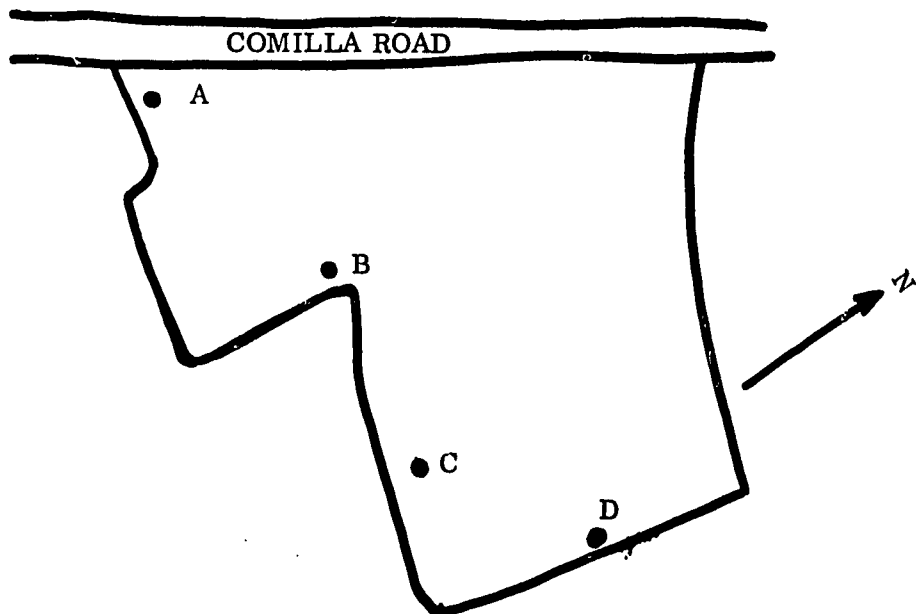
These soils in the small pond area are extremely variable. Here again sands lie below 7.5 to 10 feet with more impervious soils above. If ponds must be built in such an area, repacked core trenches must be used below dams, the pond bottoms should not lie below 4 feet from the soil surface, and the pond bottoms should be packed as tightly as possible.

October 30-31, 1968

Figure 7. Chandpur Fisheries Station  
New Area (6.2 Acres) - Across Road From Station



AREA MAP





of both pond bottoms and dams, suitable ponds could be constructed here. Since no water would be available to replace losses during the dry period, it would be necessary to drill about 4 wells to supplement water supplies. Two 2-inch wells are already present in the existing pond areas, but their yield on a continuous withdrawal basis is unknown. Depths were 90 to 110 feet, with an estimated lift of 30 feet. Losses at periods of maximum evaporation and maximum seepage is estimated in the following table for the better ponds that held water throughout the dry season.

### CHANDPUR STATION

#### Evaporation and Seepage Data

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<u>Item</u>	<u>Inches per day</u>	<u>Average gallons per minute per day</u>
Maximum evaporation (December)	0.138	26.0
Maximum seepage (January)	<u>0.82</u>	<u>153.4</u>
Total loss	0.958	179.4
Rainfall (7.5" January - May)	0.06	11.2
Replenishing required	0.90	168.2

---

If both maximum evaporation and seepage occurred at the same time, approximately 168 gallons water per minute per acre would be required to replace these losses. If 4.8 acres of new ponds are constructed, the new total of 13.8 acres of experimental ponds would require approximately 2500 gallons water per minute per acre replacement at maximum loss. Possibly compaction of the bottom soils and

care in construction could greatly reduce this requirement.

With proper care it was considered possible to construct 18 ponds 0.1-acre, and 12 ponds 0.25-acre. The general plan of construction is given on the following diagram. All ponds are drained into a central closed canal from which water can be lifted by pumps over the surrounding levee. Ponds are drained into the central canal by underground 4-inch transite pipe between each 2 sets of ponds. Within each pond a 4-inch galvanized iron standpipe connected by a 90° ell to the drain pipe removes and/or regulates the water level. The bottom of the ponds are excavated to 4 feet below soil level and carefully packed. Dams extend 5 feet above soil level, with 8 feet width of dam from water level to water level. Slope of dams is 1.5:1 and tops are 5 feet wide. Other details of construction are given in the Appendix under Pond Construction at Chandpur.

The estimated costs of construction are as follows:

A total of 18 ponds 0.1-acre and 12 ponds 0.25-acre can be constructed on the land available on the Chandpur Station resulting in 4.8 acres of water. Total volume of earth to be excavated is 800,000 cubic feet or 30,000 cubic yards.

	<u>Dollars</u>	<u>Rupees</u>
Excavation-dam construction 30,000 yds. <sup>3</sup> @ 4 rupees		120,000
Drain pipes	3,000	
Pump, 6-inch for dewatering canal	600	
Two portable tube irrigation pumps	600	
Labor, 1,000 man-days		5,000
Wells, 4 with pumps	2,500	20,000
Sealing ponds (14 acres total)	3,000	10,000
Laboratory equipment	<u>15,000</u>	<u>          </u>
Totals	\$24,700	155,000

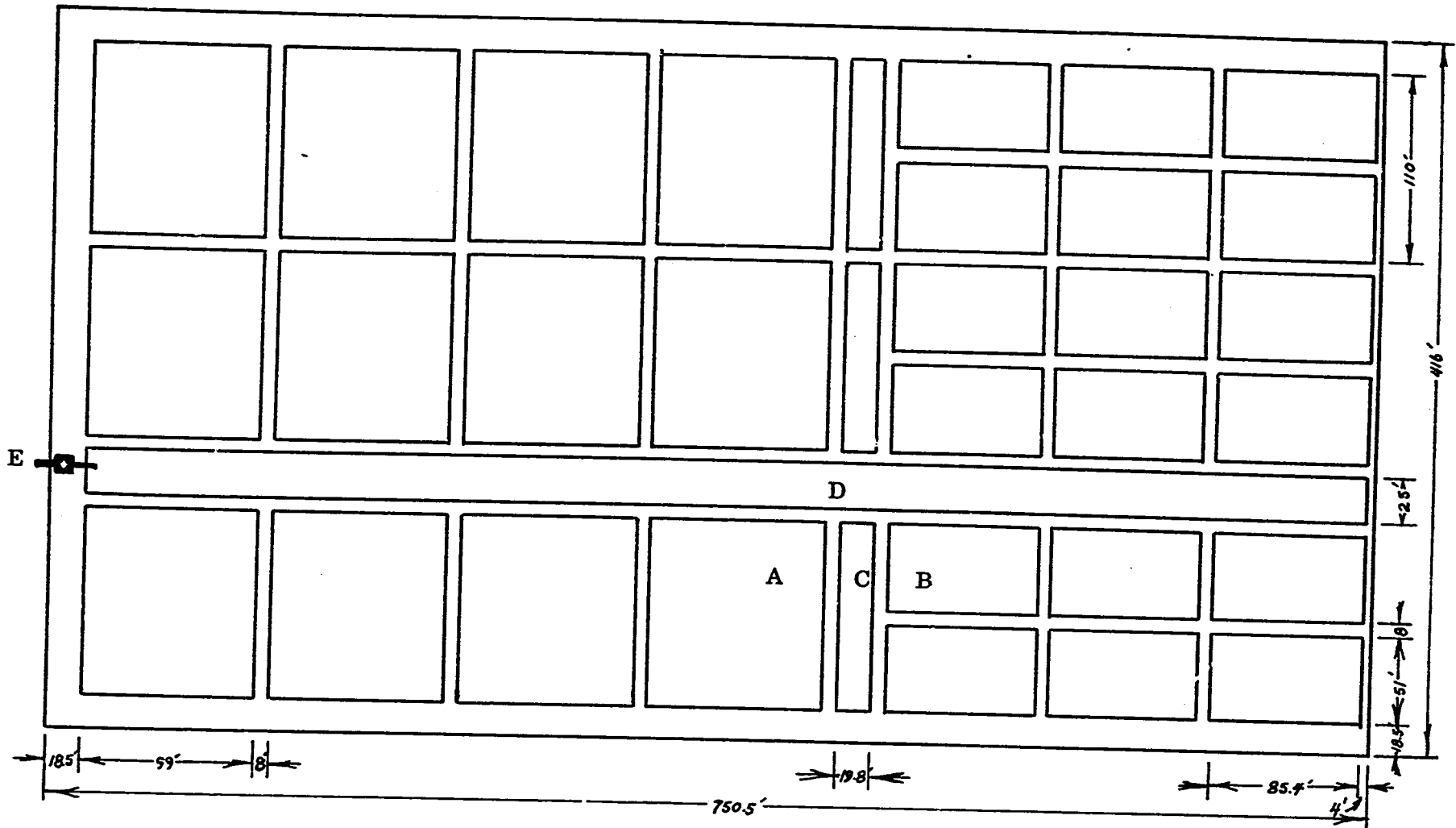


Diagram of earthen ponds proposed for Chandpur Fisheries Station showing (A) twelve 0.25-acre ponds, (B) eighteen 0.1-acre ponds, (C) three 0.05-acre ponds and (D) drainage canal.  
 An electric pump installed at point E will dewater canal when experimental ponds are being drained.

### Other Research Facilities

It is proposed to construct 48 concrete-covered brick center ponds each having an area of 1/100 acre for use at the Chandpur Fisheries Station. These are extremely useful in research on fish feeds and feeding, induced spawning, rearing of fry to fingerling size and many other fish production problems. The general plan of construction is given in the attached drawing and further details are given in the Appendix under Pond Construction at Chandpur. The center walls are of brick, covered with a cement-sand mixture made of 3 parts fine sand to 1 part portland cement.

The estimated cost is as follows:

33,500 square feet in floors and walls	140,000 rupees
Labor	2,000
Leveling of area	3,000
Pipe inserts for drains 2" x 50' plastic pipe	100
48 stoppers (rubber, wood or plastic)	<u>100</u>
Total	145,200 rupees

Approximately 50 plastic-lined ponds 10 feet in diameter are also needed.

The cost is estimated as follows:

50 ponds	\$1,400
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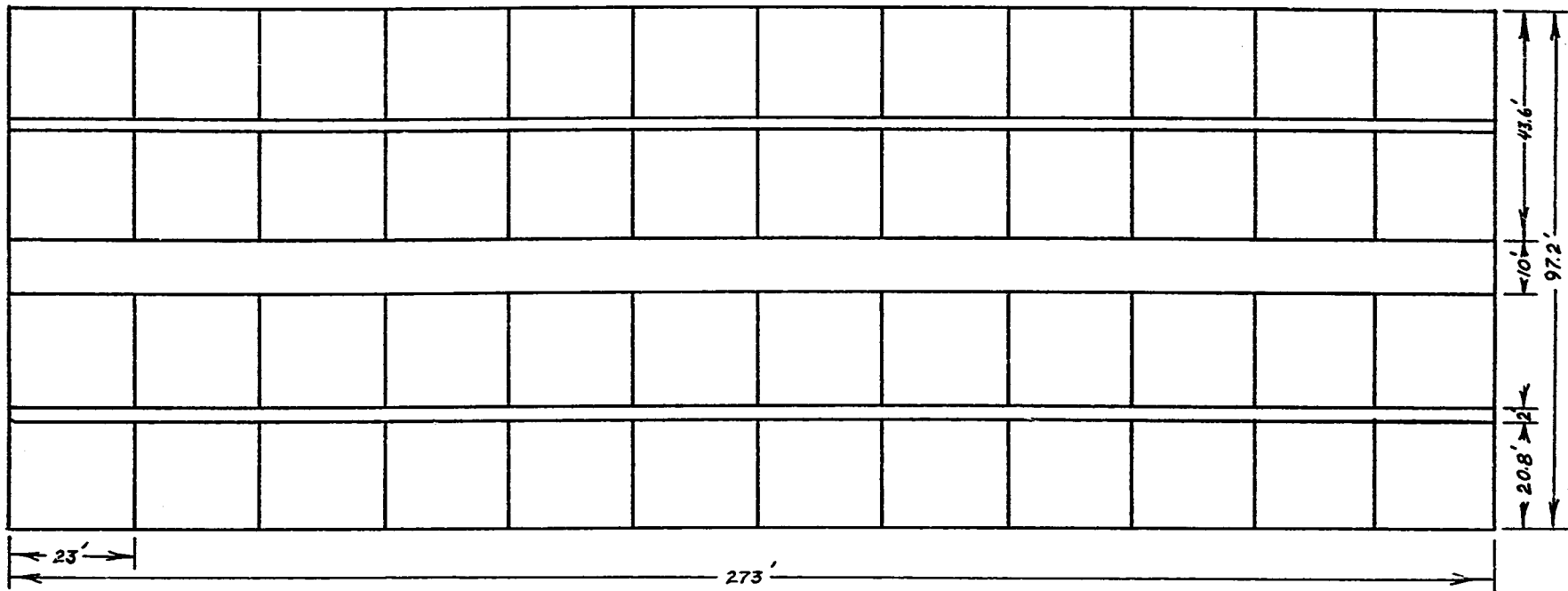


Diagram of concrete ponds proposed for Chandpur Fisheries Station showing 48  
1/100-acre ponds with draining canals between series of ponds.

**Total Costs of New Facilities at Chandpur**

	<u>Dollars</u>	<u>Rupees</u>
30 earthen ponds	\$ 9,700	155,000
48 concrete ponds		145,200
50 plastic-lined ponds	<u>1,400</u>	<u>          </u>
<b>Totals</b>	<b>\$26,100</b>	<b>300,200</b>

**Use of Ponds on Fish Seed Farms for Research**

Since Chandpur would have an inadequate number of ponds for most effective research, some of the better fish seed farms should be used to test rates of stocking, fertilization and feeding that were developed at the main station. The cooperating stations would be carefully selected by the Directorate of Fisheries on the basis of suitability of ponds and level of training of the manager. It would be necessary to set up a short course in research methods and procedures for the cooperating station personnel and to arrange for periodic visits to each participating fish seed farm by biologists in the host country, accompanied once annually by a member of the Auburn Team.

<u>Cost</u>	<u>Dollars</u>	<u>Rupees</u>
1 Jeep or similar vehicle	\$3,000	
Annual operation		5,000
1 biologist (salary)		5,000
Per diem	<u>          </u>	<u>2,000</u>
<b>Totals</b>	<b>\$3,000</b>	<b>12,000</b>

Plan of Pondfishery Research Station on Impervious Clay Soils at Joydepur, Dacca

Suitable clay soils for pond construction with minimum seepage were found only at the Jangalia Fish Seed Farm near Comilla, at Khalia Prsiamari (Paikgacha), at Amnura Fish Seed Farm, at Rajshahi Fish Seed Farm, and at Joydepur Fish Seed Farm near Dacca. Soil profiles and general descriptions are given in the Appendix.

Of these, Paikgacha was considered too remote and isolated for a research station. The Amnura and Rajshahi Fish Seed Farms are in an area where evaporation equals the rainfall, thus eliminating the possibility for water storage in reservoirs for use in the dry period. The Jangalia area near Comilla was suitable, but more remote from the central office than Joydepur (Dacca). At the latter station, a stiff clay extended from the surface down to 11 feet, the maximum depth of boring. The rainfall in the area is approximately 83 inches.

The general plan of construction is given on the following diagram.

The following plan of construction in heavy clay soil near Dacca at the Joydepur Fish Seed Farm was planned to overcome most of the difficulties encountered at Chandpur. It proposes:

1. Construction of a 9.2-acre moat around the 3 sides of the experimental pond area. This will store 83 acre-feet of water if excavated to a depth of 10 feet. Approximately 70 percent or 58 acre-feet should be available as late as April as this tight clay should not allow over 6 inches of seepage during the dry period as compared to 60 inches loss at Chandpur.

2. The bottom of the ponds will be 1 foot below ground level, with the soil excavated from the moat used to construct the dams for 111 ponds to a height of

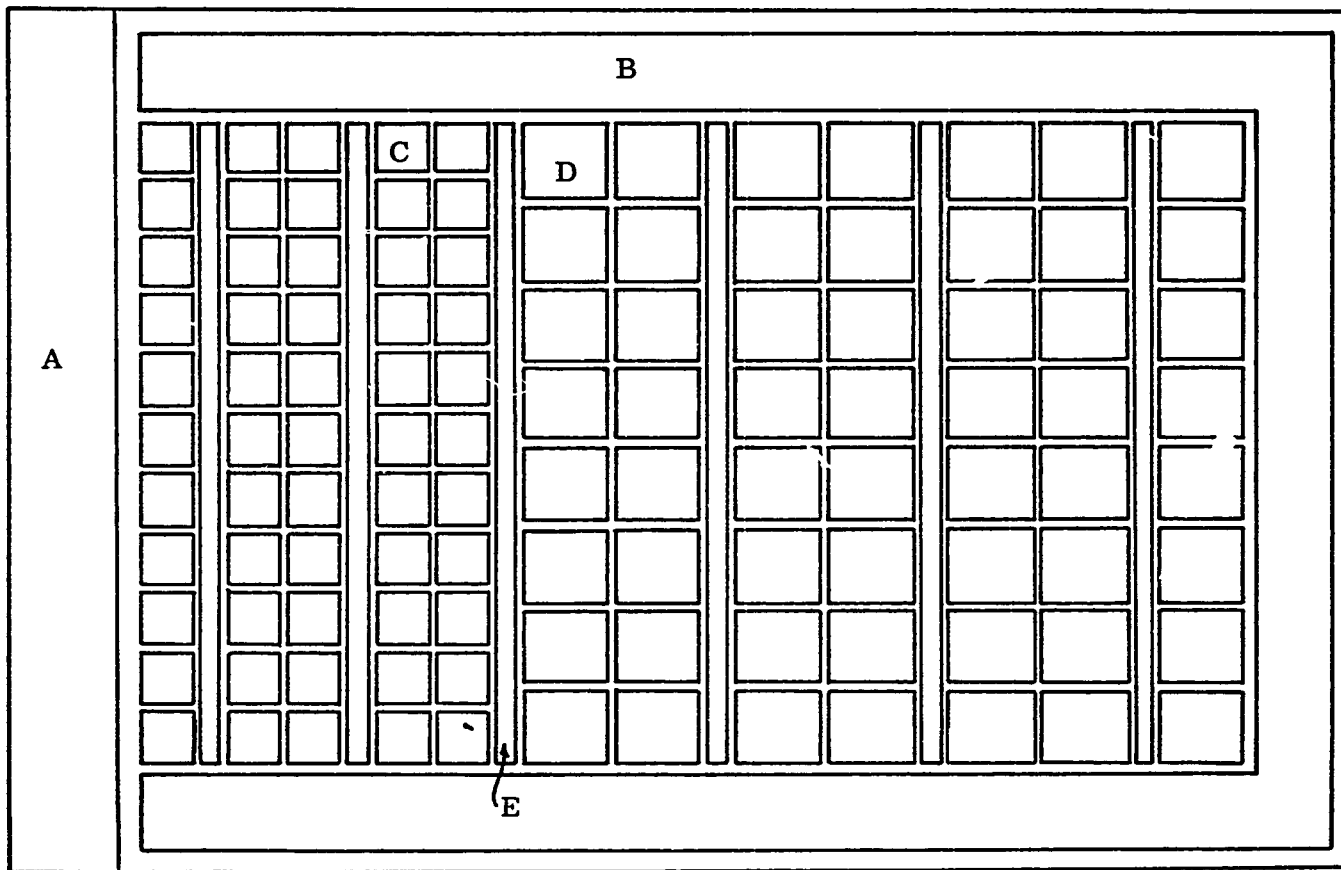


Diagram of proposed research station ponds at Joydepur showing (A) building area, 4.5 acres, (B) moat, (C) 0.1-acre ponds, (D) 0.25-acre ponds, and (E) drain canals. Overall dimensions of area required for above plan are 1136 feet by 1700 feet totaling 49.3 acres. Size of 0.25-acre ponds are 99 x 110 feet; height of dams 6 feet. Size of 0.1-acre ponds are 70 x 62 feet; height of dams 6 feet. Width of drainage canal is 25 feet. The U-shaped moat is 1482 feet long, 1080 feet wide and 10 feet deep. Total land required is 50 acres, but an additional 25 acres should be acquired for expansion in the future.



5 feet above ground level. With 1 foot of freeboard, this will leave 5 feet of water. This level can be maintained by adding water from the moat to replace evaporation plus seepage estimated at 2 to 2.5 feet.

3. The ponds will be constructed with 4-inch standpipe drains, which will empty into a drainage ditch whose depth is 1 foot below the pond bottom. The drainage ditch will collect from a series of ponds the overflow water during rains and will carry water when the pond is drained into a deep sump where it can be pumped outside into the moat or discharged into a roadside ditch. This will allow drainage of each pond at the end of experiments and will allow reuse or disposal of the water as desired.

Estimated Cost of Pondfishery Research Station<sup>1</sup>  
on Impervious Clay Soils at Dacca (Joydepur)

	<u>Dollars</u>	<u>Rupees</u>
Excavation 160,000 cubic yards @ 4 rupees		640,000
Drain pipes	\$ 5,000	
Water supply pipes	6,000	
Labor		45,000
Buildings for research		
Research laboratory 1,000 square yards		400,000
Fish processing shed 200 square yards		20,000
Service building - garage, workshop, storage		20,000
Residence and Guest Houses		400,000
Fencing		20,000
Laboratory equipment	15,000	

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<sup>1</sup> Excluding cost of 50 acres of land.

	<u>Dollars</u>	<u>Rupees</u>
Other facilities		
Electricity generating system	\$10,000	
Wells (2) and pumps	500	30,000
Sump pumps (2)	<u>1,000</u>	<u>        </u>
Total	\$37,500	1,575,000

Periodic Visits by Auburn Research Specialists

The success of the proposed program lies in teaching personnel of the host country to think, plan, and use experimental methods to develop improved and more highly productive fishcultures.

It is not desired to place trained Auburn personnel full-time in the host country because too much dependence upon them for planning and conducting experiments usually develops. It is expected that periodic visits by trained Auburn University personnel at approximately 6-month intervals to assist in planning experiments, to teach experimental methods and to check upon the progress and problems of the research personnel will more rapidly develop personal responsibility and competence on the part of the host country personnel.

Annually, a short course in one or more locations in the host country will be conducted by specialists from Auburn University to strengthen research capabilities and competence among fishery personnel of the host country.

Special Visits of Specialists from Auburn University

If special problems arise, such as fish kills from disease or parasites, for which there is urgent need for a specialist to help the host country in its fishery program, short-term trips of up to 2 or 3 weeks will be arranged when requested

by the Directorate of Fisheries, and such visits are considered essential for advancement of this program.

Experiments on Reduction of Seepage in Ponds

If the Chandpur Station is to be used for fisheries research, there must be a certain amount of testing and research on methods of sealing pond bottoms. This should include compaction of the pond bottom and the dams, which could be done by the use of the water buffalo if mechanical equipment is not available. Tetra-sodium pyrophosphate mixed with the top 6 to 8 inches of the pond bottom, followed by compaction should also be tested. These are usable methods only where considerable amount of clay is present. Where the pond bottoms are practically pure sand, either clay must be brought in or the use of a soil cement for the pond bottom should be investigated.

The many ponds at the fish seed farms with excessive seepage will be excellent places for testing various methods of reducing seepage.

APPENDIX

I. SOILS OF EAST PAKISTAN

## SOILS OF EAST PAKISTAN

The soils of East Pakistan are classified into 7 distinct soil tracts.<sup>1</sup>

These can be grouped into three physiographic divisions: hill soils, old alluvial soils, and recent soils. The soils of the Comilla district including Chandpur and Comilla belong to the recent soil group and specifically to the Brahmaputra alluvium. The soils of the area are fully inundated and replenished each year by fresh deposits of silt. The soils are grey in color without developed profiles, but with stratification of alluvial deposits. The texture varies from place to place and the pH varies from 5.5 to 6.8. The coastal saline tract is part of the active flood plain but subject to flooding with salt waters at high tides. Most soils appear to be developed in fine textured tidal deposits with peat and organic layers in some locations. Even when protected against tidal inundation, the soils become saline during the dry period due to upper movement of salt from saline water table below. Some of the soils in the Chittagong area belong to this classification. These areas contain large deposits of organic material and other forms of sulfur that oxidize to sulfuric acid in these soils making a large amount of aluminum sulfate and giving them such an acid reaction that they are not usable for agriculture. This oxidation to sulfuric acid takes place as the soils are dried out. Consequently, some of these soils are better used for flooding in ponds so that this oxidation to sulfuric acid does not occur with any great rapidity, if at all. In these

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<sup>1</sup> Islam, Muhammad Amirul. 1967. Soil fertility investigations in East Pakistan. East Pakistan Dept. Agr. Agr. Information Service. 72 pp.

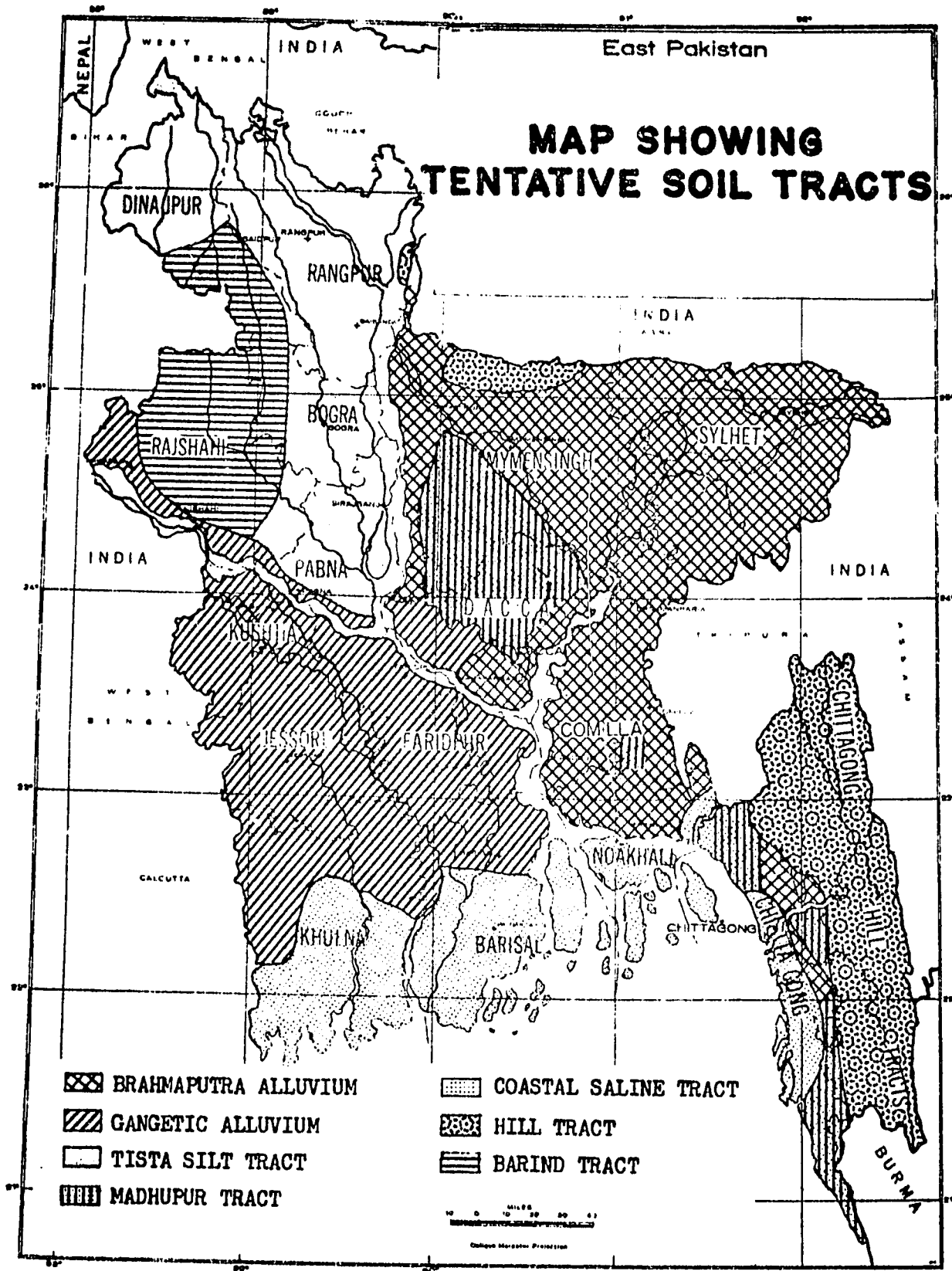
areas, however, certain amount of the aluminum sulfate and sulfuric acid will be formed and heavy liming of ponds is necessary.

The next group, the Gangetic alluvium is formed by the deposits from the Ganga River and its tributaries and classified as river landscape soils. These are rich in calcium, magnesium, potassium and free calcium carbonate. They are often strongly alkaline, and are made up of fine silty loams, grey in color, without a profile, with a pH ranging from 7 to 8.5.

The next group is Tista silt tract. These soils are sandy to sandy loam in texture, no profile development, light greyish in color and poor in lime, pH is 6 to 6.5.

The next group is the Hill tract. These soils are composed of tertiary rocks and unconsolidated Tertiary and Pleistocene sediments. They are sparsely forested. Most of the Chittagong Hill tracts are under this classification. In this area, there is often a shifting agriculture practiced by the primitive tribal people.

The next division, Old Alluvial Soils, Madhupur tract, and Barind tract, are formed on the old alluvium of the Pleistocene. They are clay in texture, reddish to yellowish in color and contain iron concretions, with a pH of 6 to 6.5. A map showing these soil tracts follows.



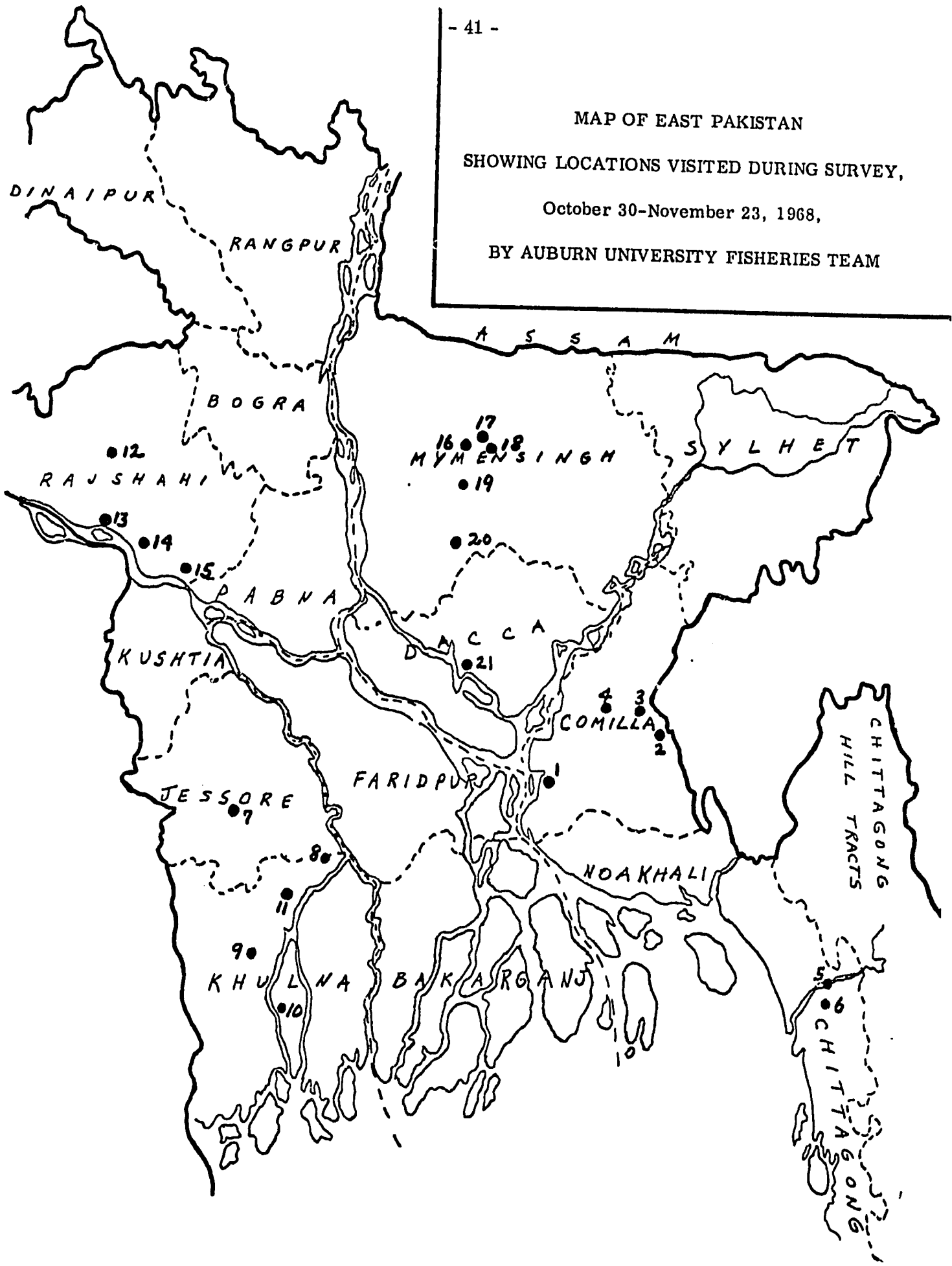
II. ITINERARY OF AUBURN TEAM  
MAPS OF AREAS VISITED  
LOCATIONS OF FISH SEED FARMS



ITINERARY OF AUBURN UNIVERSITY FISHERIES TEAM  
DURING SURVEY OF EAST PAKISTAN, OCTOBER 30 - NOVEMBER 23, 1968

October 30-31	Chandpur Fisheries Station	(1)
November 1	Chandpur and Adjacent Areas	
November 2	Jangalia Fish Seed Farm (near Comilla)	(2)
November 2	Shangraish Fish Seed Farm (near Comilla)	(3)
November 2	Chandina Fish Seed Farm (Comilla)	(4)
November 5	Kaptai Reservoir	(5)
November 5	Patiya Fish Seed Farm (Chittagong)	(6)
November 8	Jessore Fish Seed Farm	(7)
November 8	Baluhar Baor (near Bazrupur)	(8)
November 9	Paikgacha Fish Seed Farm (Proposed)	(9)
November 9	Khalia Prsiamari (Paikgacha) Proposed Site for Brackishwater Fish-Rice Culture Research Station	(10)
November 11	Krishnanagar Fish Seed Farm (Khulna)	(11)
November 13	Amnura Fish Seed Farm	(12)
November 13	Rajshahi Fish Seed Farm	(13)
November 14	Thana Fish Seed Farm (Proposed)	(14)
November 14	Natori Fish Seed Farm	(15)
November 18	Mymensingh-Directorate of Fisheries (Proposed 16-Acre Site)	(16)
November 18	Mymensingh Fish Seed Farm	(17)
November 18	Mymensingh University (Proposed)	(18)
November 19	Hamil Beel (Madhupur Tangail Subdivision)	(19)
November 19	Tangail Fish Seed Farm (Dacca Road)	(20)
November 19	Dacca Fish Seed Farm (Joydepur)	(21)

MAP OF EAST PAKISTAN  
SHOWING LOCATIONS VISITED DURING SURVEY,  
October 30-November 23, 1968,  
BY AUBURN UNIVERSITY FISHERIES TEAM

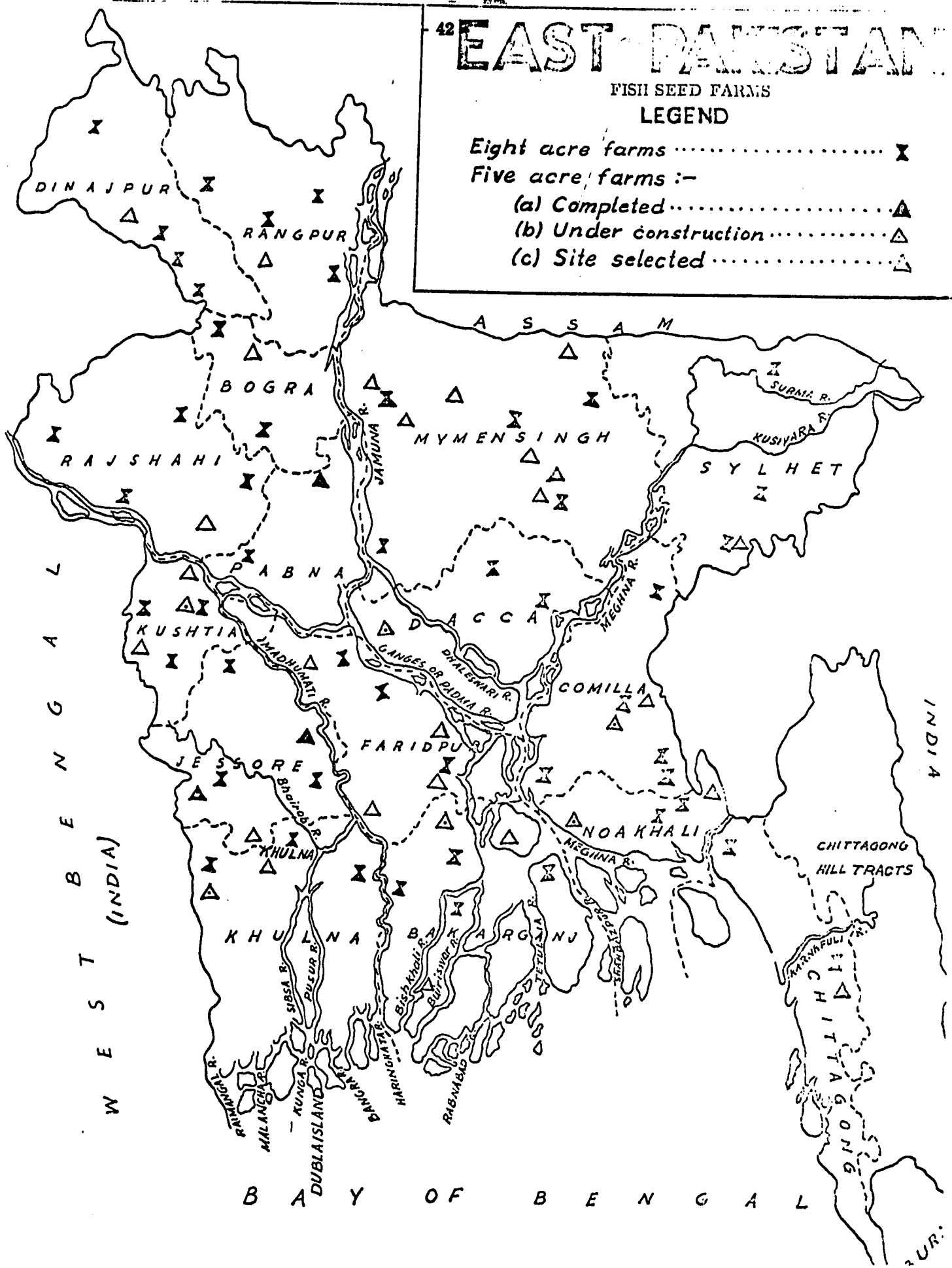


# EAST PAKISTAN

FISH SEED FARMS

## LEGEND

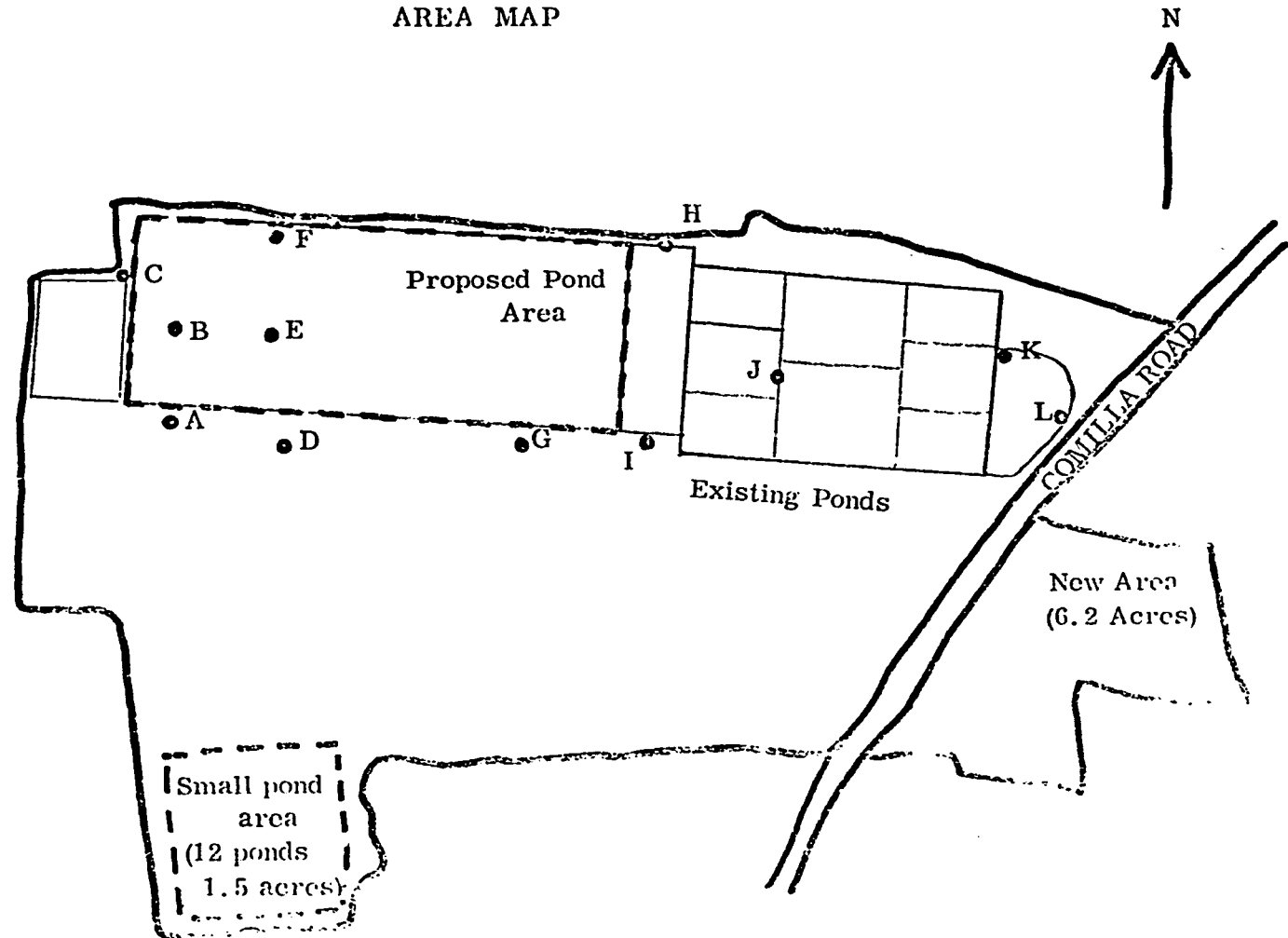
- Eight acre farms ..... X
- Five acre farms :-
  - (a) Completed ..... ▲
  - (b) Under construction ..... △
  - (c) Site selected ..... ◡



**II.**

**1. Chandpur Fisheries Station and Adjacent Areas**

Figure 1. CHANDPUR FISHERIES STATION  
AREA MAP

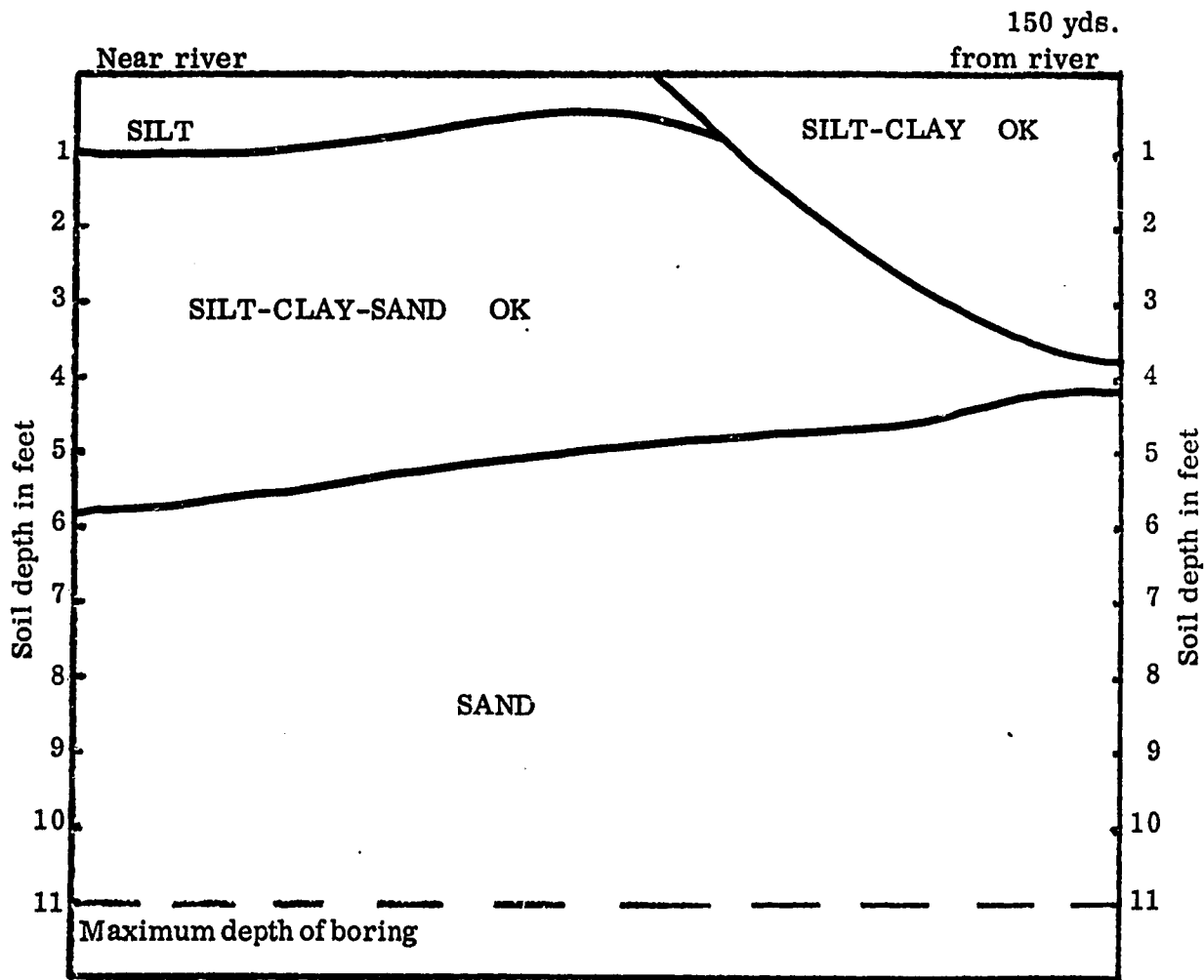


Map showing location of soil profiles and of pond areas. The concrete ponds will be placed south of the "Proposed Pond Area".

November 1, 1968

Chandpur Area (Beside Dakatia River, Ischubi Ghat)

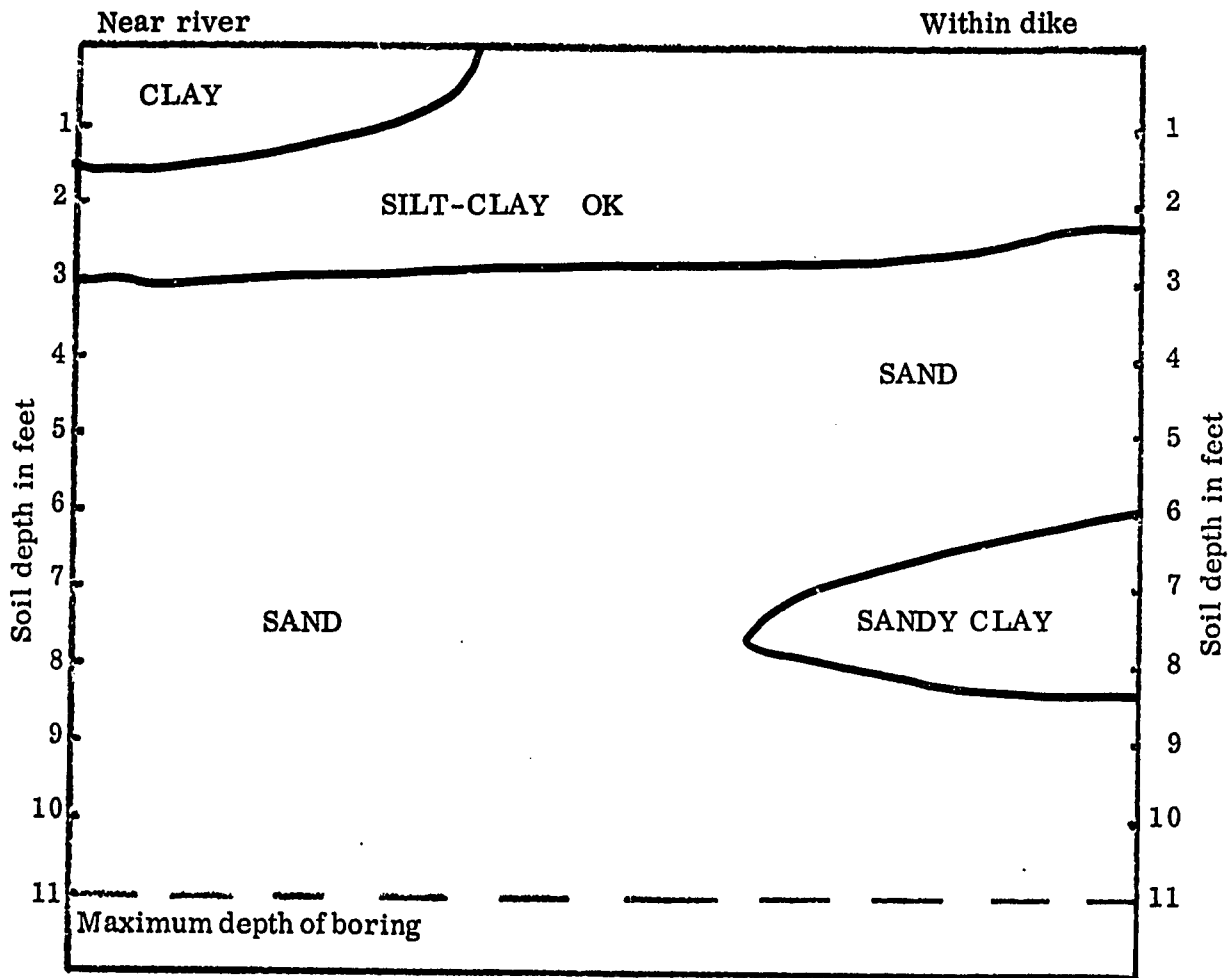
SOIL PROFILE CHART



Soils along the Dakatia River contained greater amounts of coarse sands than soils at the Chandpur Station 1 mile away. It is unsuitable for pond construction. These soils were within an area to be enclosed by embankments.

Chandpur Area (Bend in Dakatia River nearest Chandpur)  
1 mile from Fisheries Station

SOIL PROFILE CHART



Soils here were similar to those near Ischubi Ghat, but were nearer the river edge and sands were closer to the surface. They are unsuitable for pond construction. This is the point along the river closest to the Chandpur Station.

**II.**

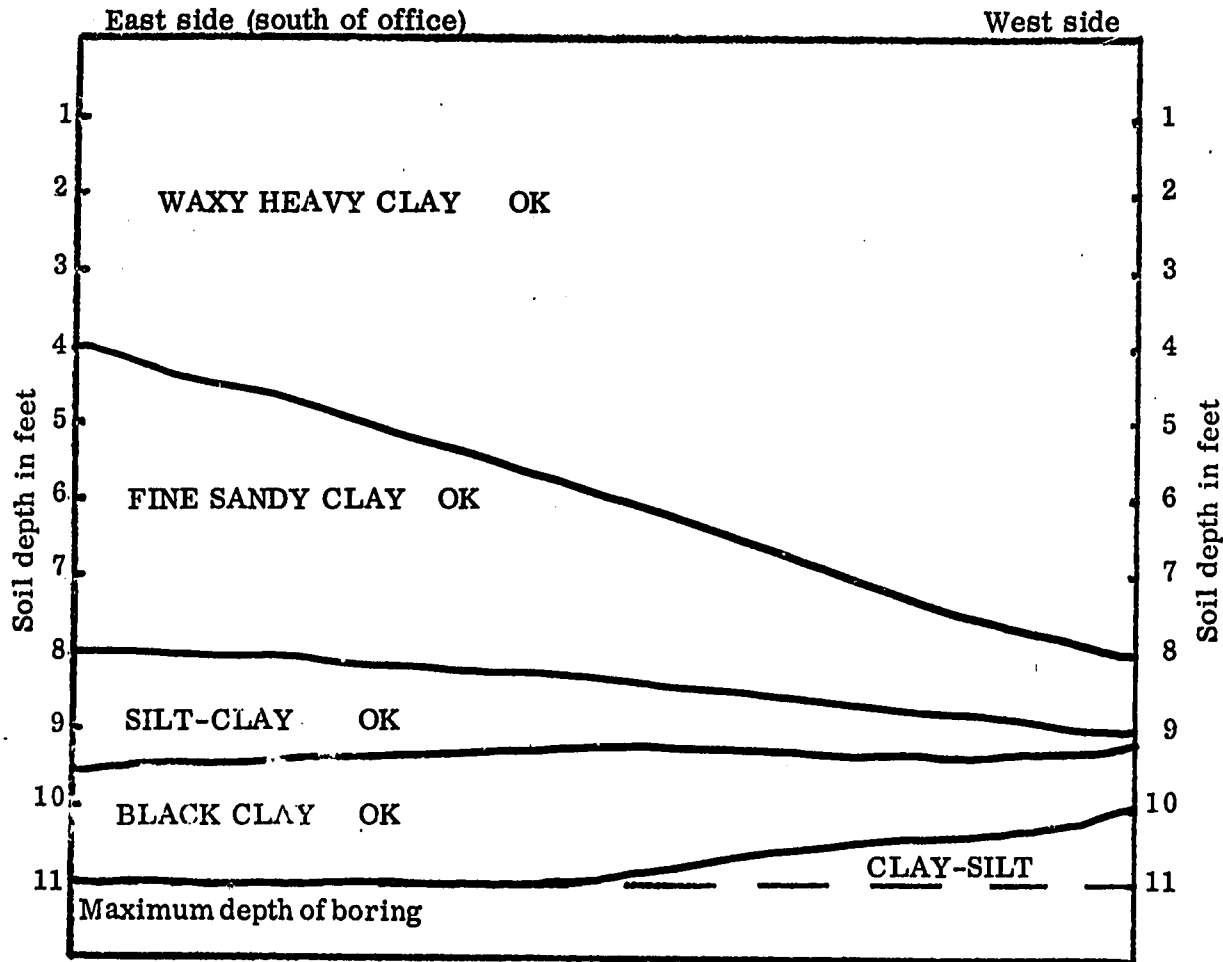
**2. Jangalia Fish Seed Farm Near Comilla**



November 2, 1968

Jangalia Fish Seed Farm (Near Comilla)

SOIL PROFILE CHART



Excellent soils for pond construction were found down to a depth of 11 feet. The 8 ponds on this farm suffer a drawdown of 4 to 4.5 feet during the dry period, largely due to evaporation. South and east of the farm are extensive rice fields and a pond station could be located there. It would be possible to construct a large water storage reservoir and build ponds to water depths of 6 to 7 feet. Last year floods overtopped the dams by about 2 feet following a break in the river levee. No flooding has occurred in other years. The present dams are about 5 feet above the old ground level on the south and east sides. The cost of the land in the area was 10,000 rupees per acre.

**II.****3. Shangraish Fish Seed Farm Near Comilla**

### **Shangraish Fish Seed Farm Near Comilla**

This Farm had 12 ponds, 1 to 2 acres each, that had been built years ago by Indian fish farmers. Since the owners had migrated to India, the ponds were requisitioned by the Government. By use of induced spawning method, fry of mrigal were produced but this method has not been successful in spawning catla. From a 1-acre pond stocked with 500,000 fry and fertilized with N-P-K, it was estimated that 300,000 fry were produced and sold to farmers. The remaining fish were at a size of between 6 and 9 inches on November 2 and will be raised to market size and sold to add to the income of the Government.

The pond drawdown was between 4 and 4.5 feet during the dry period. The maximum depth of water was 7 feet. In the ponds operated only for production, approximately 1200 carp fry were stocked per acre. The estimated production was 200 to 250 pounds per 1/3 acre or 600 to 750 pounds per acre. Unfortunately, the fish were not weighed as they were taken from the pond. The fish seed farm operators indicated that no scales were available for weighing fish, but the fish were measured and the total lengths of the fish were recorded. The average size of the fish sold was said to be between 2 and 3 pounds, which would mean that not more than 250 fish survived out of the original 1200.

These ponds would make very good experimental areas to obtain data on the effects of various rates of stocking and fertilization on production.

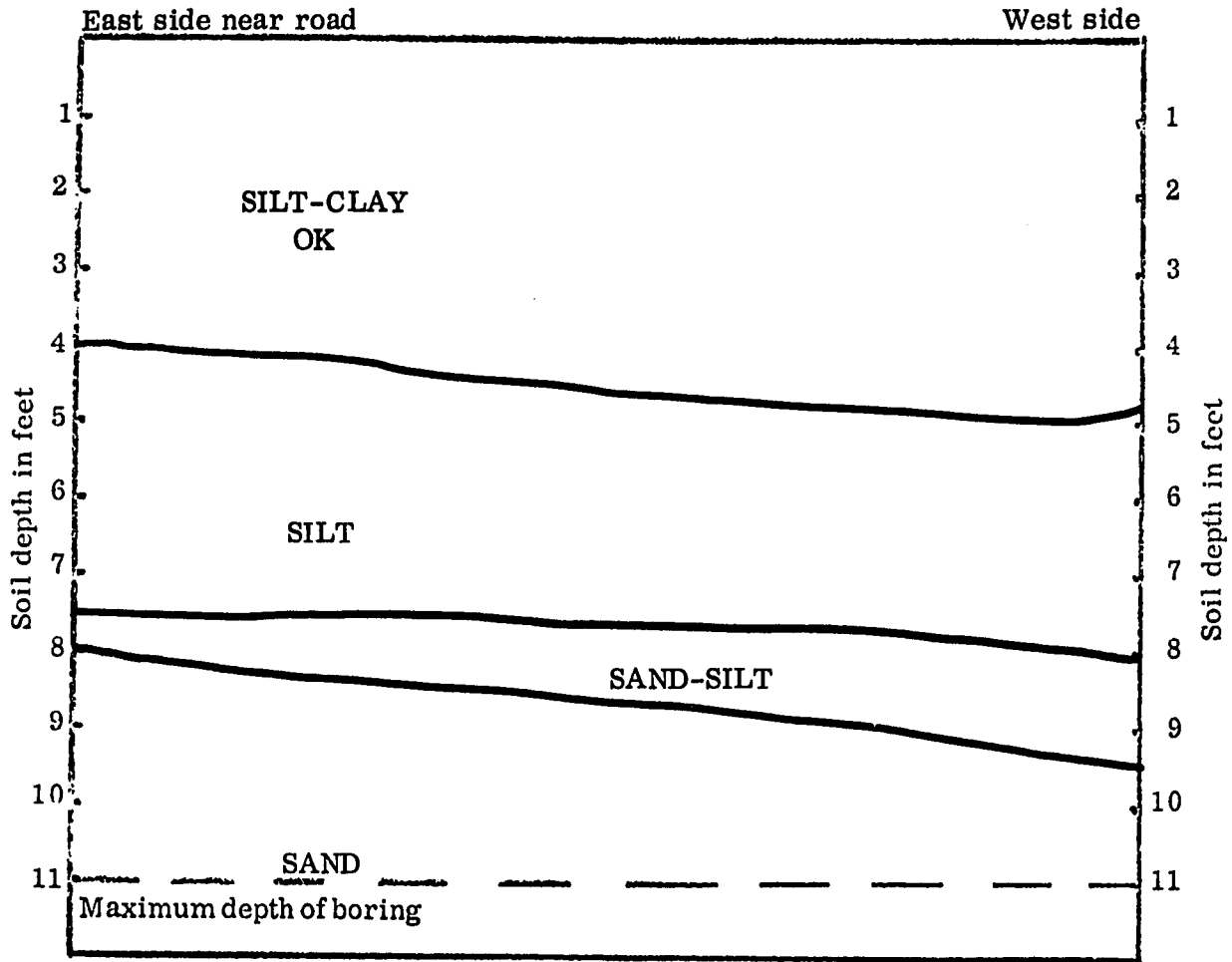
**II.**

**4. Chandina Fish Seed Farm Near Comilla**

November 2, 1968

Chandina Fish Seed Farm (Comilla)

SOIL PROFILE CHART



Ponds on this Farm held water poorly as would be expected from the above soil profile. Also, the dams contained so much sand that they were eroding excessively. It would be a suitable place to determine the value of compaction and/or chemical treatment of the pond bottom to reduce seepage.

- II.
  5. Kaptai Reservoir and the East Pakistan Fishery Development Corporation

### **Kaptai Reservoir and the East Pakistan Fishery Development Corporation**

On November 5 we made the trip to Kaptai Reservoir on the Karnaphuli River, in the Chittagong Hill tracts. One purpose of the trip was to evaluate the possibility of a pond research station using water from the Kaptai Reservoir. This was not feasible because of the isolation of the reservoir and because no level land is available in the area for pond construction.

The reservoir had a maximum depth of 110 to 120 feet. It covers an area of 343 square miles equivalent to 219,520 acres. However, since the impoundment varies in area from the rainy period to the dry period, partly because water is drawn out of the reservoir for hydroelectric power, the East Pakistan Fishery Development Corporation (EPFDC) has estimated that the average surface acreage was 192,960 acres for the entire year. This is the figure used in calculating the production of fish per acre. The water was clear, with a visibility down to approximately 6 feet and the investigations indicated there was no part of the lake that was without oxygen, there being approximately 1 ppm in the deepest water.

Rangamati is the headquarters of the Chittagong Hill tract area and the central landing and fish market operated by the EPFDC. The Directorate of Fisheries is constructing a laboratory for research on the lake at this location. At the present time, they are conducting limnological studies of a limited nature on the lake. A table showing the catch and composition of fish by species during 1967-1968 follows. The total catch was 7,150,424 pounds or approximately 37 pounds per acre.

CATCH AND COMPOSITION OF FISH BY SPECIES  
IN KAPTAI LAKE 1967-1968

<u>Species</u>	<u>Catch</u> <u>(thousands of pounds)</u>	<u>Percentage</u> <u>Of total catch</u>
<u>Cirrhina mrigala</u>	1,257.8	17.5
<u>Labeo calbasu</u>	986.1	13.7
<u>Labeo gonius</u>	875.8	12.2
<u>Catla catla</u>	710.6	9.9
<u>Barbus sarana</u>	655.5	9.1
<u>Gadusia chapra</u>	629.1	8.7
<u>Mystus aor</u>	561.2	7.8
<u>Notopterus chitala</u>	367.1	5.1
<u>Wallago attu</u>	324.8	4.5
<u>Labeo rohita</u>	239.6	3.3
<u>Ophiocephalus marulius</u>	237.6	3.3
<u>Notopterus notopterus</u>	102.0	1.4
<u>Barbus tor</u>	100.2	1.4
<u>Eutropiichthys vacha</u>	79.0	1.1
<u>Mystus armatus</u>	15.7	0.2
<u>Engraulis telara</u>	5.9	0.08
<u>Mystus tengara</u>	<u>1.9</u>	<u>0.02</u>
Totals	7,149.9	99.3



The reservoir fishery is operated by the EPFDC with two landing sites; one at Kaptai, which gets about 10 percent of the landings and the rest at Rangamati, which gets approximately 90 percent of the total fish. All fish caught, except those eaten by local fishermen, must be brought to the landings, weighed, and a royalty of 5 rupees per maund (82 pounds) is paid to the EPFDC, who is trying to operate the fishery at maximum sustained yield. The operation apparently consists entirely in the regulation of the fishery. The program of the Corporation, which is a part of the Government, includes mechanization by the use of outboard motors, improvement of fishing gear, and providing fish markets for selling fish by auction, within a fixed price system. The gear used is principally floating nylon gill nets with mesh varying from 3 inches to 6.5 inches. Nets are supplemented by the use of long lines which take species of fish such as the eel which are not taken by the floating gill nets. However, no population survey has been made to determine whether all fish present in the reservoir are being adequately harvested.

There is a yearly license of 2 rupees per unit of gear. A unit consists of a fishing boat with or without a motor, three fishermen, and 10 pounds of nets. The fish caught by the fishermen are sold through cooperatives or directly to fish buyers. A fisherman gets for major carps approximately 35 rupees per maund. All fish catches must come to the landings operated by the EPFDC, which determines a minimum price by consulting sale values of fish at Chittagong and other cities. The cooperative, or fish buyers, then bring the fish into a central market on the edge of the lake and get 50 to 55 rupees per maund.

The EPFDC also makes outboard motors available to cooperatives for transporting fish to the market areas. There is one 5-ton iceplant and a new iceplant and cold storage facility is to be constructed at Rangamati. At present, there are no fish storage facilities.

Mr. Abdul Latif, Manager, Fish Harbor, Chittagong, explained that operation of the EPFDC in the Chittagong area was divided into five categories. 1. Pre-investment survey scheme - to evaluate the extent of a fishery as a commercial possibility. At the present time, trawlers purchased by private investors have failed to make a profit. This is due in part to the fact that fishing in the Bay of Bengal is not especially good and also because no fishing at all is possible during the monsoon period. During the rest of the year, there are certain periods when storms in the Bay prevent the fishermen from going out. There is a five-month period in which fishing may be possible, but the storms probably reduce the actual fishing time to not over three months. 2. Outboard motorization of the fishing fleet and improvement of fishing vessels. This is being accomplished in part through assistance programs sponsored by various foreign countries. 3. Fish processing. There is now a plant in Cox's Bazar which processes fish that are inferior or surplus. This constitutes almost 33 percent of the marine catch. Fish fall into this category due to the lack of ice, poor transportation, and sometimes lack of adequate market nearby. At the fish processing plant, the fish are dried or salted and a small amount is prepared as fish meal. This fish meal was prepared by drying the fish and grinding them to a powder. Thus, it contains the oil which is usually pressed from fish

in the making of commercial fish meal. 4. Harvesting methods. Floating nylon gill nets have been introduced and are used widely. Trawling is being tried experimentally but has yet to demonstrate that the return is sufficient to pay for the equipment. However, Mr. Latif pointed out that this type of operation might be necessary despite the lack of profits in order to supply the protein needed by his country. 5. Fish landing areas and harbor. Fish landing markets or ports are being built in various areas so that the fish may be brought in on a concrete floor where water is available to keep them clean and also where the buyers can come to buy the fish. Also under construction is a fish harbor to hold approximately 60 fishing vessels, complete with ice-plant, cold storage facilities, workshops, dry docks, and other facilities. Since fishing is possible in the Bay of Bengal principally during the fair weather months of November to March, the facilities will find only seasonal use unless the supply of fish and shrimps is augmented by their culture or capture along the coastal areas.

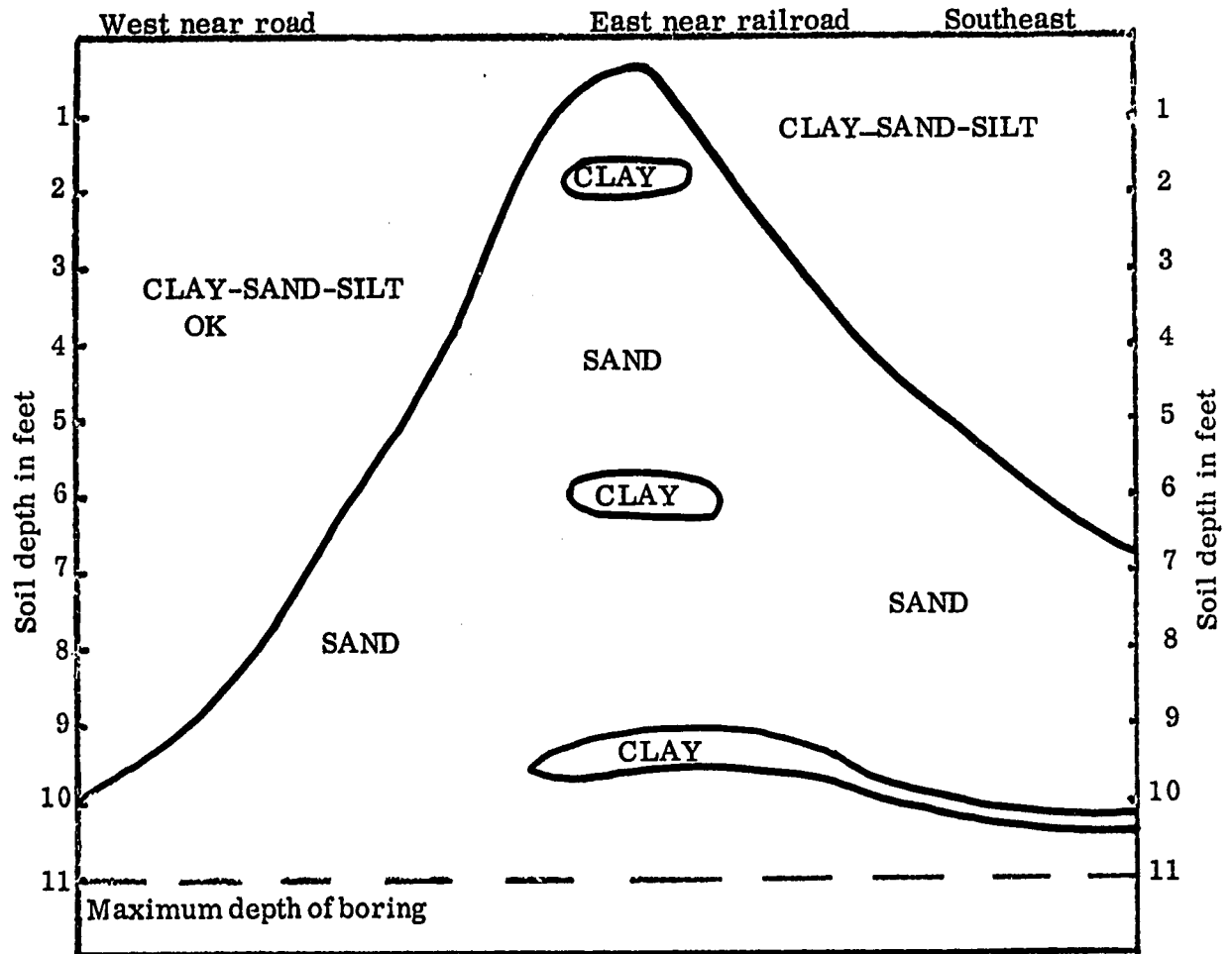
The East Pakistan Fishery Development Corporation has almost no salinity measurements along the east coast, north or south of Chittagong, but indicated that such measurements will be made in the future. The possible areas for brackishwater culture appear principally to lie south from Chittagong to Cox's Bazar. However, there is still the possibility that some of the area north of Chittagong would be useful. This can only be determined when adequate salinity measurements have been made. Some of the areas mentioned as possible sites for a research station were: Sangu River, Marskal Channel, Kutubdi Channel, and Eadgong River. The difference between high and low tide in this area is between 10 and 12 feet.

II.

6. Patiya Fish Seed Farm (Chittagong)

Patiya Fish Seed Farm (Chittagong)

SOIL PROFILE CHART



The soils at this farm were quite varied. Maximum depth of ponds was 4 feet and drawdown in the dry period was 2 feet. Annual rainfall in the area exceeds 90 inches; only the months of November, January, and February have rainfall less than 3 inches. The soils were considered unsuitable for construction of an experimental station.

**II.**

**7. Jessore Fish Seed Farm**

### Jessore Fish Seed Farm

The total area of the Jessore farm is 13 acres with a water area of 3.3 acres in 8 ponds. The ponds were constructed in 1961 and 1962, and cost of construction was 44,458 rupees. The construction of the office and residences for the officers cost 17,820 rupees.

Young fish are obtained from nearby rivers after the major spawning period. They were raised to a size of 2 to 3 inches and sold to fish farmers. The sale price varied with size and the price over the years varied from 5 to 15 rupees per thousand fish. The annual cost of operation of this farm was approximately 2,000 to 2,700 rupees. The number of fry produced varied from 100,000 to 412,000. The gross income from the sale of fish rose from 948 rupees in 1962 to a high of 2,425 rupees in 1963-64. Fish that could not be sold were retained in the ponds and grown to large size. Some of these were finally sold as commercial fish on the market.

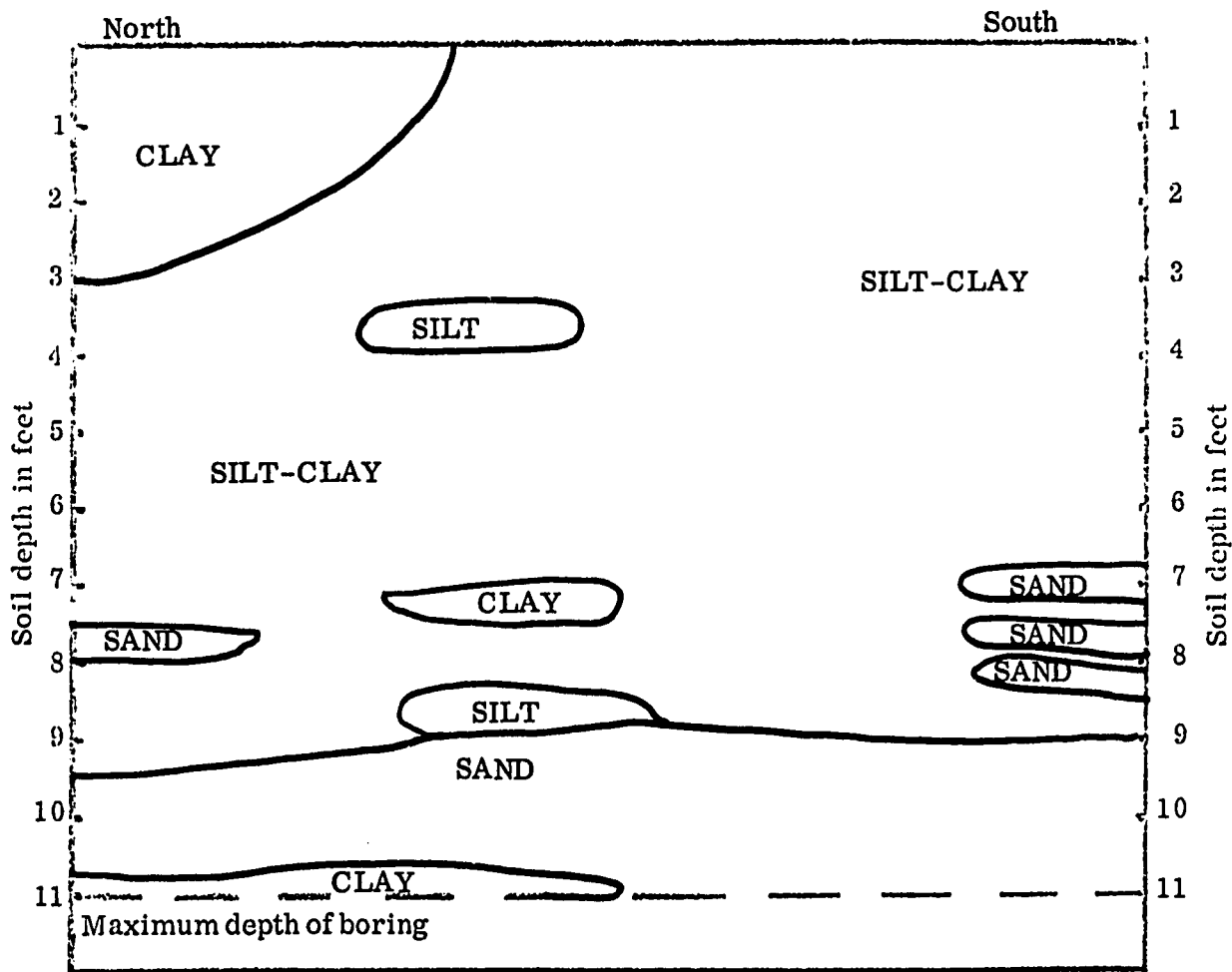
The induced spawning center, under supervision of the same personnel, operates six ponds consisting of 2.6 acres. In 1967, the number of fry produced was 1,000,000 of which over 700,000 were sold. In 1968, the total was 692,000 with 248,000 being sold. The success of spawning following injection of various species was given as follows:

Year	<u>Number of pairs injected</u>			<u>Number of pairs spawned</u>		
	<u>L. rohita</u>	<u>C. mrigala</u>	Others	<u>L. rohita</u>	<u>C. mrigala</u>	Others
1966-67	11	26	1	2	--	--
1967-68	75	58	4	27	19	--
1968-69	26	9	---	9	1	--

November 8, 1968

Jessore Fish Seed Farm

SOIL PROFILE CHART



Pond depths on this farm were 6 to 8 feet and the drawdown during the dry period was 6 feet. It would have been advisable to have excavated the ponds to depths not over 4 feet, and to have packed the pond bottoms to reduce seepage. Also, excavated and refilled clay cores under dams are necessary to prevent cross seepage through dams. Deepening the ponds into the layer of sand at 9 to 9.5 feet would increase seepage.



**II.**  
**8. Baluhar Baor**

### Baluhar Baor

Baluhar Baor is a 630-acre oxbow lake. During the dry part of the year, approximately 200 acres of this is lost by the drawdown. During the monsoon period, the rivers rise and water flows through the baor; its depth is from a few feet to 40 feet in the deepest holes. The lake is an abandoned course of the Bhairab River which once played an important role in communications in the district. The remnants of the buildings now visible on the banks indicated the sites of inland ports when the river was navigable. However, the river changed its course and now only flows through the oxbow lake area at very high water levels during the rainy season. This fishery was originally owned by a Zamindar, a big land owner, who used to lease out the fishery annually. This was abolished and the fishery became the responsibility of the Revenue Department of East Pakistan. Fishing rights were subsequently leased out to the highest bidder. Ultimately, the water was completely covered by water hyacinths and the fishery dropped to a very low level. Mosquitoes were produced in the weed-filled lake and malaria became prevalent in the nearby village. In 1957-1958, the fishery was leased from the Revenue Department by the Directorate of Fisheries on the basis of payment to the Revenue Department of 1,500 rupees per year. During the subsequent period, the water hyacinths were brought under control by spraying with 2, 4-D and to some extent by manual removal. A program of restocking large fingerling carps, principally L. rohita, C. catla, and C. mrigala, was initiated. Approximately 500 fingerlings about 6 inches in length were stocked per acre in the lake. This management program also reduced the problem of malaria. The procedure of fishing is more or less as

follows: Fishing rights are given to local fishermen in the villages around the lake. A charge of 16 rupees per year is made for a general fishing permit which allows villagers to take small fish around the edge of the lake; none of these are recorded in the total catch. Fishing for the large carps, however, is done by local fishermen in groups. Fish are then brought to the landing specified by the Directorate of Fisheries. Here the fish are auctioned off to the highest bidder. If the price locally is not satisfactory, then the fish are transported to the larger markets nearby in an attempt to get approximately 1 rupee per pound for the more desirable fish. About 60 percent of the income from the sale of fish is retained by the Fisheries Department for the Government and 40 percent is returned to the fisherman. Yield increased from 924 pounds in 1958-59 to 11,000 pounds the following year and to 110,000 pounds in 1960-61. Since then, it has varied from 60,000 to 154,000 pounds per year. Correspondingly, the income to the Government increased from 2,755 rupees in 1958-59 to a high of 60,000 rupees in 1961-62. Income to the fishermen has risen to 5 rupees per day.

There were two types of commercial fishing in the lake. The first type is the use of a drop net, called a chakjal net. This device has a bamboo frame, the bottom of which is a 6-foot circle. Three equally spaced poles are joined at the top at a height of approximately 7 feet, roughly in a conical form. A nylon net is suspended inside this frame from the 6-foot circle to the top. It is used by one or two men from a small boat. One rows and the other looks for a stream of bubbles resulting from fish moving through the submerged

vegetation. Occasionally the look-out will slap the water with an oar to cause the fish to dart into the vegetation and reveal its location. When the stream of bubbles is seen, the net is carefully dropped over the edge of the boat on top of the fish. The fisherman climbs out of the boat on to the top of the framework using bamboo supports attached to the sides for this purpose. This pushes the conical net into the bottom muds. The net is tied to the boat which may drift around if only one man is fishing. Standing on top of the supports at the top of the cone, the fisherman stirs the bottom muds to determine if the fish is in the net. When he located the fish, he then dives underwater and traps the fish in the loop of the net. Apparently, the stirring of the bottom makes the fish rise off the bottom towards the top of the net. After catching the fish in the loop of the net, the fisherman twists it so the fish cannot get out, climbs back into the boat, pulls the frame and boats the fish. The boats are equipped with a number of short cords with various size loops. The fisherman selects a loop that will just fit over the head of the fish and runs the other end of the line through the gill cover and out of the mouth. The fish is returned to the water and kept alive on its own stringer. The average size fish caught was 5 pounds or more.

The second method is a team effort involving two boats with approximately 6 to 8 persons per boat. One or more row and three or more handle the net. The net is about 200 yards long of 2-inch mesh nylon about 20 feet deep near the ends and 60 feet deep toward the center. The net is set out in a circle by two boats letting out the net from both boats at the same time. The boats then haul in the bottom lines to pull the net over the pond bottom under the fish and

form a type of purse seine. One man in each boat beats on the side of the boat in a fast rhythm that apparently scares the fish into the net and at the same time paces the rate at which the net is being pulled into the boat. Again, the average size caught was in excess of 5 pounds. Probable range was a minimum of 3 pounds to a high of 15 pounds. Fish smaller than 14 inches were returned to the water.

During the period we observed these fishing operations, the two methods of fishing were producing about the same number of fish per person per boat. However, the water was somewhat high and it was stated that when the water became lower, the purse type seining was much more effective than the drop net.

**II.**

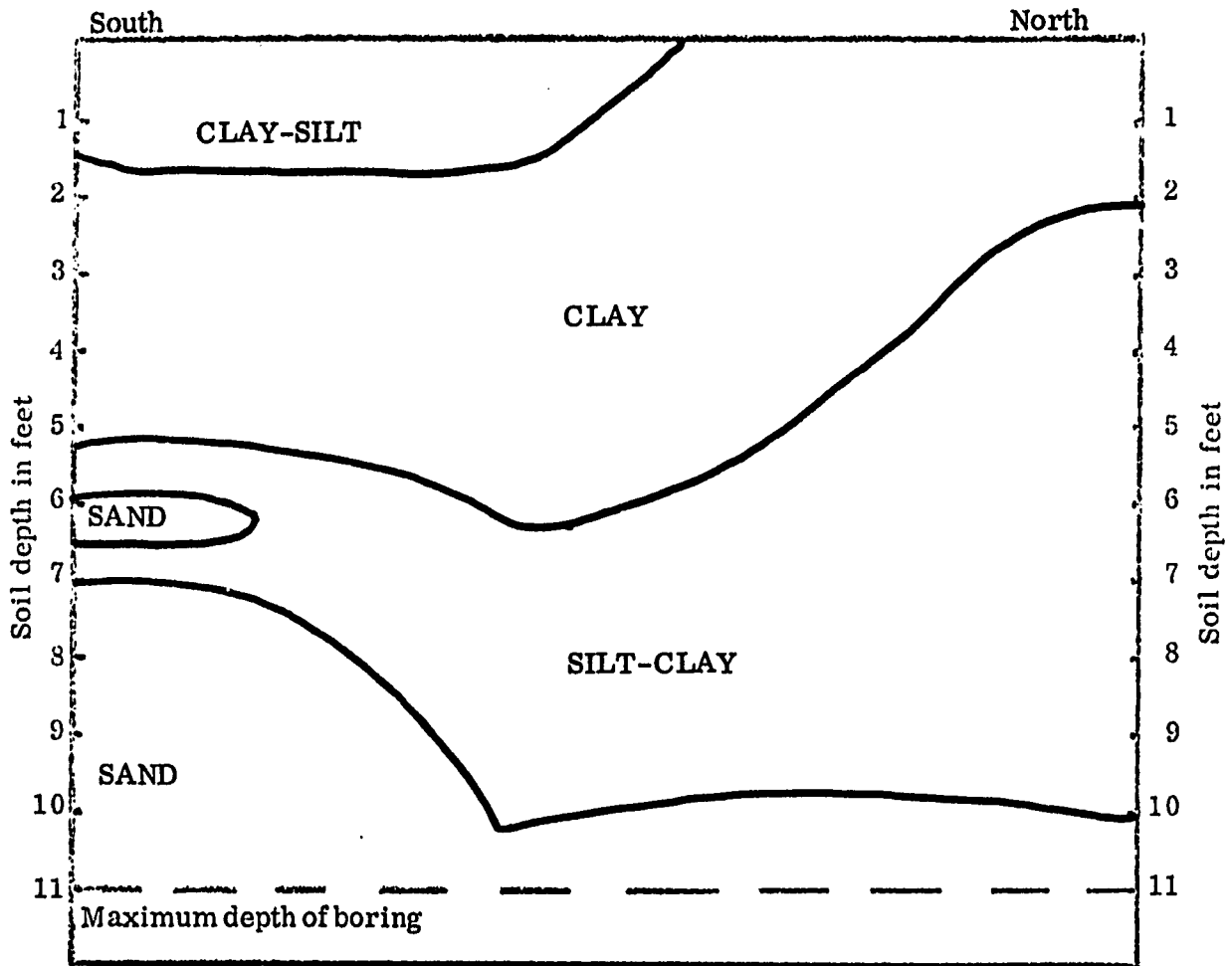
**9. Paikgacha Fish Seed Farm**

**Two proposed sites were examined  
at Saral Village.**

November 9, 1968

Proposed Paikgacha Fish Seed Farm (Saral Village)  
Site No. 1

SOIL PROFILE CHART

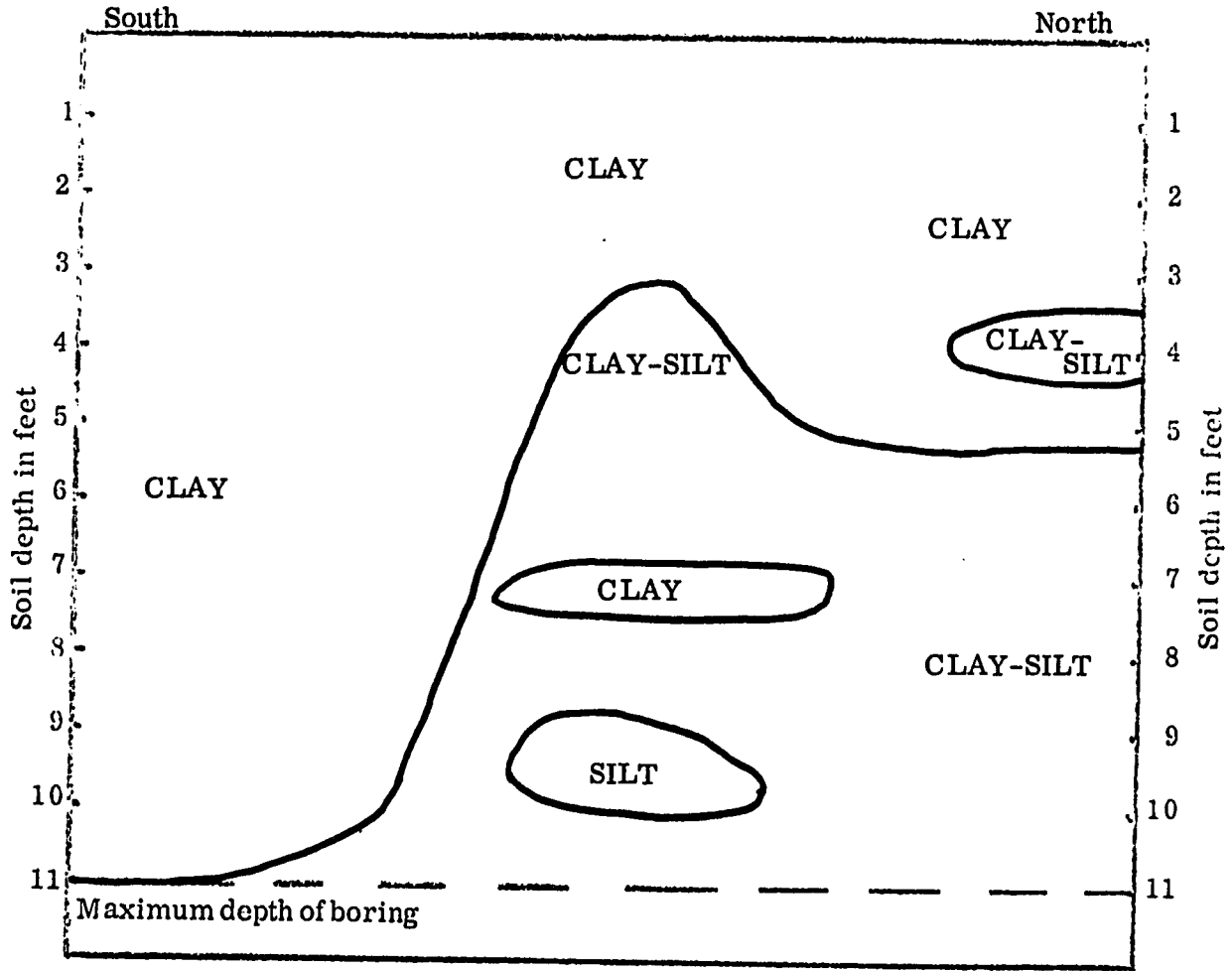


This area was investigated as the site for a proposed fish seed farm. It was rejected because of the underlying sand.

November 9, 1968

Proposed Paikgacha Fish Seed Farm (Saral Village)  
Site No. 2

SOIL PROFILE CHART



This site was considered suitable for ponds. Pond bottoms should be compacted by trampling with cattle or buffalo. Depth of ponds below the soil surface should not exceed 4 feet.



- II.
  - 10. Embankment Project and Proposed Station at Khalia Prsiamari

### Embankment Project

The East Pakistan Water and Power Development Authority near Khulna has an embankment project that constructs dikes around the land at approximately mean high tide level to a height sufficient to prevent entrance of salt water. In this area, land is 4 to 8 feet above sea level and tides reach a height of 12 feet. The land area within the dikes is put into rice production. Areas where the water contains more than 2,000 micro ohms<sup>1</sup> salinity (equivalent to about 1.4 ppt or 1,400 ppm) are considered unsuitable for rice production. The embankments are usually 6 to 10 feet above the ground level, with slopes of 4:1 on the outside and 2:1 slope on the inside. Drainage structures or gates are installed during construction of the embankment dikes to facilitate discharge of freshwater falling within the enclosed area and exclusion of salt water. In the southwest corner of East Pakistan is the Sundarbans, meaning "beautiful forests". This area is reserved by the Government and is managed by the Forestry Department. In the area where the diking process is going on, the water salinity most of the year is less than 2 ppt. The only areas in which it appeared there was sufficient salinity for the growth of the larval shrimp is in the Sundarbans area, where the salinities range from 10 to 27 ppt, and possibly over on the eastern side of the Bay near Chittagong. The diking project has been reported to have greatly reduced the production of shrimp. In times past, the farmer allowed young shrimp to enter into rice fields with the brackishwater in the spring and then closed off the area. The shrimp grew rapidly in the fields as the water freshened.

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<sup>1</sup> Ppm is equivalent to 60 to 70 percent of the micro ohm value on the average.

#### **Proposed Station at Khalia Prsiamari**

Leaving Paikgacha by small boat, we traveled out of the Sibsra River into the Kerulia River to the site proposed by the Directorate of Fisheries for Brackishwater Rice-Fish Culture Research Station at Khalia Prsiamari. The site is bounded on one side by the Kerulia River and on the other side by the Prsiamari River. However, the whole area is within an embankment project which prevents the entrance of water during high tides.

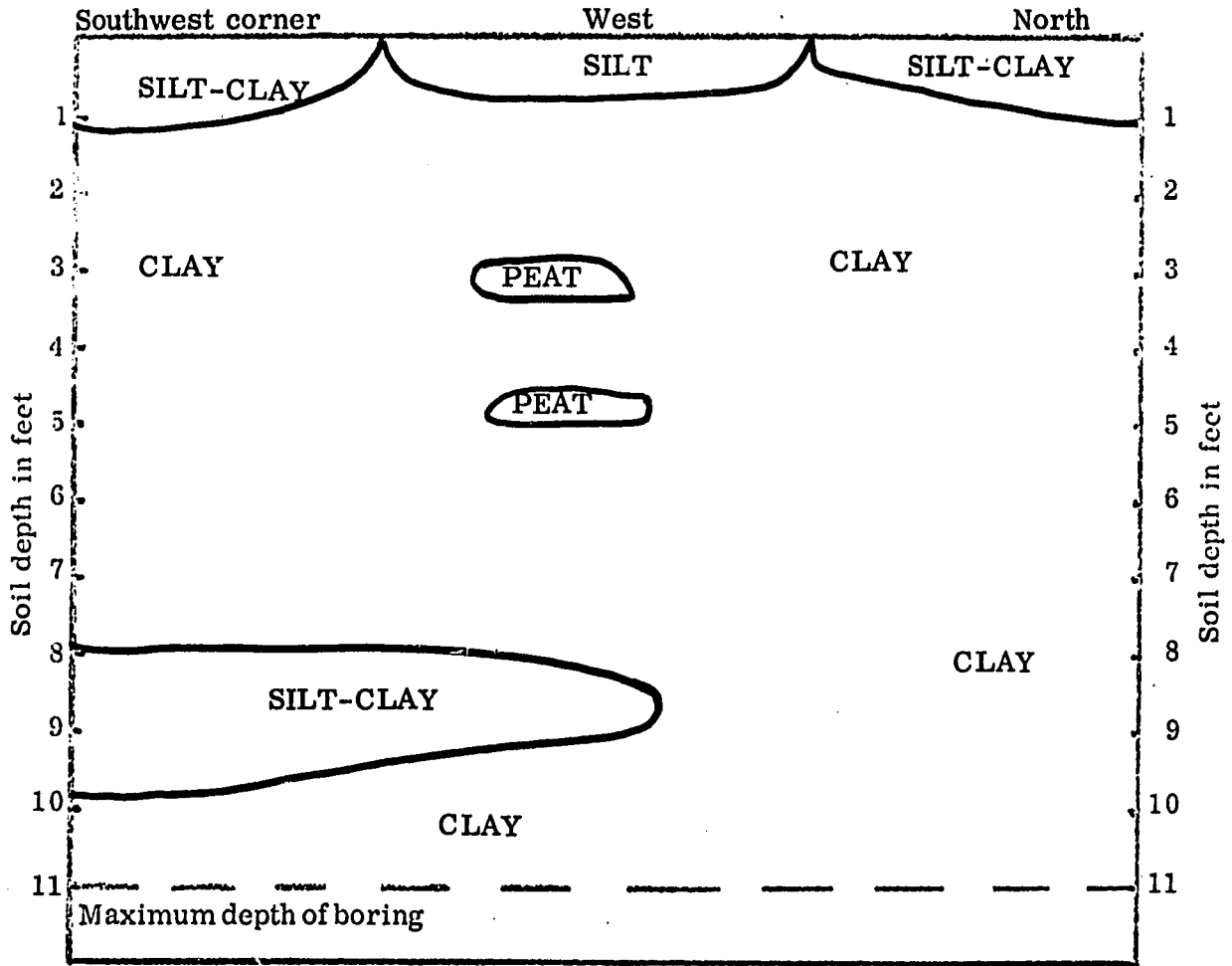
The site is quite suitable for the research work if the salinity is also suitable. The proposed area is completely enclosed by impounded rivers or canals. The canal has a depth of 20 feet, so adequate water is available to supply a research station. Brackishwater, however, would have to be pumped over the embankments from the river for use in the ponds. Soils were quite suitable for pond construction.

At this site there was a small community of farm houses. If a station were to be built here, it would require a fairly large staff so the workers would not feel completely isolated. Good communications by boat to the small towns up river would also be required. It would be difficult to staff such a station with well-trained men. An advantage, however, is that it is in the midst of a large area where the results of research could be applied.

Khalia Prsiamari (Paikgacha)  
Sibsa River - Karulia River

Proposed Site for Brackishwater Fish-Rice Culture Research Station

SOIL PROFILE CHART

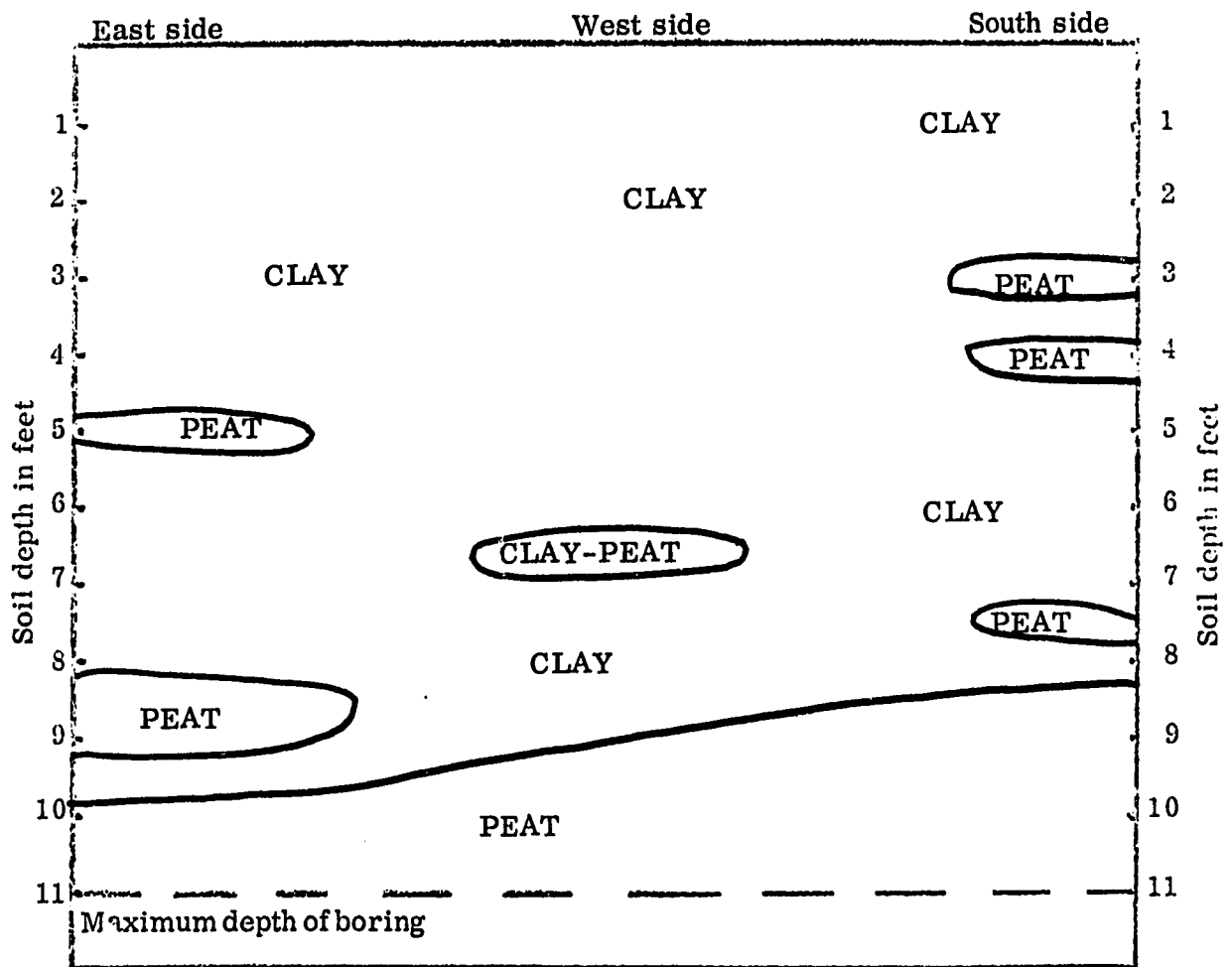


The soils at this location are very suitable for pond construction provided cores are excavated and refilled under the center of each dam to break up layers of silt-clay and peat.

- II.
  - 11. Krishnanagar Fish Seed Farm (Khulna)

Krishnanagar Fish Seed Farm (Khulna)

SOIL PROFILE CHART



Ponds of this farm range in depth from 5 to 8 feet. The drawdown is in excess of 5 feet in dry weather, largely due to the underlying porous layers of peat.

Ponds should not have been excavated to depths of over 4 feet, and core trenches in the center of dams should have been used to break up the shallower layers of peat.

**II.**  
**12. Amnura Fish Seed Farm**

### Amnura Fish Seed Farm

The Fish Seed Farm was located 1/2 mile from the train station. This is an isolated area with no paved road into the city or town. There was, however, a cart trail at least part of the way into the city. The pond depths ranged from 8 to 10 feet and the drawdown was 4 feet. The water level was at the original ground level. Soil borings (see following chart) indicated a very stiff, heavy clay from the surface down to a depth of 11 feet, the maximum depth of boring. In fact, it was so stiff that the handle on the soil auger was broken off. Because of the stiffness of the soil, it would appear that most of the drawdown of 4 feet was due to evaporation. The dry period amounts to approximately 7 months and the total rainfall is approximately 44 inches per year.

The pond waters become a milky white color due to suspended clay particles. It was suggested that this could be eliminated by using organic matter in the pond as decaying organic matter will usually precipitate suspended soil colloids. We suggested the use of about 500 pounds of the rice straw at intervals of about 3 to 4 months, liming to reduce the soil acidity and fertilization with 15 pounds superphosphate, and 100 pounds rice bran.

A problem in these ponds is that there is very low seepage and practically all the loss of water is by evaporation. Due to the stiffness of the soils, it would appear that the seepage should be less than 1 foot and possibly the evaporation may approach 4 feet. In ponds at Auburn, the evaporation during a 7-month period is 33 inches and the seepage 47.2 inches. Since the loss at Amnura is due to evaporation, the salts added to the pond will accumulate year after year in the pond. A

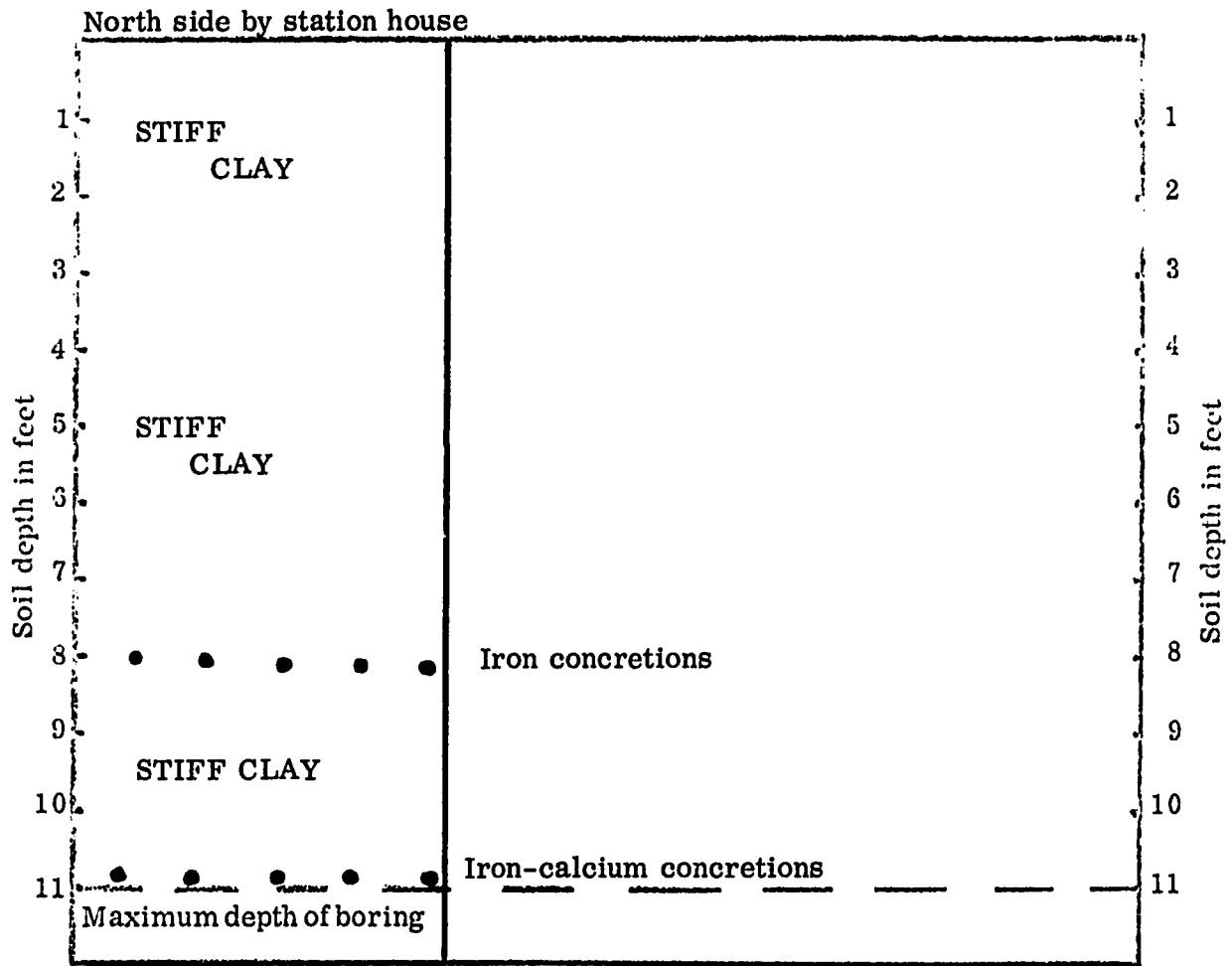


certain amount, of course, will be removed and tied up by the bottom muds. This, however, in general restricts usage of the ponds for experiments as prior treatments may have a residual effect on subsequent treatments. In experimental ponds at Auburn with a complete change of water at least each year at the end of an experiment, there is a downward leaching action equal to approximately 9 feet per acre per year. The effect of these impervious types of clay and lack of salt removal upon the usability of the ponds after a period of years is unknown. However, in this area there are 15,000 fish ponds. These have been operated over a long period of time for fish production and apparently is a quite successful operation. It is in the Rajshahi District that the best ponds and the best pond management of anywhere in East Pakistan occurs.

November 13, 1968

Amnura Fish Seed Farm (Rajshahi)

SOIL PROFILE CHART



Ponds constructed in soils of this type have an annual seepage rate of less than 12 inches.

**II.**  
**13. Rajshahi Fish Seed Farm**

### Rajshahi Fish Seed Farm

This Fish Seed Farm is located on the edge of Rajshahi. Soil borings were made and Soil Profile Charts are attached. The ponds had maximum depths of between 6 to 8 feet, and the drawdown was 4 feet per year. The pond depths are about 8 feet below the original soil level. No attempt in construction was made to hold water above the original soil level. However, this would be quite possible in clays as heavy as these. Since the excavated soil could not be removed from the area, it was placed around the ponds in high dams. These dams are from 5 to 7 feet above the original soil level and the widths of the dams vary between 18 and 33 feet. This is a tremendous amount of soil to have moved for the small amount of ponds made available. There is no need in this area for the high dams around the ponds as there is no flooding here by the river. With the high quality of the clay, it would have been much more economical to have excavated just enough, about 3 feet, below the ground level to obtain the soil necessary to construct dams to a height of 5 feet above the soil surface with 1 foot of freeboard. This would give a water depth of 7 feet leaving 3 feet after the dry season drawdown of 4 feet.

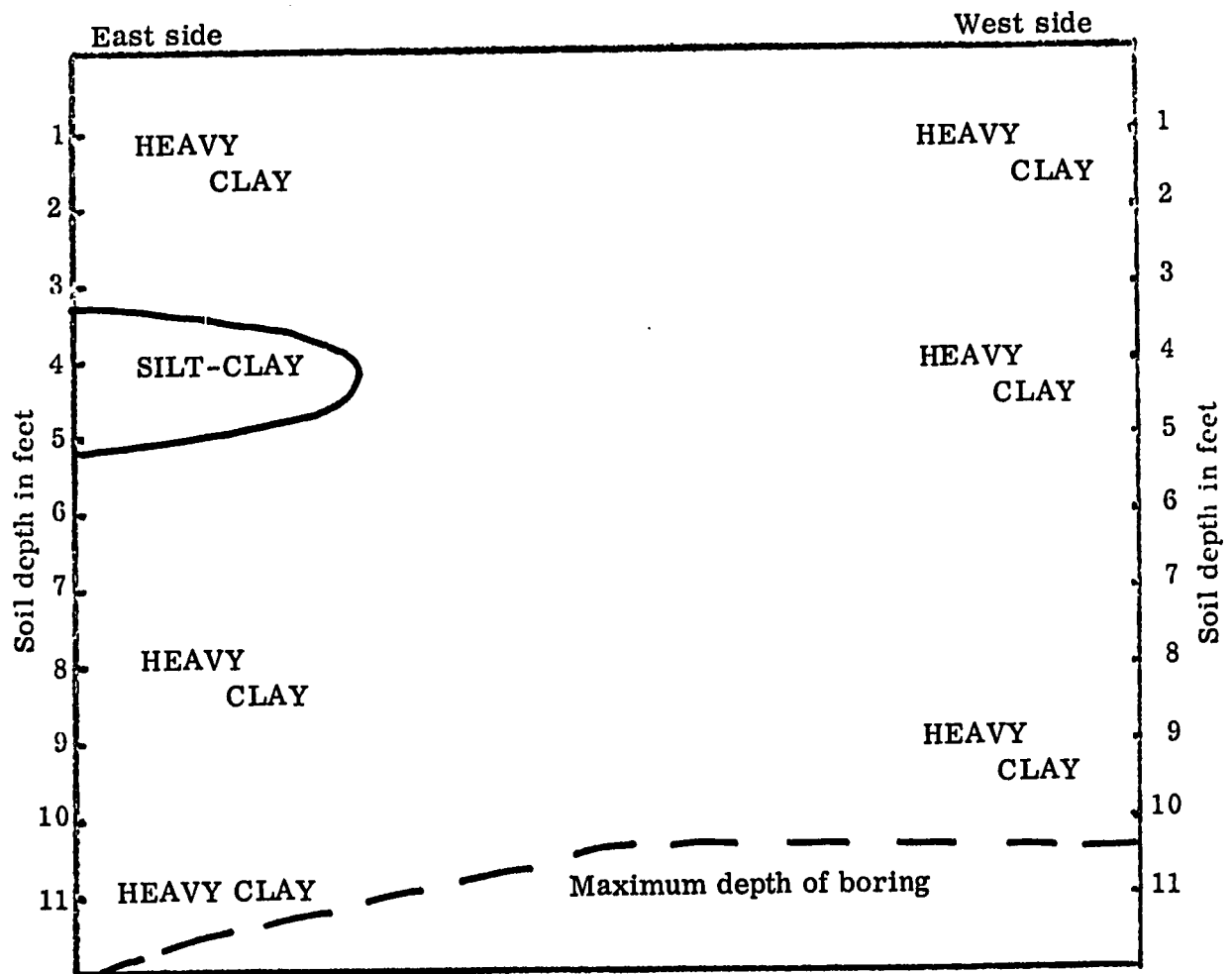
In this area, the rainfall is all the water available to a pond as the dams prevent catchment of runoff from fields. Furthermore, rainfall is approximately 44 to 50 inches per year, just equal to or slightly less than evaporation estimated at 4 feet and seepage estimated at 1 foot, or less. Consequently, year by year as rain falls upon the pond, additional depth of water does not accumulate. Thus,

6 to 7 feet in height of dams around the ponds is undesirable. The area receiving rainfall is larger actually than the pond surface due to a 3- to 4-foot edge at the old ground level and a 2:1 slope of dam to a height of 5 to 7 feet above the ground level, thus adding 28 to 36 feet horizontally to each dimension of the pond. The actual catchment area for rainfall on the 0.3-acre ponds is approximately 0.2-acre larger or 0.5 acre, whereas the catchment for the 0.5-acre pond is 0.25-acre larger or a total of 0.75 acre. The exposed banks within this watershed, of course, would add to the total evaporation, an amount equal to the loss from the grassed dams along the pond and up the slope to the top of the dam.

November 14, 1968

Rajshahi Fish Seed Farm

SOIL PROFILE CHART



This soil is quite suitable for ponds, but core trenches under the dams should be used to cut through silt-clay layers such as that on the east side.

- II.
  - 14. Thana Fish Seed Farm (Proposed)

**Thana Fish Seed Farm (Proposed)**

On the road back to Dacca the proposed site for the fish seed farm near Thana was investigated. Here it was found that uniformly good soil in the area is not to be expected. The Soil Profile Chart follows.

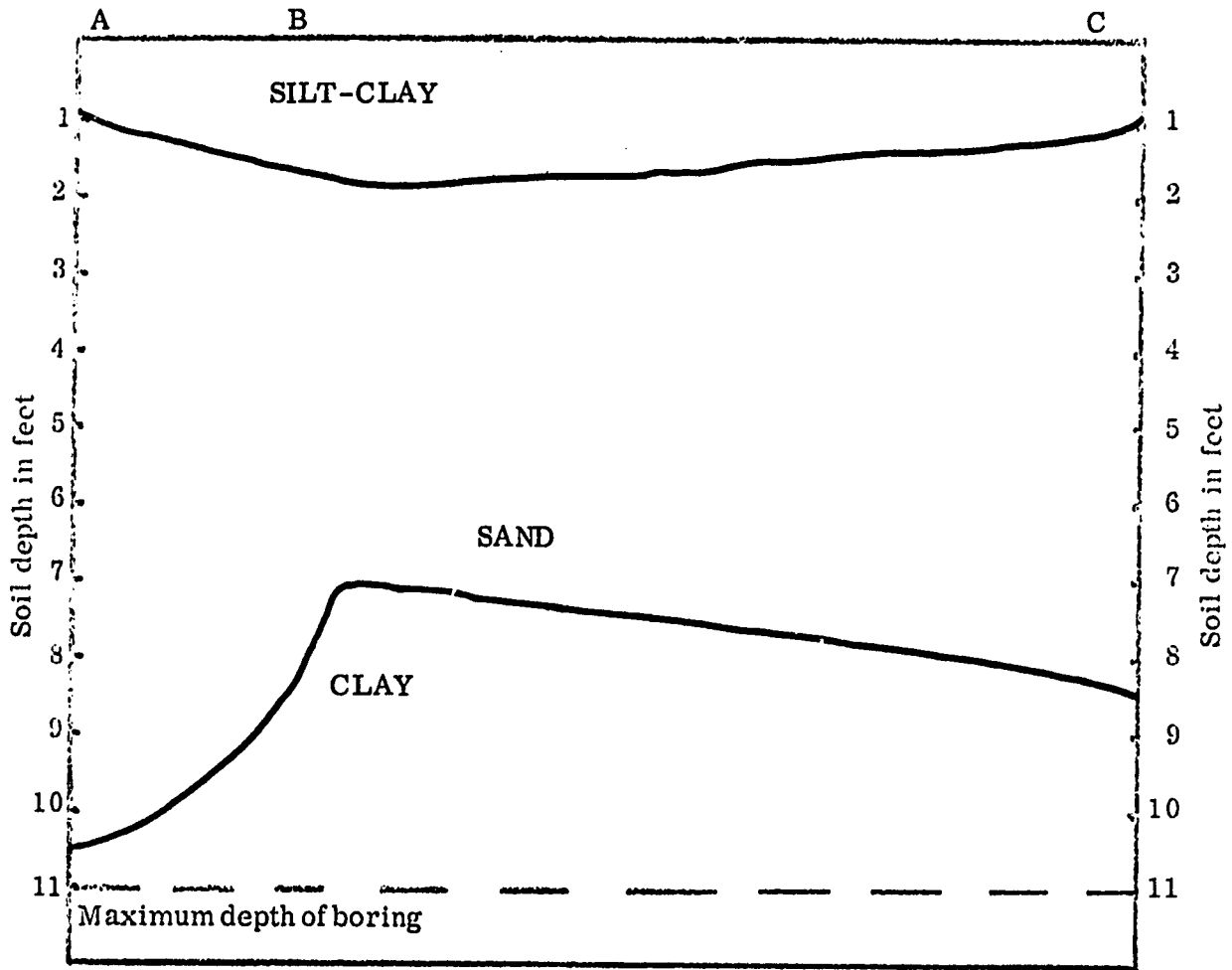
This area was not considered desirable for the construction of a fish seed farm because of the quality of soil. However, if the area had to be used, then the buildings should be placed on the corner where the sand extends down deeper than 10 feet and the ponds put in the area where the clay is present to a depth of 7 to 8.5 feet below the surface. It would then be necessary to cut a core under the locations of each dam down through the top silt and through the sand into the bottom clays. This core should be approximately 3 feet wide and then should be repacked with the very best clay available, preferably that obtained from depths below 5 to 8 feet. It would, of course, be best to move to a more suitable location as removal of 5 to 7.5 feet of sand to reach clay would be rather expensive.



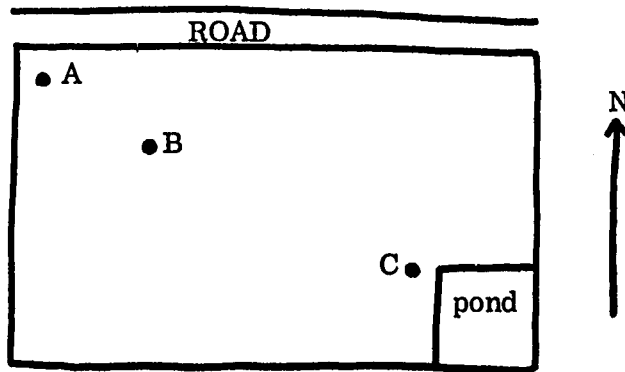
November 14, 1968

Proposed Site for Thana Fish Seed Farm (0.5 miles from Thana Training and Development Center, Putra)

SOIL PROFILE CHART



AREA MAP



**II.**  
**15. Natori Fish Seed Farm**

### Natori Fish Seed Farm

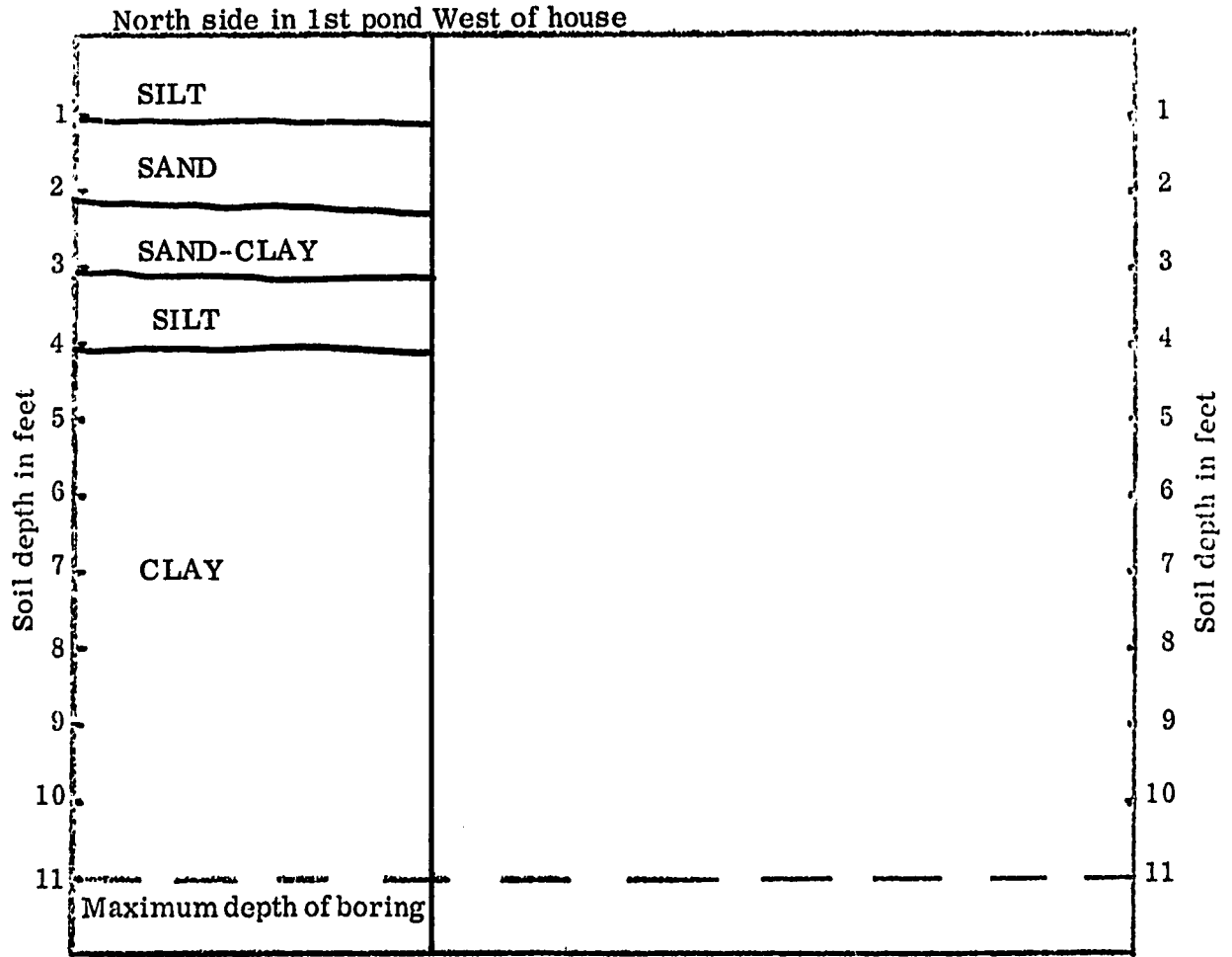
The Natori Fish Seed Farm had 8 ponds 6 feet deep. The drawdown was between 5 and 5.5 feet. This Farm produced on an average 100,000 fry per year. The soil profile is shown on the following chart.

Excessive seepage in these ponds was apparently due to the failure to cut cores for the dams down through the layers of sand and sandy clay to the area of heavy clays lying at depths below 4 feet. Due to the deep layer of clay, these ponds could be deepened. However, before this is done, additional borings should be made on each of the sides to determine if the whole area is underlain with heavy clay. We had time to make only one boring in the center of the pond area.

November 14, 1968

Natori Fish Seed Farm

SOIL PROFILE CHART



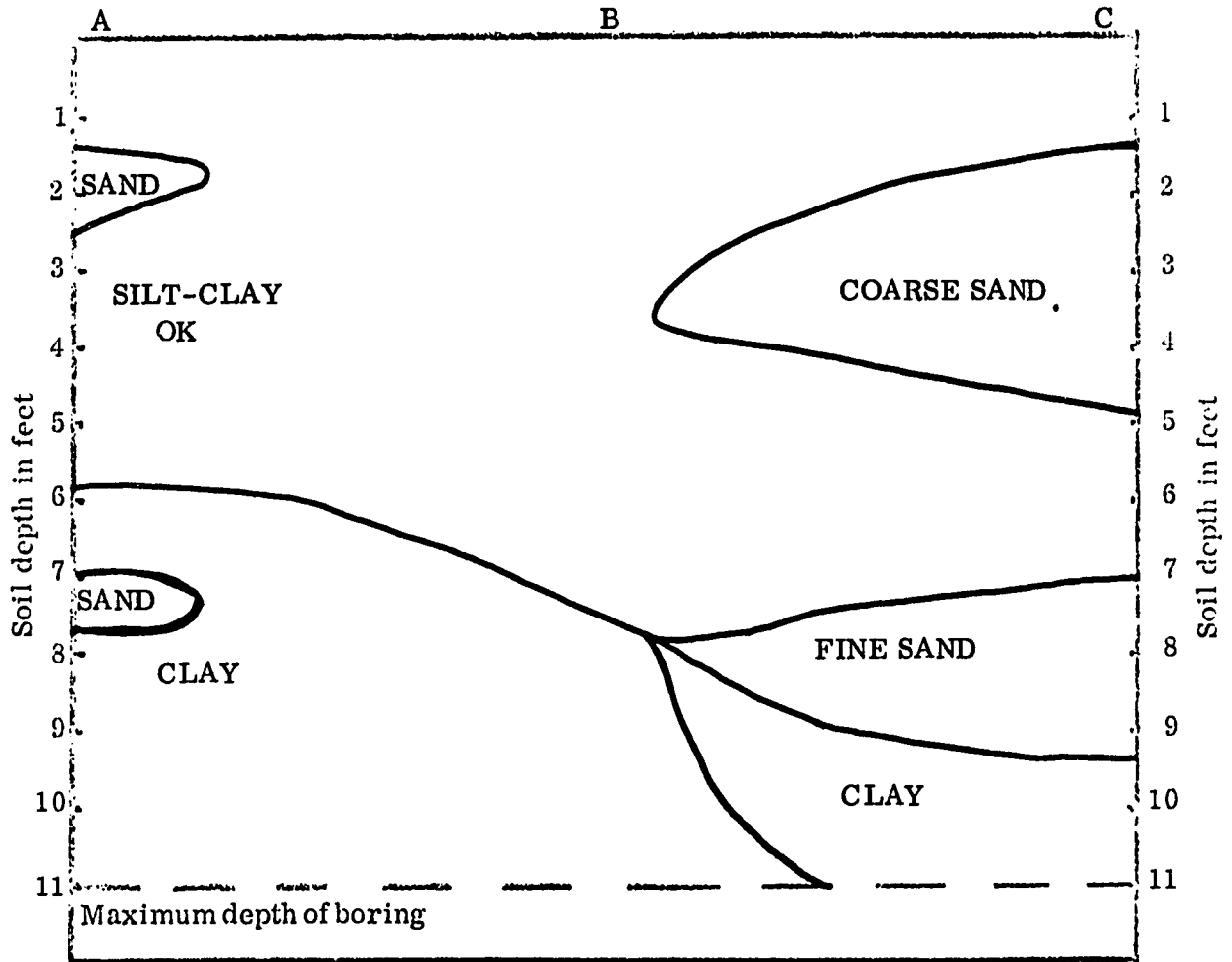
Soils such as shown above are suitable for pond construction provided core trenches under dams are excavated down into the clay and refilled with a tightly packed clay-silt mixture or with clay.

- II.
- 16. Mymensingh Area (Directorate of Fisheries)

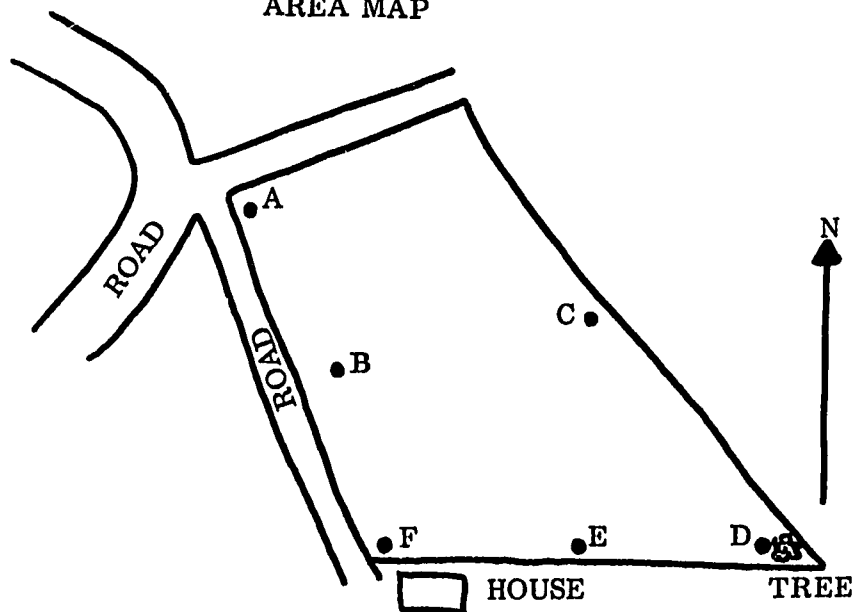
November 18, 1968

Mymensingh (Directorate of Fisheries, Proposed 16-Acre Site)

SOIL PROFILE CHART



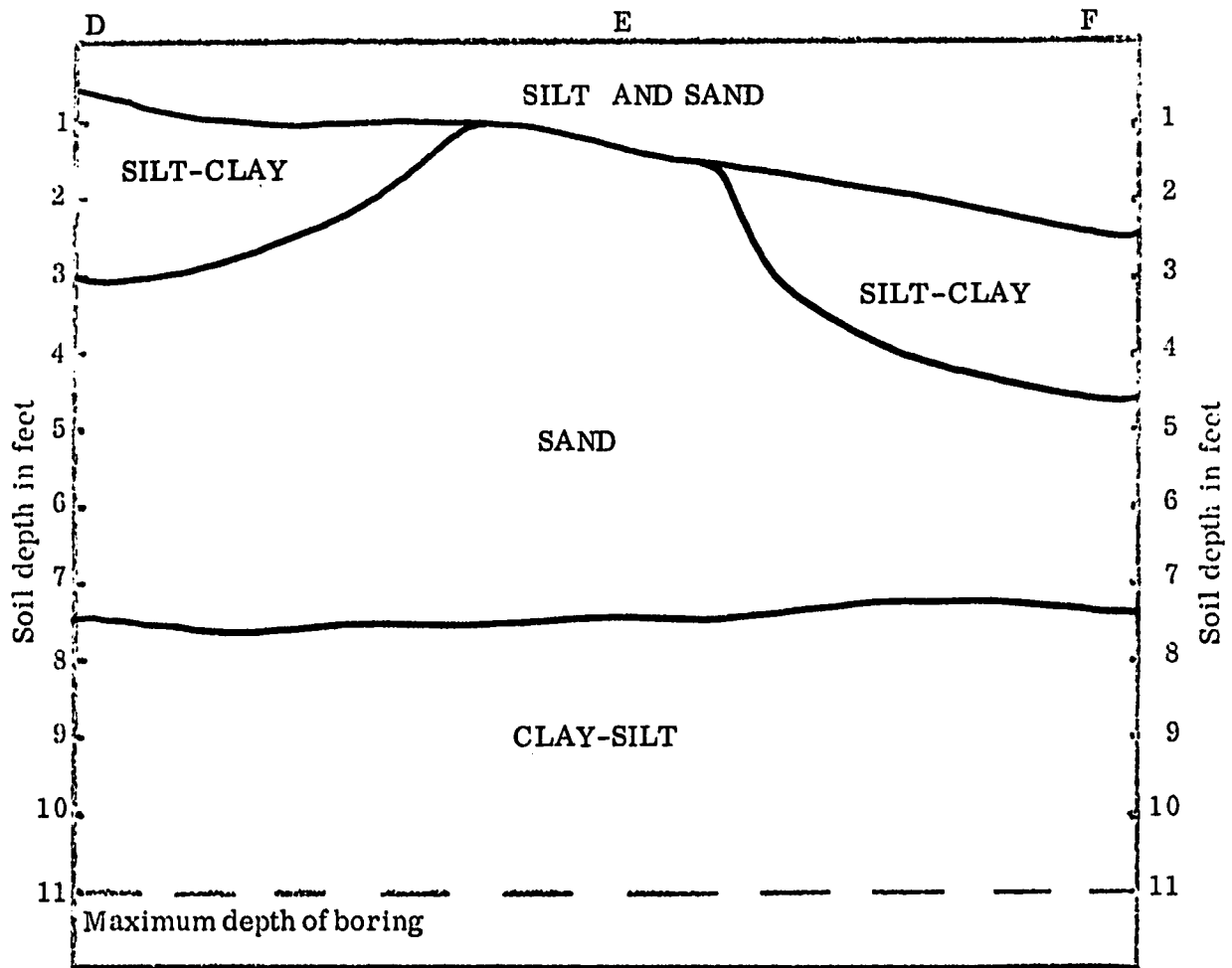
AREA MAP



November 18, 1968

Mymensingh (Directorate of Fisheries, Proposed 16-Acre Site)

SOIL PROFILE CHART



It would be difficult to construct good ponds on this 16-acre site because of the depth to which one must go to get clay for the cores of dams and for the dams as well.

**II.**

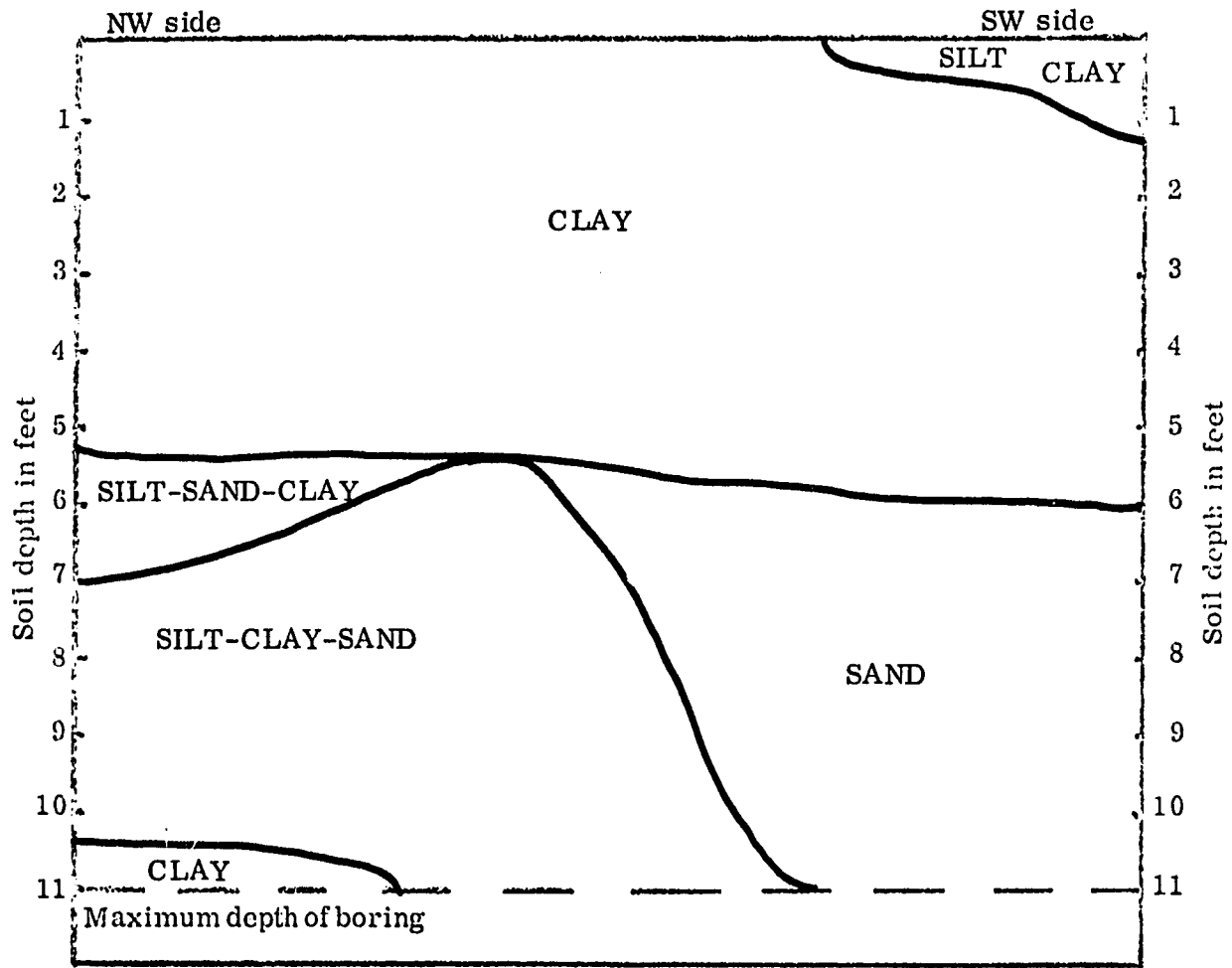
**17. Mymensingh Fish Seed Farm**



November 18, 1968

Mymensingh Fish Seed Farm

SOIL PROFILE CHART



The ponds at this Farm have an annual drawdown of approximately 4 to 5 feet.

This is not a suitable area in which to construct experimental ponds because of underlying sand.

**II.**  
**18. Mymensingh University**

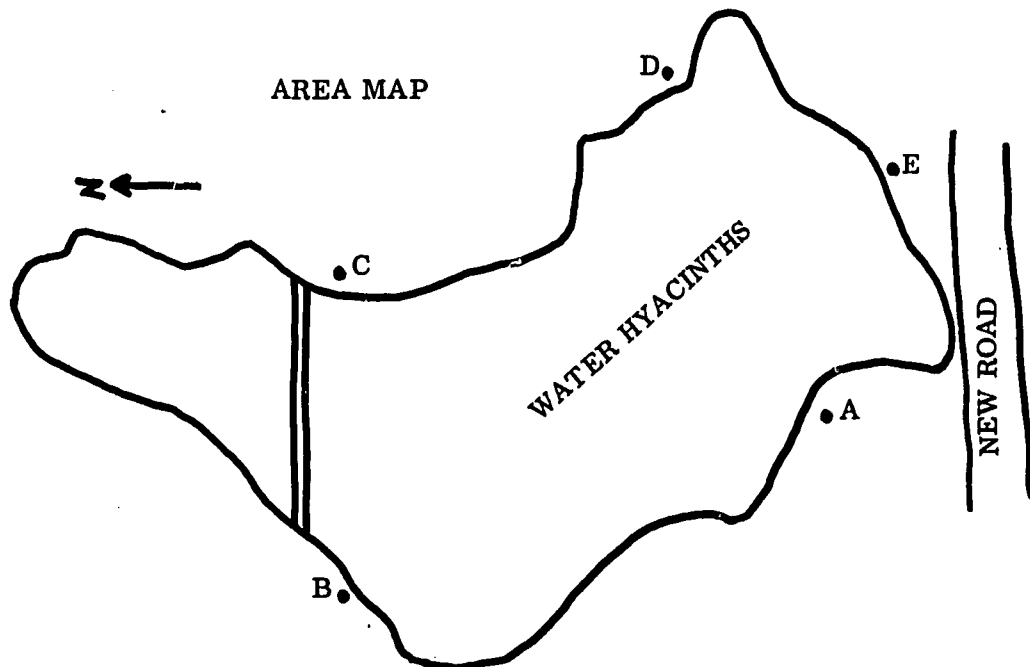
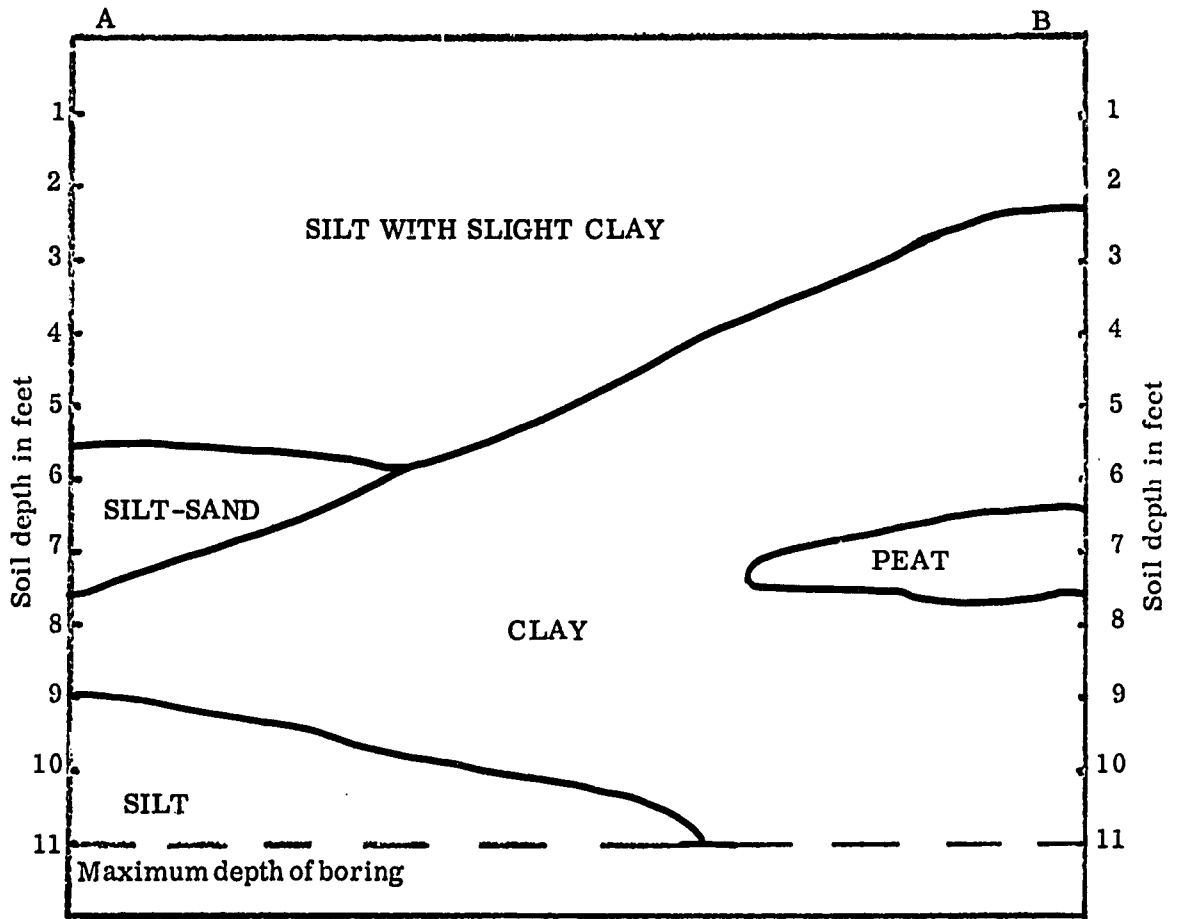
### Mymensingh University

Officials at the University expressed the willingness to donate approximately 50 acres of land to a fish culture station if the land appeared to be suitable. This is the area pictured in the first report from Pakistan. Five borings were made around the perimeter of the proposed site. The profiles are shown on the following charts. Part of this boggy area is covered with 1 to 2 or more feet of water at the present time and the whole area is covered with water hyacinths except where they were being removed in long rectangular plots for use elsewhere. The lowland area does hold water, apparently because the very fine soil particles have over the years washed down on to this lowland part of the field. However, the whole area is underlain with sand and it did not appear possible to construct experimental fish ponds at this location, especially since water would have to be provided by pumping from deep wells. Consequently, the site at Mymensingh University did not appear usable for a pond research station. The area across the river from the University is apparently owned by the Government and could be available. We did not investigate it as the University officials were indefinite about whether any site would be available there.

November 18, 1968

Mymensingh University  
Proposed Pond Area

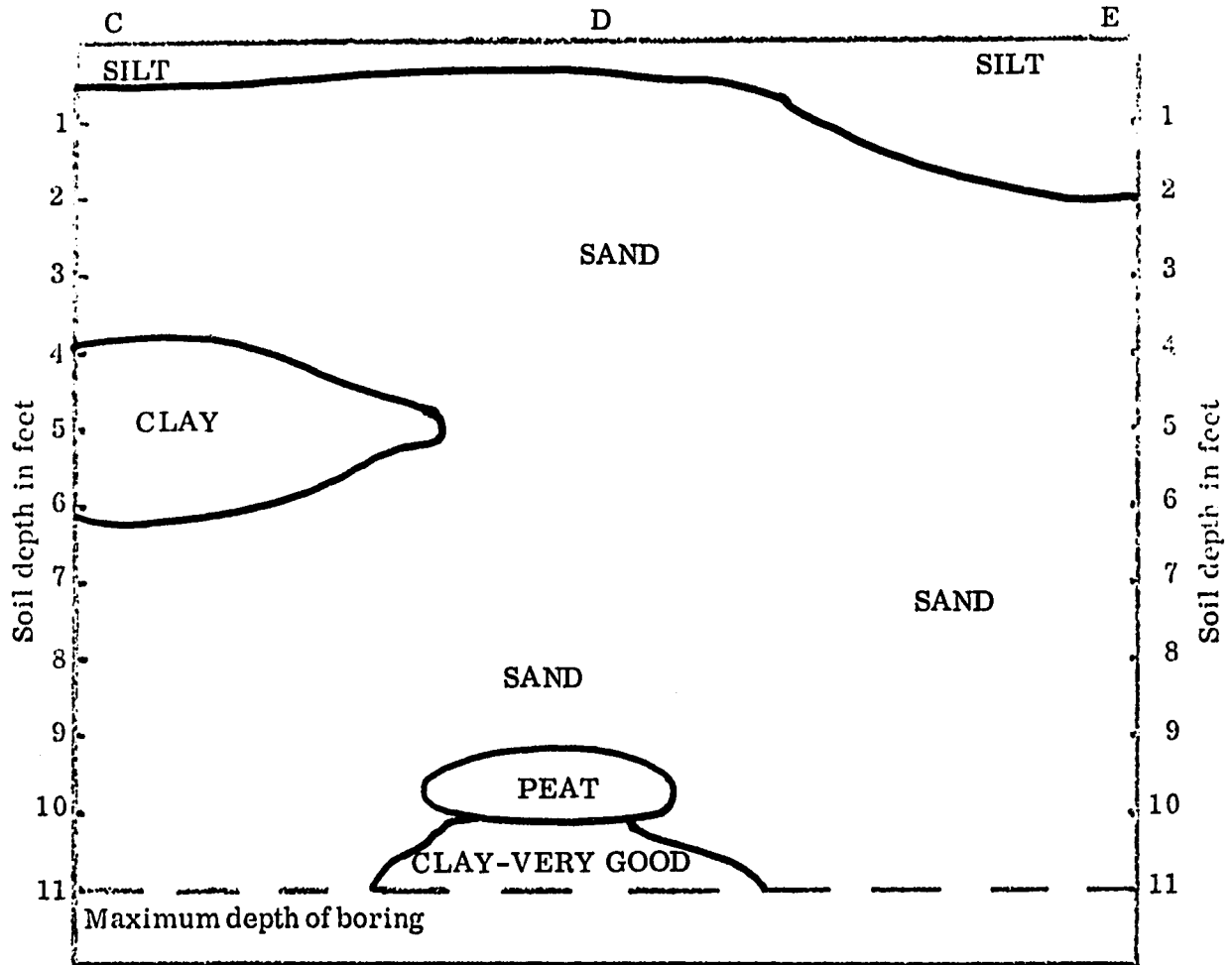
SOIL PROFILE CHART



November 18, 1968

Mymonsingh University  
Proposed Pond Area

SOIL PROFILE CHART



II.  
19. Hamil Bheel

### Hamil Bheel

This lake is in reality an old oxbow bend in the river. While this is called a "Bheel", it should have been called a "Baor" since this is the correct term for an old oxbow lake. It is similar to Baluhar Baor which was visited on the trip to Khulna. It also was operated by the Directorate of Fisheries on lease from the Revenue Department. Here water hyacinths were under control and carps were stocked annually. The present harvest of fish approximates 200 pounds of fish per acre per year.

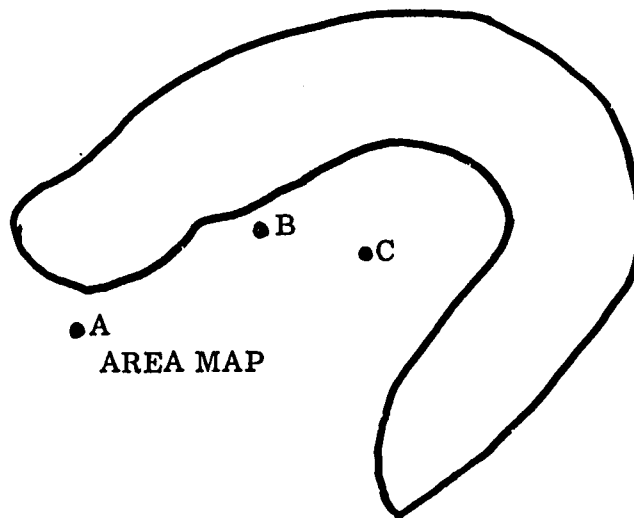
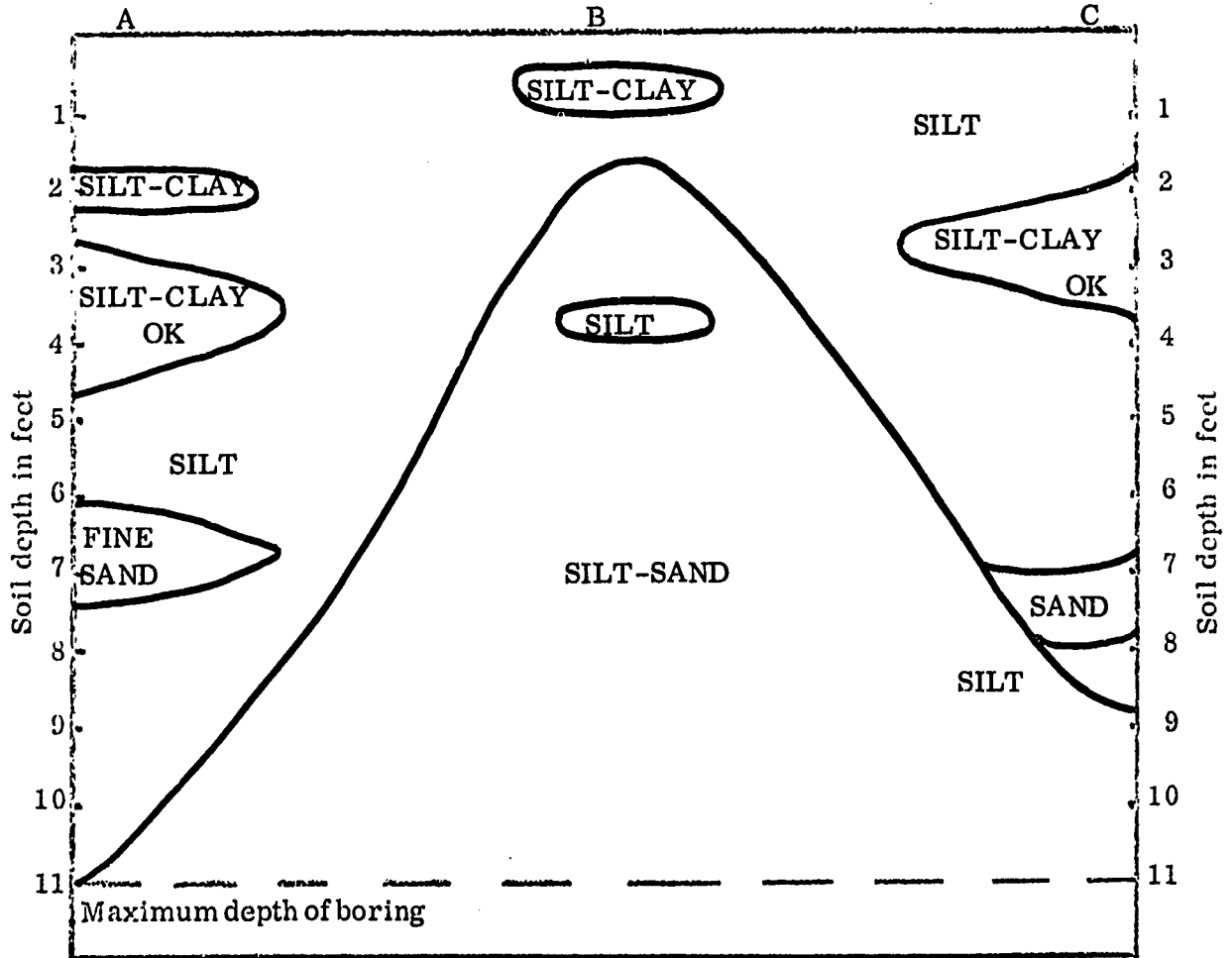
Total area was approximately 90 acres and maximum depth was approximately 30 feet. It was quite difficult to get definite information on the exact drawdown during the dry period, but it was thought to be about 3 to 6 feet.

Our reason for visiting this lake was because we thought it possible to build the experimental station either around the lake or in the shallow water of the lake and use the lake itself for the water supply. The edges of this bheel dropped off so rapidly that it would not have been possible to construct many ponds in the shallow edge. There was, however, a beautiful area in between the horseshoe bend which would have made an excellent place for experimental ponds if the soil had been suitable. Three borings were made, and the profiles are given on the following chart. Because of the underlying sand, it was considered impossible to construct a suitable pond research station at this place.

November 19, 1968

Hamil Beel (Under Madhupur Tangail Subdivision)

SOIL PROFILE CHART





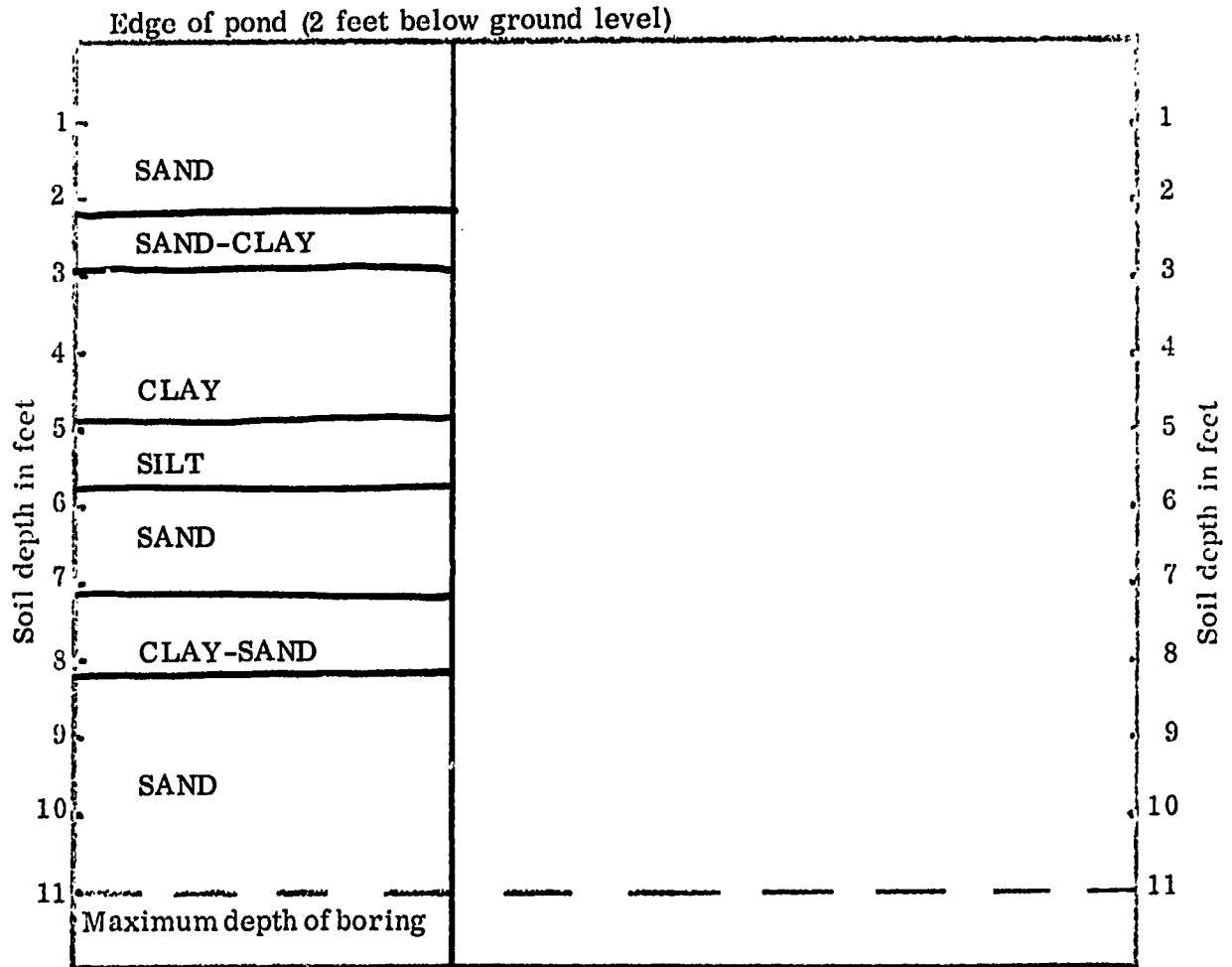
II.

20. Tangail Fish Seed Farm

November 19, 1968

Tangail Fish Seed Farm (Dacca Road)

SOIL PROFILE CHART



Ponds of this Farm often dry up, and the soil profile indicates the area is unsuitable for pond construction. However, this would be a good place to test various methods of reducing seepage in ponds.

**II.**

**21. Dacca Fish Seed Farm (Joydepur)**

**Dacca Fish Seed Farm (Joydepur)**

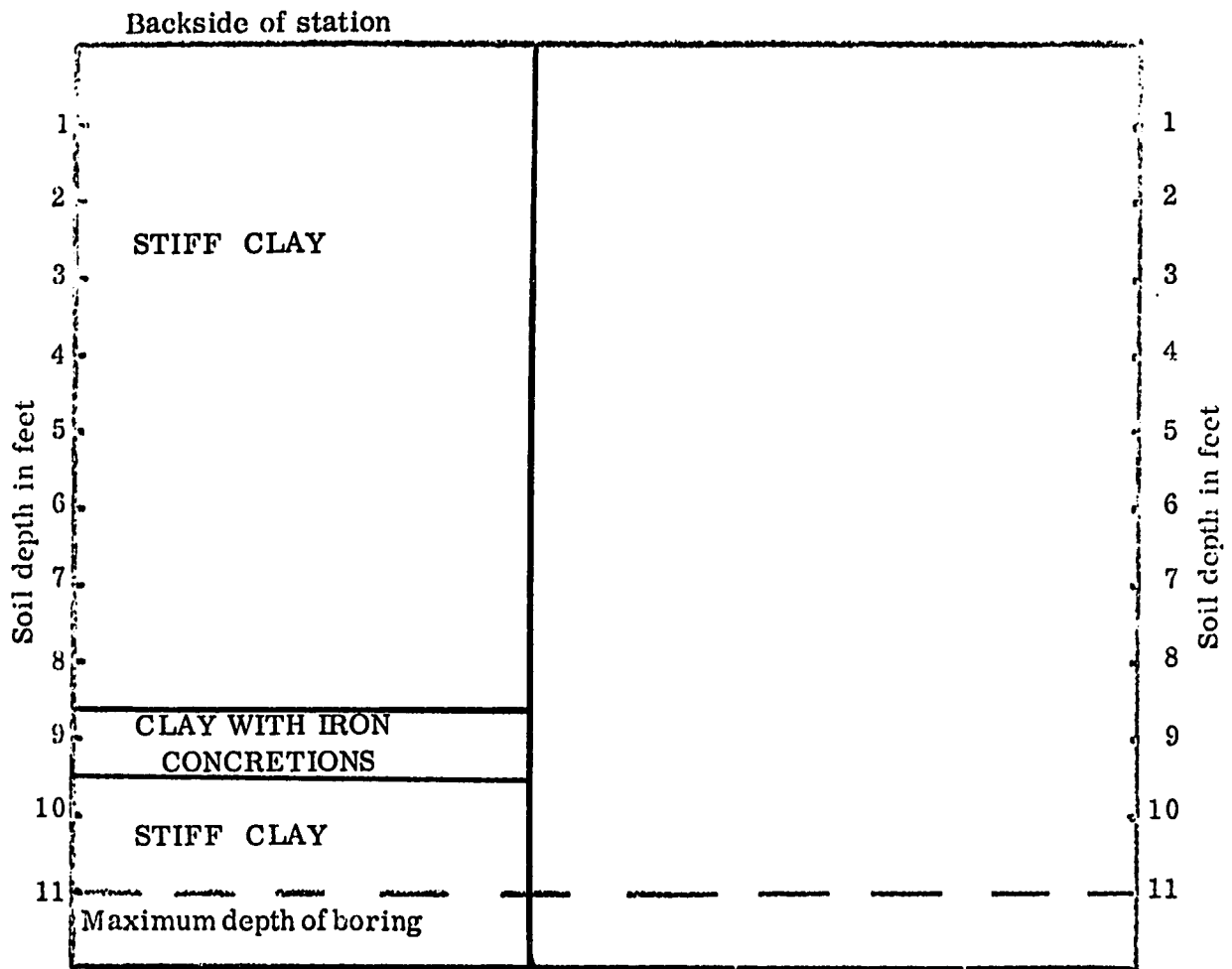
This Fish Seed Farm is about 8 miles out of Dacca. The ponds are in stiff clays and the drawdown is less than 3 feet, the exact amount was not known. Soil borings indicated an extremely stiff clay from surface down to a depth of 11 feet. The bottom soils taken from the bottom of the ponds and placed on top of the dams all indicated a heavy clay that cracks severely upon drying out. When wet, it is extremely sticky and similar to the heavy clays in the Alabama black belt areas. The rainfall in this area is 80 inches and all in all this appeared to be the best site that we found anywhere in East Pakistan for a pond research station, if a new station were to be built.

A plan was drawn up for an experimental fish farm at this site. This included 111 ponds set on 36 acres in the center, surrounded on three sides with a moat dug to a depth of 10 feet and 100 feet wide which would be used to supply water for the ponds. For the 111 ponds and surrounding moat, a total of approximately 50 acres of land would be required. The cost of land in this area is probably high. The cost of excavation and pond construction was estimated to be 705,000 rupees plus \$11,000. Details of construction and estimated costs are given in Section VI of the Appendix.

November 19, 1968

Dacca Fish Seed Farm (Joydebpur)

SOIL PROFILE CHART



This Farm had very impervious clays and is the most suitable area of those inspected for construction of a fisheries research station. Its nearness to the central office at Dacca would make it especially desirable.

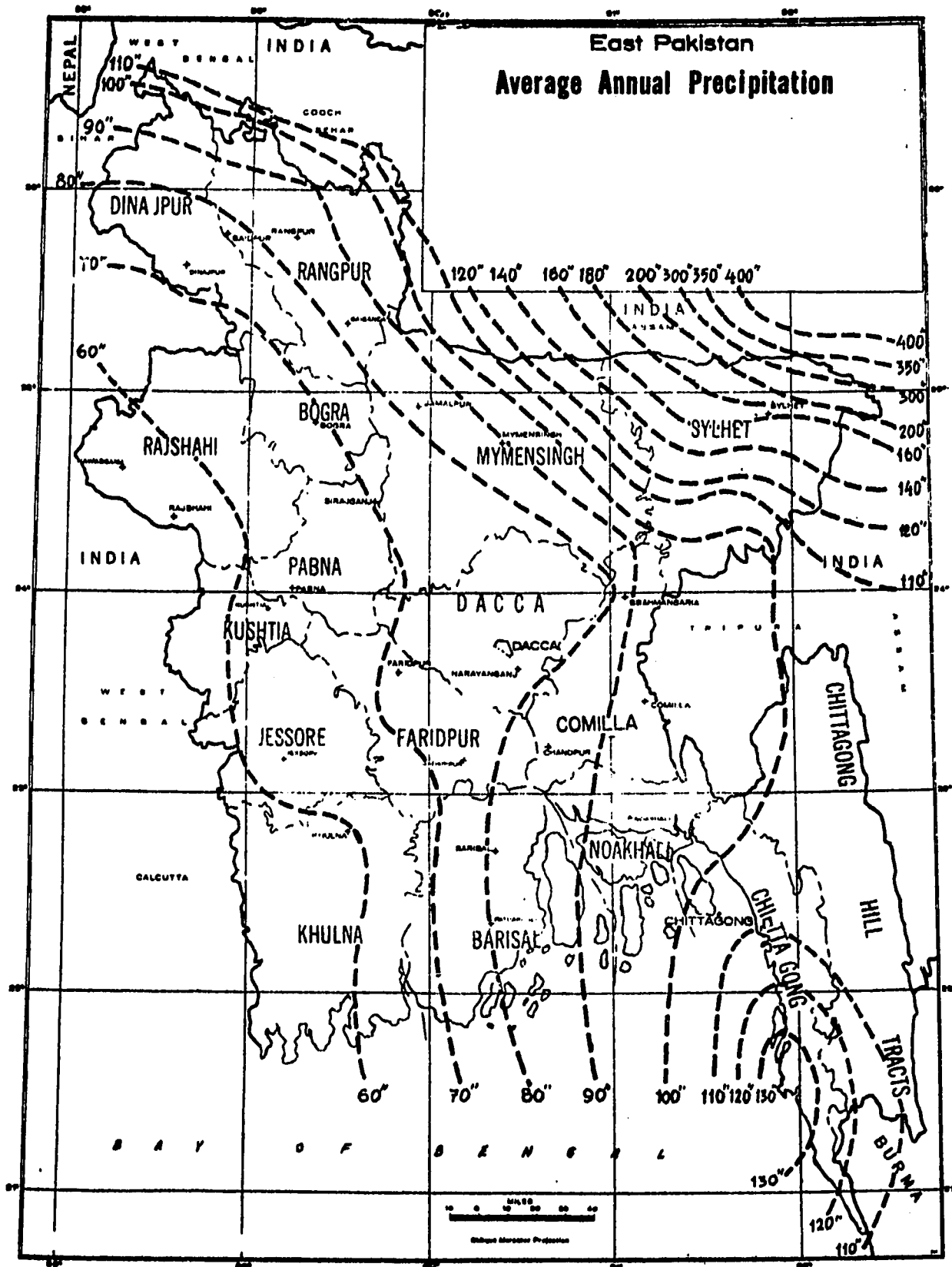
III. WELLS AND PUMPS



#### IV. RAINFALL, EVAPORATION, SEEPAGE, AND SALINITY DATA

1. Average Annual Precipitation in East Pakistan
2. Rainfall Distribution by Months at Selected Localities in East Pakistan, 1966-1967
3. Rainfall Records for Chandpur Station, 1968
4. Evaporation Records in Concrete Ponds at Chandpur Station
5. Evaporation and Seepage in Earthen Ponds at Chandpur Station
6. Salinity of Streams in the Sundarbans Area





RAINFALL DISTRIBUTION BY MONTHS AT SELECTED  
LOCALITIES IN EAST PAKISTAN, 1966-1967.

Date	Rainfall in inches		
	Dacca	Rajshahi	Chandpur
April 1966	1.32	0.20	1.02
May	5.62	2.80	5.48
June	13.94	4.06	14.65
July	12.87	8.51	11.15
August	10.88	15.47	15.10
September	23.91	8.51	23.70
October	8.77	1.02	11.45
November	0.65	1.07	0.50
December	0.65	0	3.75
January 1967	0.28	0.20	1.25
February	0	0	0
March	<u>4.56</u>	<u>2.50</u>	<u>5.85</u>
Totals	83.45	44.34	93.90

CHANDPUR STATION

Rainfall Records  
1968

Month	Inches	Total Inches
February	0.2	0.25
	0.05	
March	2.9	5.3
	1.6	
	0.8	
April	0.77	1.78
	0.08	
	0.48	
	0.05	
	0.13	
	0.17	
	0.02	
	0.08	
May	0.91	5.22
	0.27	
	2.13	
	0.04	
	0.87	
	0.07	
	0.73	
	0.20	
June	0.01	6.34
	0.01	
	0.07	
	0.05	
	0.07	
	1.32	
	0.53	
	0.22	
	1.16	
	0.08	
	2.24	
	0.02	
	0.06	
	0.01	
0.41		
0.08		

CHANDPUR STATION

Evaporation Records in Concrete Ponds

Date	Per day Lbs. of water per 72 sq. ft.	Inches Per day
December 1967	52.0	0.138
January 1968	48.3	0.117
February	43.5	0.116
March	31.36	0.084
	30.7	0.082
April	32.29	0.086
	32.48	0.087
May	18.60	0.049
	21.25	0.057
June	9.60	0.025
	16.0	0.043

CHANDPUR STATION

Evaporation and Seepage in Earthen Ponds Holding Water Best

Pond 0.73 Acre

Date	Maximum Depth (feet)	Drawdown (inches)	Drawdown + Rainfall = Evaporation & Seepage (inches)	Evaporation (inches)	Seepage (inches)
1967 December (end)	9.41				
1968 January (end)	7.0	- 29	29.1	3.63	25.5
February (end)	6.41	- 7	7.25	3.36	3.9 ?
March (end)	5.33	- 13	18.3	2.60	15.7
April (end)	4.50	- 10	11.8	2.58	9.3
May (end)	4.08	- 5	10.2		
Total		- 64	76.7	12.17	54.4

Pond 0.5 Acre

1967 December (end)	7.41				
1968 January (end)	5.25	- 26	26.1	3.6	22.5
February (end)	3.50	- 21	21.25	3.4	17.9
March (end)	3.0	- 6	11.3	2.6	8.7
April (end)	2.41	- 7	8.8	2.6	6.2
May (end)	2.75	+ 4			
Total		- 56	67.45	12.2	55.3

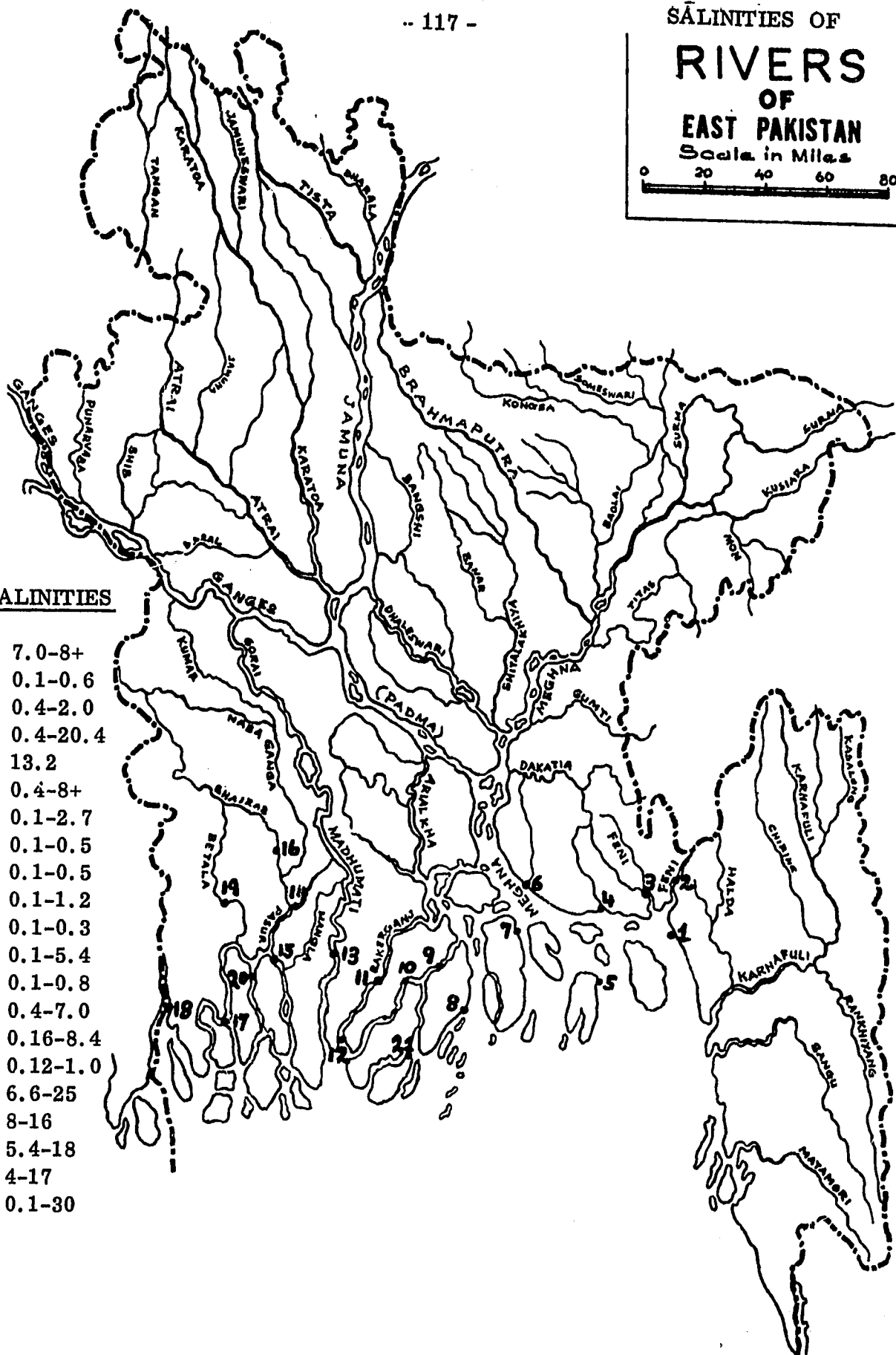
# SALINITIES OF RIVERS OF EAST PAKISTAN

Scale in Miles



## SITE SALINITIES

1	7.0-8+
2	0.1-0.6
3	0.4-2.0
4	0.4-20.4
5	13.2
6	0.4-8+
7	0.1-2.7
8	0.1-0.5
9	0.1-0.5
10	0.1-1.2
11	0.1-0.3
12	0.1-5.4
13	0.1-0.8
14	0.4-7.0
15	0.16-8.4
16	0.12-1.0
17	6.6-25
18	8-16
19	5.4-18
20	4-17
21	0.1-30



**V. DATA ON PROPOSED CONSTRUCTION AT CHANDPUR**

- 1. Summary of Costs of New Facilities for Chandpur Station**
- 2. Construction Details for Earthen Ponds**
- 3. Construction Details for Concrete Ponds**

**Summary of Costs of New Facilities for Chandpur Station**

	<u>Dollars</u>	<u>Rupees</u>
A. 30 earthen ponds with well and pumps	\$ 9,700	155,000
B. 48 concrete ponds		145,200
C. 50 plastic-lined ponds	<u>1,400</u>	<u>          </u>
<b>Totals</b>	<b>\$26,100</b>	<b>300,200</b>

Details on construction and costs are given on the following pages.



**Excavated Earthen Ponds to be Constructed at Chandpur Station**

A total of 18 ponds 0.1-acre, 12 ponds 0.25-acre, and 3 ponds 0.05-acre can be constructed on the land available on the Chandpur Station. Total volume of earth to be excavated is 800,000 cubic feet or 30,000 cubic yards for 4.8 acres of water.

Cost is estimated as follows:

	<u>Dollars</u>	<u>Rupees</u>
Excavation-dam construction 30,000 yards <sup>3</sup> @ 4 rupees		120,000
Drain pipes	3,000	
Pump, 6" low lift for dewatering canal	600	
Two portable tube irrigation pumps, 6" x 15'	600	
Labor, 1000 man-days		5,000
Wells, 4 with pumps	2,500	20,000
Sealing ponds (14 acres total)	3,000	10,000
Laboratory equipment	<u>15,000</u>	<u>          </u>
Totals	\$24,700	155,000

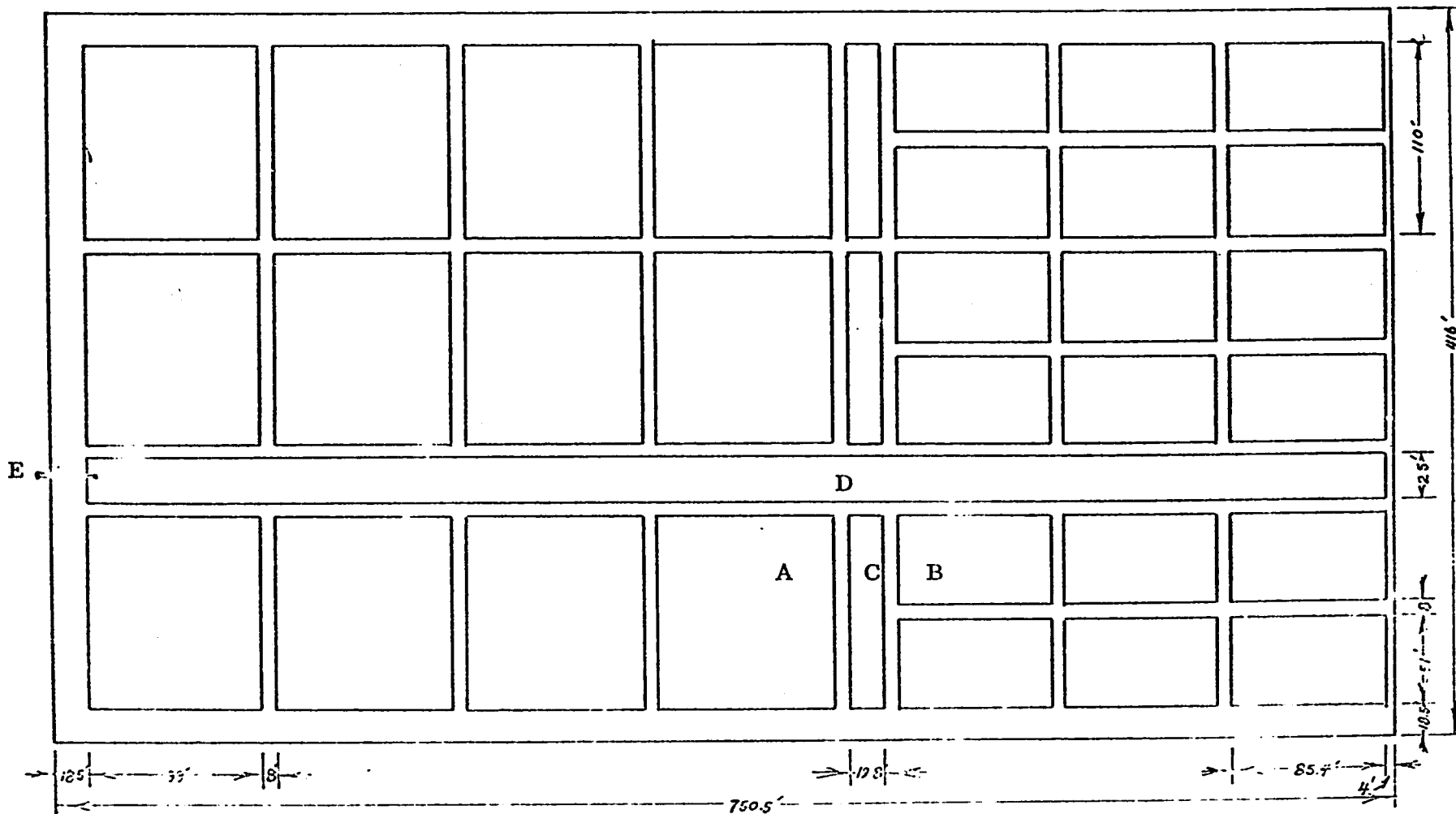


Diagram of earthen ponds proposed for Chandpur Fisheries Station showing (A) twelve 0.25-acre ponds, (B) eighteen 0.1-acre ponds, (C) three 0.05-acre ponds and (D) drainage canal.

An electric pump installed at point E will de-water canal when experimental ponds are being drained.

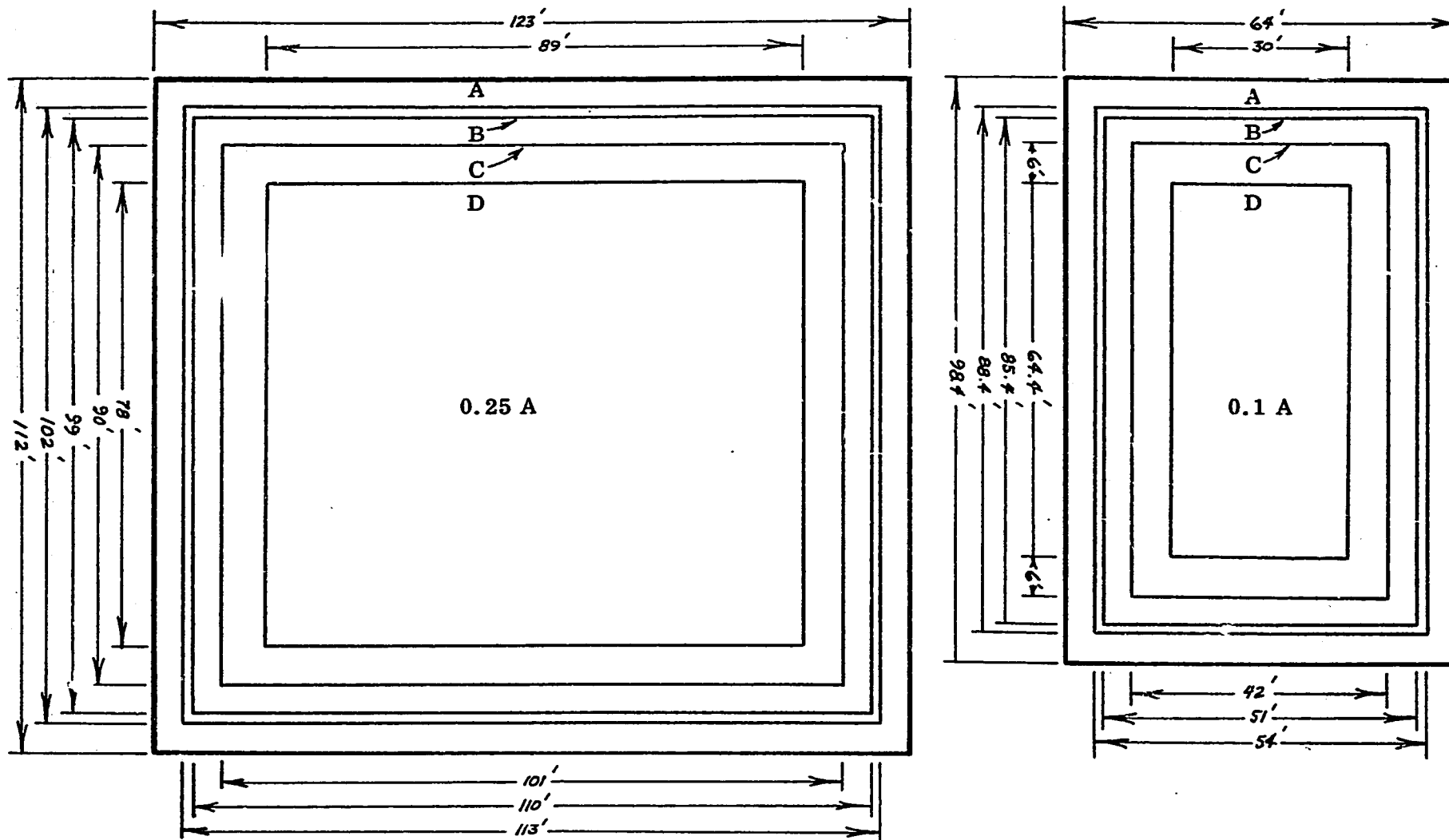
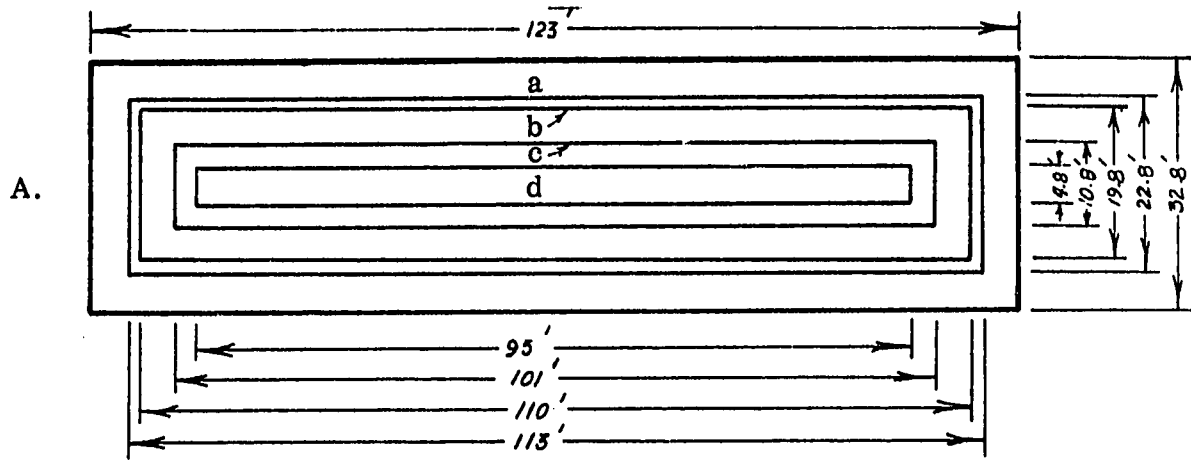
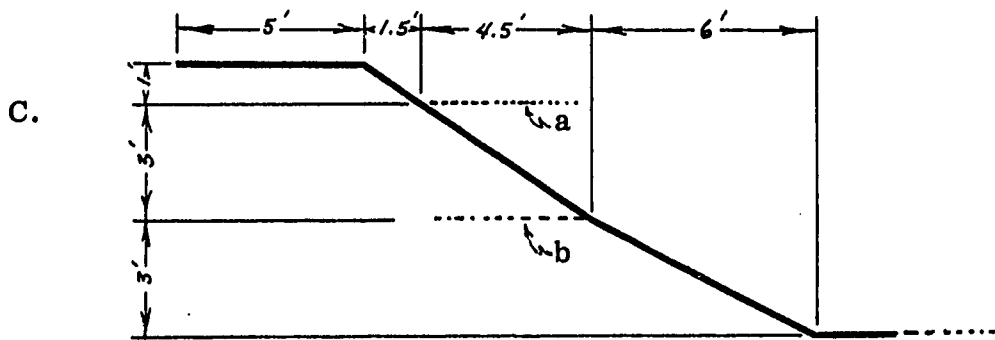
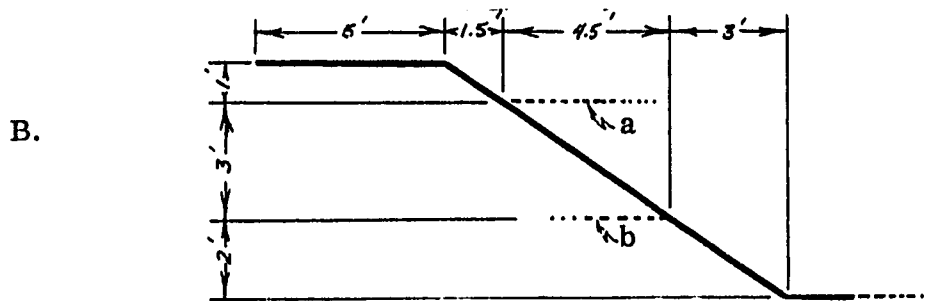


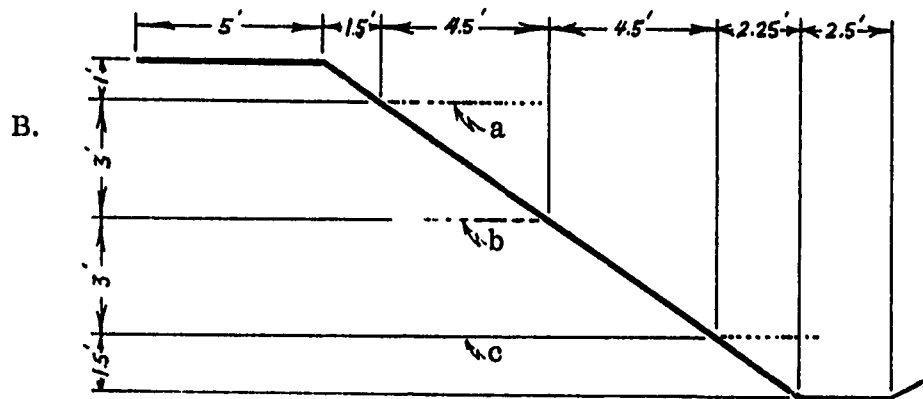
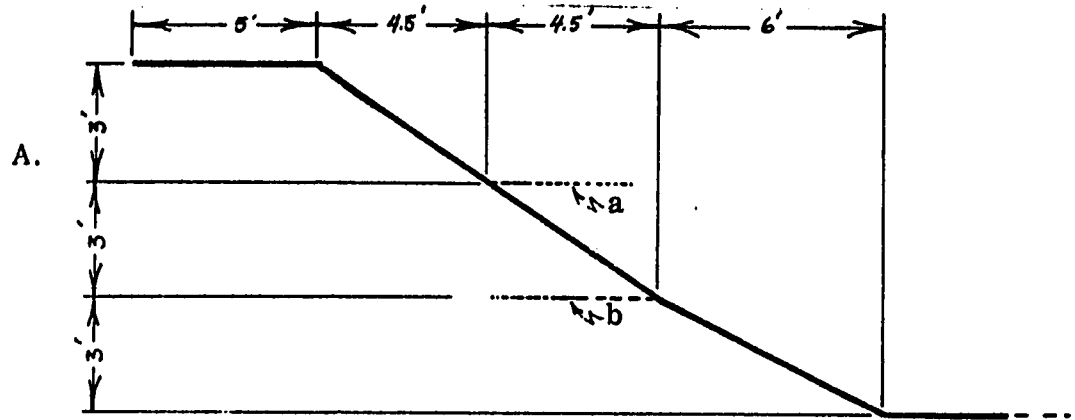
Diagram of 0.25-acre and 0.1-acre earthen ponds proposed for Chandpur Fisheries Station showing (A) top of dam, (B) water level, (C) original soil level and (D) bottom of pond.



A. Diagram of 0.05-acre earthen pond showing (a) top of dam, (b) water level, (c) original level of soil and (d) pond bottom.



B. and C. View of cross-section showing slope and excavation - fill of 0.05-, 0.1- and 0.25-acre earthen ponds proposed for Chandpur Fisheries Station. (a = water level and b = ground level.)



View of cross-section showing slope and excavation - fill of (A) dike and (B) drainage canal in earthen pond system proposed for Chandpur Fisheries Station. (a = water level, b= ground level, c= pond bottom.)

**Concrete Ponds to be Constructed at Chandpur Station**

It is proposed to construct 48 concrete-covered brick center ponds each having an area of 1/100 acre for use at the Chandpur Fisheries Station. These are useful in research on fish feeds and feeding, induced spawning, rearing of fry to fingerling size and many other fishery problems. The general plan of construction is given in the attached drawings. The center of the walls are of brick, covered with a cement-sand mixture made of 3 parts fine sand to 1 part portland cement. The estimated cost is as follows:

33,500 square feet in floors and walls	140,000 rupees
Leveling of area	3,000
Labor	2,000
Pipe inserts for drains 2" x 50' plastic pipe	100
48 stoppers (rubber, wood or plastic)	<u>100</u>
Total	145,200 rupees

**Plastic Ponds**

Approximately 50 plastic lined ponds 10 feet in diameter are also needed.

The cost is estimated as follows:

50 pools	\$1,400
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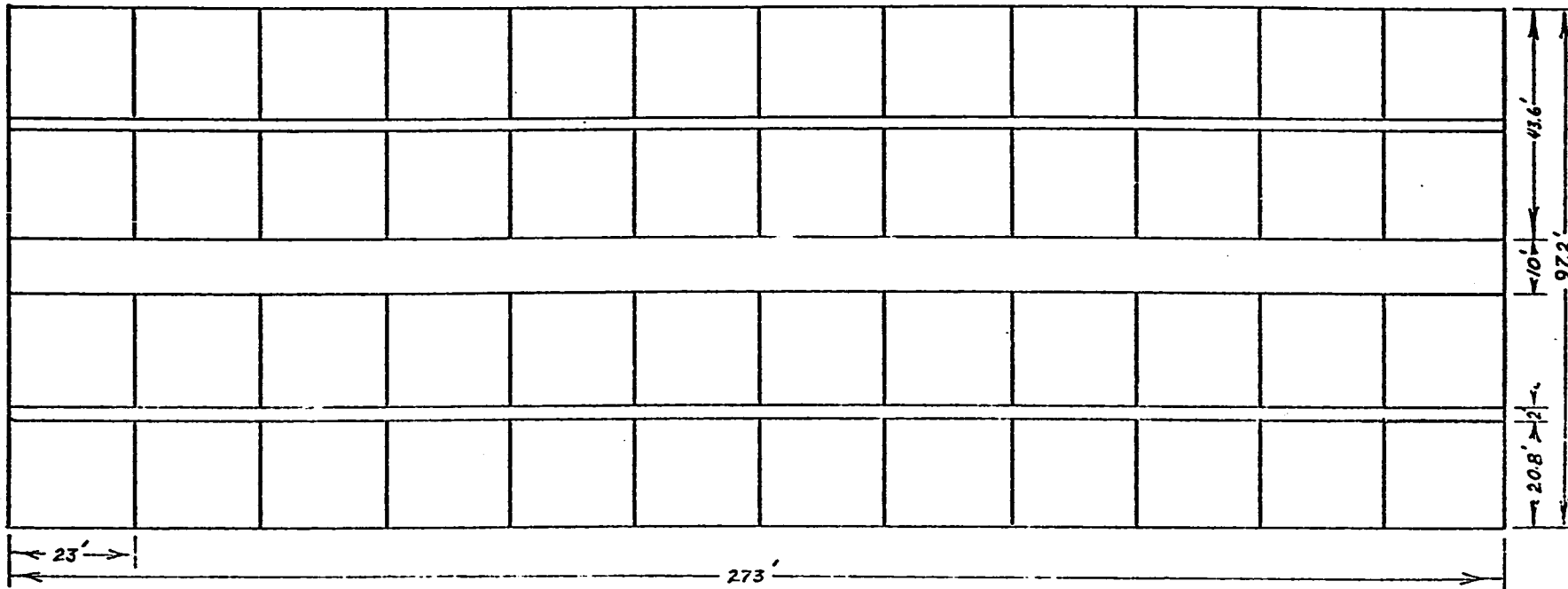
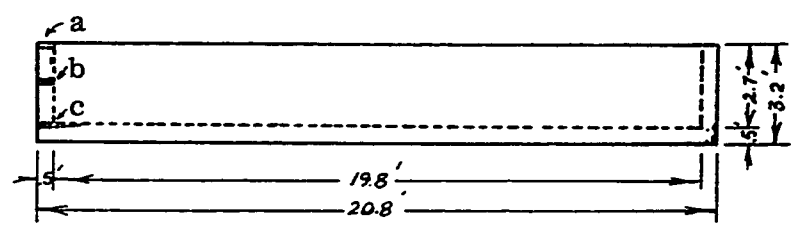
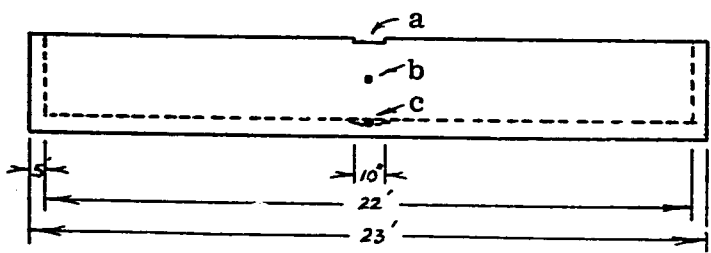
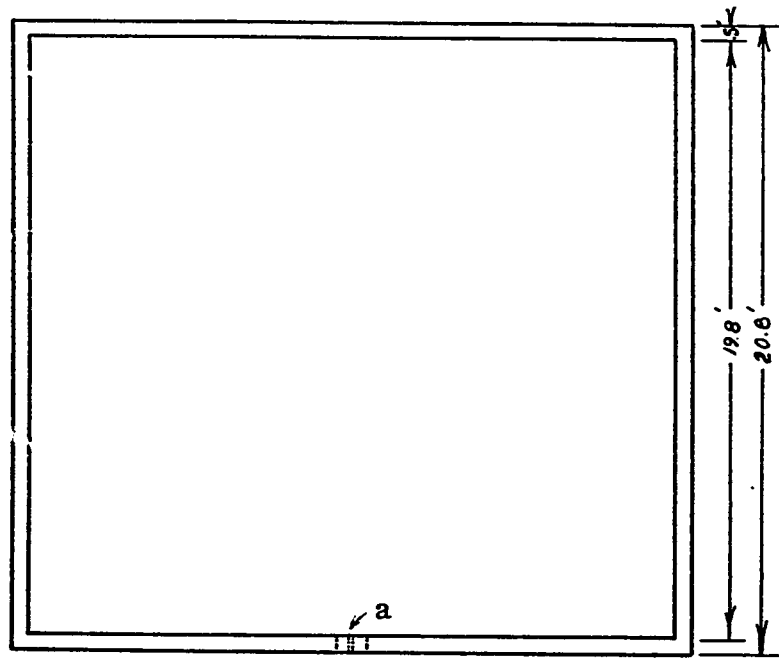
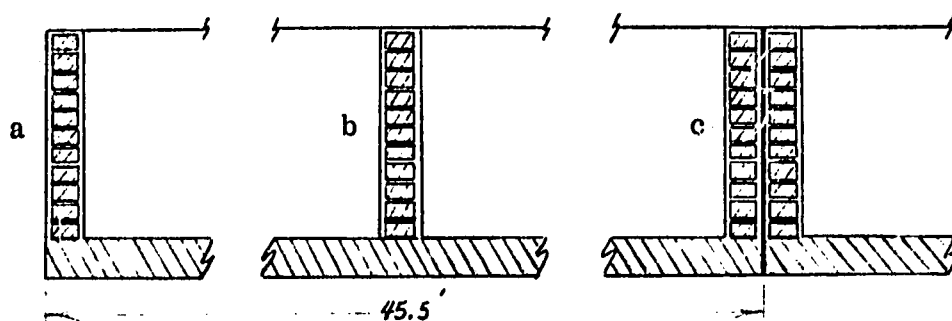


Diagram of concrete ponds proposed for Chandpur Fisheries Station showing 48  
1/100-acre ponds with draining canals between series of ponds.

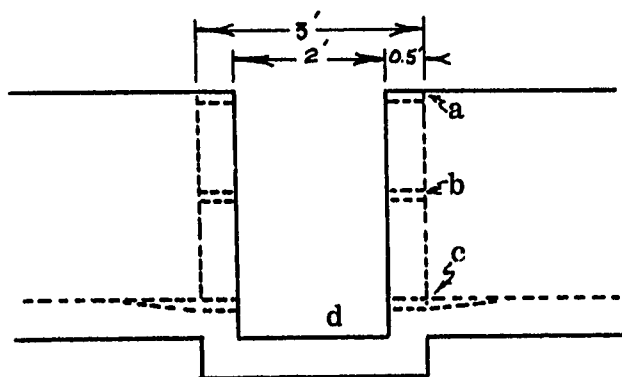


Top, end and side views of individual concrete pond (1/100-acre) showing (a) overflow outlet, (b) top drain and (c) bottom drain with sump.





View of cross-section of concrete ponds (1/100-acre) showing (a) end wall, (b) single wall between ponds (c) double wall between every second pond.



View of end of drain between two series of concrete ponds showing (a) overflow outlet, (b) top drain, (c) bottom drain with sump and (d) drainage canal.

**VI. DATA ON CONSTRUCTION FOR PROPOSED PONDCULTURE  
RESEARCH STATION AT JOYDEPUR (DACCA)**

**CONSTRUCTION OF A NEW PONDCULTURE RESEARCH STATION  
AT JOYDEPUR, DACCA**

This is the alternate to the proposal to enlarge pond research facilities at the Chandpur Station. Over a short period of time, the expansion at Chandpur would be preferable and cheaper. However, research at this Station will always be handicapped by inadequate pond space, high seepage rates in ponds and lack of a satisfactory water supply.

Consequently, over a longer period of time, construction of the new Pond-culture Research Station at Joydepur (Dacca) would be preferable. Its accessibility from all parts of the country and its nearness to the central office in Dacca make it a much better location than Chandpur. Its construction would be dependent (in part) upon ability to purchase 50 acres of land at this location. An additional 25 acres should be purchased for expansion in future years.

The estimated costs, excluding purchase of land, for construction of Pond-culture Research Station and basic plans for ponds follow.

	<u>Dollars</u>	<u>Rupees</u>
Excavation 160,000 cubic yards @ 4 rupees		640,000
Drain pipes	\$ 5,000	
Water supply pipes	6,000	
Labor		45,000
Buildings for research		
Research laboratory 1,000 square yards		400,000
Fish processing shed 200 square yards		20,000
Service building - garage, workshop, storage		20,000
Residence and guest houses		400,000
Fencing		20,000
Laboratory equipment	15,000	
Other facilities		
Electricity generating system	10,000	
Wells (2) and pumps	500	30,000
Sump pumps (2)	<u>1,000</u>	<u>          </u>
Total	\$37,500	1,575,000

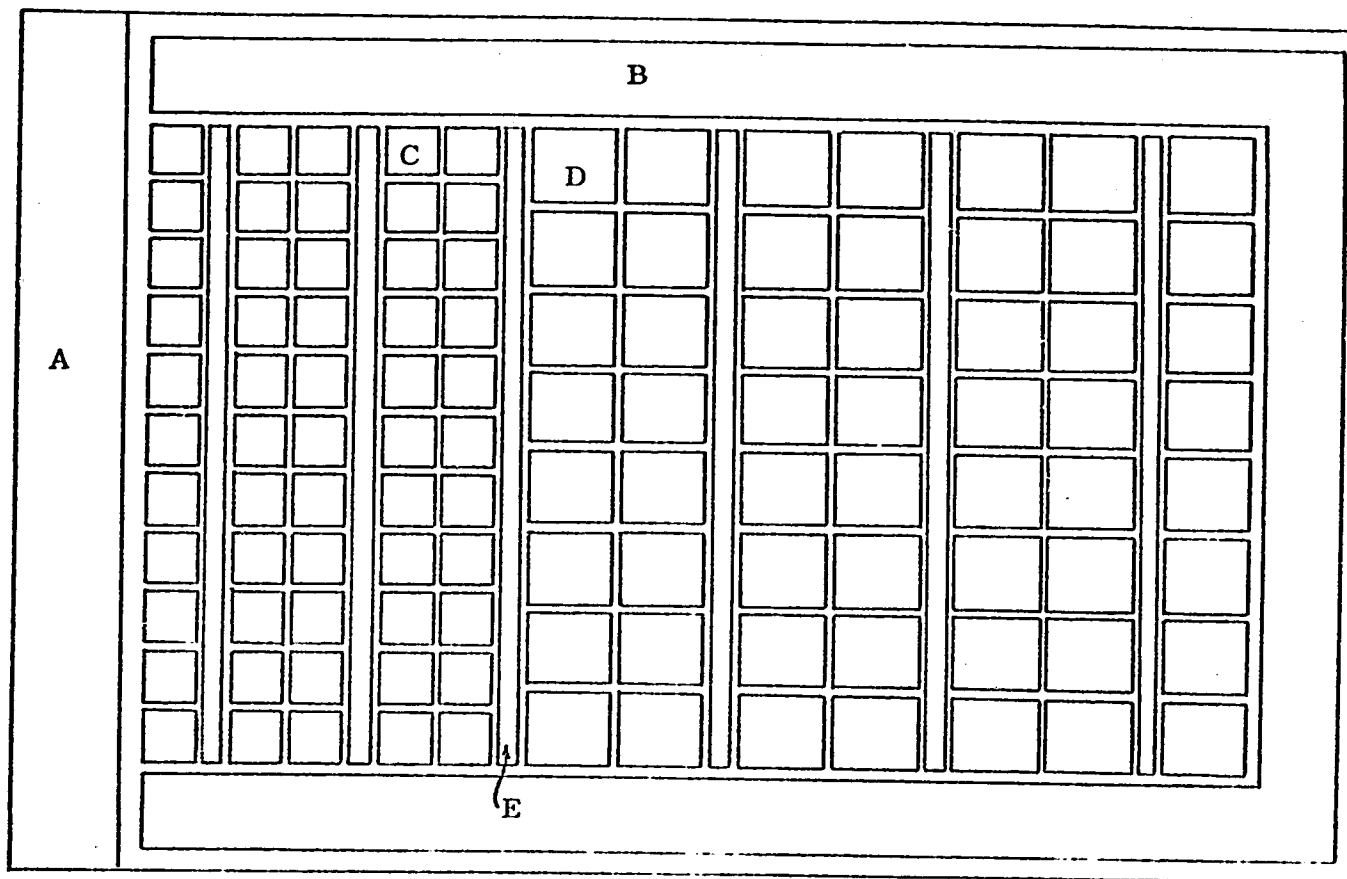


Diagram of proposed research station ponds at Joydepur showing (A) building area, 4.5 acres, (B) moat, (C) 0.1-acre ponds, (D) 0.25-acre ponds, and (E) drain canals. Overall dimensions of area required for above plan are 1136 feet by 1700 feet totaling 19.3 acres. Size of 0.25-acre ponds are 99 x 110 feet; height of dams 6 feet. Size of 0.1-acre ponds are 70 x 62 feet; height of dams 6 feet. Width of drainage canal is 25 feet. The U-shaped moat is 1482 feet long, 1080 feet wide and 10 feet deep. Total land required is 50 acres, but an additional 25 acres should be acquired for expansion in the future.