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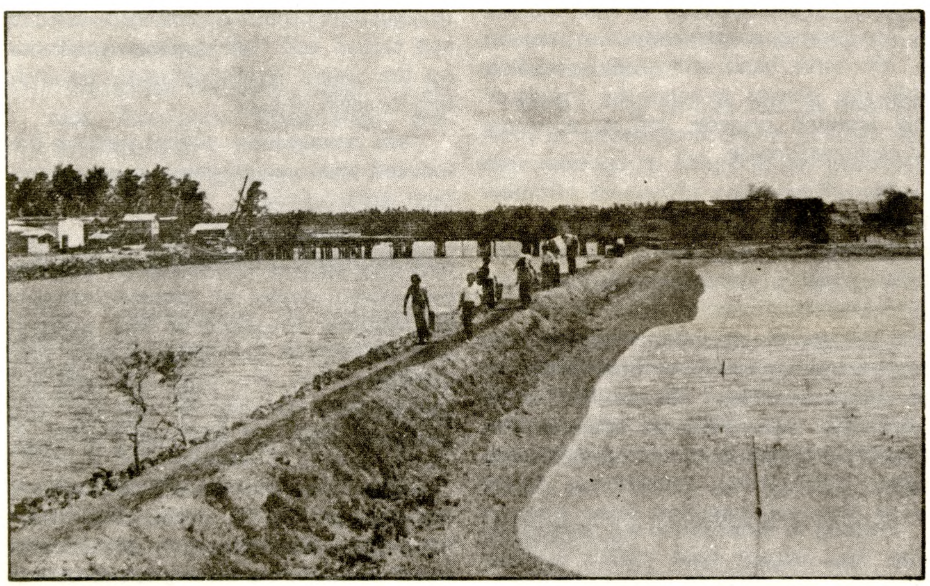
Implement 1980 Aquaculture Research Program

At the close of the first quarter of this year, the green light has been given for the implementation of the aquaculture research activities at the SEAFDEC Aquaculture Department in the Philippines. The research program has been designed to develop aquaculture technology for the Philippines, in particular, and for other Southeast Asian countries in general. With the planning stage over, research areas of impact to the industry are now activated.

Consolidated under three aquaculture systems, the research activities -- classified under the brackishwater aquaculture, freshwater aquaculture and mariculture research -- operated under the general objective of optimal utilization of resources at reduced costs.

About P7 million has been allocated for research activities in the three stations: Tigbauan, seat for mariculture studies, has 82 studies under nine projects, Leganes, the brackishwater research station, has 35 under eight projects, while Binangonan, the freshwater research headquarters, has developed 15 studies under five experimental projects. Binangonan has, aside from experimental projects, the so-called impact field trial projects to be done in cooperation with private fishfarmers.



R&D on brackishwater culture seeks to maximize pond production with the least cost. AQD's Leganes prawn and milkfish ponds will also be utilized for semi-commercial production. This would give researchers the opportunity to test experimental results against commercial performance.

The Tigbauan Research Station concentrates its activities on nine research projects.

Fish hatchery has four subprojects, namely, development of techniques to increase milkfish fry survival, development and maturation of wild and pond-reared milkfish broodstock, induced spawning and larval rearing of milkfish and mullet, and survey of the breeding and larval rearing of milkfish, mullet, grouper and seabass in other Asian countries. Nineteen studies compose the fish hatchery project which has been given top priority.

Under *crustacean hatchery* are refinement of broodstock technology of *Penaeus monodon,* refinement of prawn hatchery technology, improvement of holding systems and the improvement of technology for maturation and larval rearing of other commercially important crustacean species. Ten studies will be conducted during the year under the project.

Spatfall period determination, mollusc hatchery technology development, mollusc farming, and cage and pen culture in coastal waters have been identified for *seafarming* project. Nine studies are under the project.

Nutrition and feed development is another major project and industry needs

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for this area are the development of economically feasible feeds for prawn, milkfish and mullet, the determination of qualitative and quantitative nutrient requirement for prawn and milkfish and the study of the digestive enzyme in milkfish. Formulated pellets developed at the Tigbauan Research Station and tested under laboratory conditions will be tried in the brackishwater ponds of the Leganes Station. There are 12 studies under the nutrition and feed development project.

Ecology research has been divided simply into milkfish and prawn ecology with three studies for each species.

Of priority under *natural food research* are isolation and screening of various local phytoplankton species for larval rearing, development of techniques for maintaining zooplankton stock cultures, and *Artemia culture.* It comprises 8 studies.

Diseases of milkfish fry and fingerlings, diseases of prawns and diseases of *Artemia salina* are the major areas of *pathology research* with eight studies under it.

Aquaculture economics is composed of two studies: economics of prawn and milkfish production systems and market analysis of milkfish, prawn and molluscs.

Six subprojects fall under *aquaculture engineering:* design and development of windmill as an alternative energy source; development of a pond engineering manual; design and development of culture tank systems, nearshore culture systems, life support systems and milkfish fry catching gear.

The Leganes Research Station is programmed to do all brackishwater pond culture research in commodities like milkfish and prawn and the polyculture of milkfish, prawn and mullets. Research studies on pond fertilization using locally available materials and improving the survival rates of milkfish fry and fingerling will also be conducted.

The projects identified for Leganes are *seed production/broodstock development, culture technology, nutrition and feed development, soil and water management, milkfish nursery pond production, milkfish grow-out pond production, prawn production,* and the establishment of a chemistry-biology laboratory.

Seed production and broodstock development aims to develop maturation techniques for *P. monodon* and milkfish under pond conditions and to simplify existing hatchery techniques for *P. monodon*, other penaeid shrimps and mud crab using pond-based facilities. The improvement of transport methods for milkfish and *P. monodon* fry/juveniles and fingerlings is another target.

Culture technology seeks to maximize pond production with the least cost. Major techniques to be dealt with are polyculture, supplemental feeding, stock manipulation and agro-fishery.

Nutrition and feed development studies will explore and test the efficiency of selected agricultural materials as supplemental feed for mud crab.

Soil and water management aims at a more definitive understanding of soil and water parameters as they affect natural food production and growth as well as survival of cultured species.

Under the milkfish nursery pond production project, nursery ponds will be operated to supply the needs for fingerlings of various research projects. Data from the operations will become part of the information bank on milkfish nursery pond management.

Semi-commercial ponds will be utilized by the milkfish grow-out pond production project to test some existing management techniques under actual conditions and to generate income.

The prawn pond production project, on the other hand, will produce marketable size prawns to serve the needs of the research projects and as a means to generate income.

The Freshwater Research Station marshalls its research efforts for pen and cage culture in Laguna de Bay, specifically growth of milkfish fry to fingerling in freshwater, milkfish pen culture and polyculture, tilapia culture in pens and cages and *Macrobrachium* (locally known as *ulang*) breeding. Certain field trials have also been readied, such as the farming of sugpo (*P. monodon*) in Laguna Lake.

Projects in Binangonan are categorized into four impact field testing projects and five experimental projects.

The impact field testing projects will be carried out in cooperation with private pen operators in Laguna Lake, with the general objective of field testing economically feasible fish production technology. The four projects are:

Pilot fishfarming, which considers the establishment of a model fishfarming village at Bo. Pipindan, Binangonan, Rizal. The socio- and production economics of aquaculture technology introduced is being studied;

Tilapia farming aimed to intensify the propagation of high quality tilapia fingerlings in cages and pens for large scale production;

Milkfish-carp-sugpo polyculture, to demonstrate the feasibility of increasing fish production by polyculture of these species in pens as well as to identify the various problems related to polyculture; and

The economic feasibility of *field testing sugpo farming* in freshwater and to identify problems associated with its large-scale application. Sugpo cage farming in freshwater is being conducted.

The five experimental projects are now in various stages of implementation at the Freshwater Fisheries Station. The general objective of the freshwater research program is to solve problems of the fish industry in Laguna Lake. The projects are:

Milkfish nursery in freshwater which is broken down into two studies i.e. lake-based fingerling production in cages and land-based milkfish nursery.

Tilapia breeding which covers fry to fingerling production of tilapia species and strains and feed development make up the tilapia hatchery/nursery for high quality seeds project.

Carp propagation which includes the induced spawning of carps in ponds and their larval rearing.

Lake farming which is broken down into five studies: limnological and fish production studies of selected commercial fishpens in Laguna de Bay, polyculture of milkfish and carps in pens, production of tilapia in cages and pens and supplemental feeding of milkfish, and polyculture of carp and tilapia in cages.

The fifth project is *Macrobrachium* spawning and larval rearing. Feed development for *Macrobrachium*, physico-chemical parameters affecting larval rearing, and comparison of the performance of different configurations of tanks for *Macrobrachium* are studied. ●

Aquaculture Credit Schemes

EDITOR'S NOTE:

There are undoubtedly several credit schemes which are evolving for aquaculture out of the experiences shared among financial institutions in the Philippines. There are also notable exceptions that can be learned from the experiences of other countries. However, the volume of credit transactions for aquaculture is still in its infancy.

It is recommended that if aquaculture credit has to develop, the immediate need is to create a suitable investment climate and to produce the economic data base through pilot operations. The banks are wooed to maintain a more lenient and flexible posture when appraising feasible aquaculture projects in line with the diversified pattern and level of industry operations. The fishfarmers, on the other hand are expected to marshall farm resources to its maximum utilization in order to avoid too much expansionism and financial inconveniences.

The article ends with a note that credit should never be utilized to rehabilitate losing fishfarm ventures, least of all high risk aquaculture propositions.

Before the 1970's, aquaculture received little impetus and was considered a poor-man's entrepreneurial activity. Because most of aquaculture activities then were in traditional milkfish culture, there was no reason for the government to impose restrictions on farm operations. Statistics did not reflect aquaculture economic data base. With little importance given to fishfarming, there was limited credit support provided during the postwar decades of the 1950's and 60's. Credit programs for agricultural and fisheries sectors were lumped together and selectively favored the financially sound industrialists who were engaged in many business endeavors. Apparently, there was not enough money even to raise the agricultural sector from its socio-cultural bounds.

The foresight of financial experts then, was a poor guide for the future. Credit programs remained biased towards manufacturing industries. If there were any quick responses to farmer's needs, loans were generally granted for a political purpose or as a result of public opinion's desire to rehabilitate those affected by typhoon and other disasters.

With the New Society program, credit schemes were established for the masses particularly for agricultural cooperatives. And with the rice problem finally solved, the government turned its emphasis on the growth of the fisheries sector.

The Machinery for Credit Extension

Government and private financing institutions have undoubtedly provided a sophisticated credit machinery with many formal and informal channels for its multi-sectoral clientele. However this sophistication is neither suitable nor practical for the average fishfarmer.

Apparently, credit has been abundant in traditional areas where current technologies and practices are more or less recorded and standardized. As a result, most of the loans allocated for the basic food industries were coursed to crops, livestock, poultry, forestry and others. Aquaculture, which is only a third sector in the fisheries industry, occupies a low credit rating as against commercial fishing ventures and much less important compared to agriculture.

For instance, from 1966 to 1977, P88.4 billion was released as agricultural credit with the bulk going to the crop sector but only 2.6 per cent for fisheries.

Highlights of loans granted to the fisheries industry from 1973 to 1977, are shown below in million Philippine pesos:

Institution	Marine	Municipal	Inland	TOTAL Amount	TOTAL % Sharp
Agricultural Credit Administration	..	3.3	..	3.3	0.4
Development Bank of the Philippines	93.0	258.4	131.9	499.3	61.1
Rural Bank System-1/	..	..	..	304.3	35.5
Total	93.0	261.7	131.9	790.9	100.0

1/ No breakdown by sub-sector

From this, the government may be expected to take the initiative in financing infrastructure facilities, pioneer ventures, large-scale new development and small-scale operations at the economic margin. Many of the financing institutions active in the distribution of credit to aquaculture are either directly or indirectly controlled by the state, which owns all or a part of their capital. The question may be raised whether specialized credit facilities need to be created because existing institutions might tend to ignore the financing needs of aquaculture.

The financing of large-scale aquaculture development schemes is undertaken by institutions experienced in backing investment projects of similar size in other branches of industry, such as specialized development or investment banks like Development Bank of the Philippines and Private Development Corporation of the Philippines. For effective servicing of the small-scale sector, a network of branch banks through the Rural Banking System is utilized for maintaining local contacts, determination of credit needs and the supervision of loans.

The average commercial bank ordinarily confines itself to providing credit for low-risk, short-term operations such as the marketing of high value export products. Nevertheless, the Philippine National Bank and Land Bank of the Philippines have an open credit line for operating capital of fishponds and fishpens payable within one year duration.

Since credit lines for aquaculture cannot compete with its agricultural

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*Contributed by Emmanuel N. Encarnacion, Economist, SEAFDEC Aquaculture Department. The article has been excerpted from the lecture pages of the same title presented by E.N. Encarnacion at the seminar-workshop on Aquabusiness Project Development and Management, held at the SEAFDEC Institute of Aquaculture on 3-16 March 1980.

Management of Fishponds with Acid Sulfate Soils

1. Introduction

Millions of hectares of land in coastal plains would be suitable for cultivation but for the presence of potential and actual acid sulfate soil conditions. Acid sulfate soils which cover several million hectares of low lying coastal plains of the tropics are either poorly productive or unsuitable for cultivation. In this kind of soil an acidic condition can develop which can be detrimental to both the algae and fish. Elements like iron and aluminum maybe released to the water in toxic quantities. Likewise, an acid sulfate pond soil renders essential nutrients like phosphorus, unavailable to the algae. Under such conditions, generally there is no response to phosphorus fertilization.

Despite the high acidity and associated effects, acid sulfate soils have characteristics favorable for wetland cultivation. Their topographic and hydrologic setting is often suitable for establishing fish cultivation. They are normally well supplied with plant nutrients. The pH of the soil is also increased by soil reduction upon flooding. Furthermore, though these soils generally are under salt water influence, the salinity for aquaculture seem not to be a problem because mostly brackishwater pond biota tolerate well these salinity levels. For terrestrial crops salinity is often more problematic than acid sulfate soil conditions (Van Breeman and Pons, 1978). These favorable factors combined make fish cultivation more attractive. This article reviews some of the literature on various aspects of acid sulfate soils and presents some recent findings on the improvement of these soils for aquaculture.

2. Extent of Acid Sulfate Soils

Acid sulfate soils or potential acid sulfate soils cover over 15 million hectares of land in the tropics (Table 1). Nearly 5 million ha are in south and southeast Asia (Van Breeman and Pons, 1978). Of the 15 million hectares, less than 2 million hectares are cultivated. In addition to the areas already identified there are several large areas not yet examined that are presumed to be affected by acid sulfate soil conditions. Its extent in the Philippines however, is not yet fully established (Early, et al 1979 and Singh and Camacho, 1980). My own survey revealed that there are about 15 to 20 thousand hectares of acid sulfate soils in the Island of Panay alone, which are either uncultivated or used for brackishwater aquaculture.

Editor's Note: *This article is serialised in three parts. Part I pictures the extent of acid sulfate soils in Asia, presents the problems of fishponds with acid sulfate soils, describes the properties of acid sulfate soils, and discusses how they are formed. Part II presents the author's surveys, experiences with and studies of acid sulfate soils and their treatment particularly those in the pond system of the University of the Philippines Brackishwater Aquaculture Center in Leganes, Iloilo, Philippines. Part III contains recommendations for the management of acid sulfate soils in aquaculture areas and operations. Dr. Singh is at present assistant professor of aquaculture and project leader on acid sulfate soils at the University of the Philippines College of Fisheries brackishwater aquaculture center. He is a soil scientist as well as water management specialist. He holds the M.S. in soil science and the Ph.D. in soil and water management degrees from the University of the Philippines at Los Banos. He has had extensive research experience in soil and water management at the International Rice Research Institute and is a pioneer in aquaculture-oriented studies regarding problem soils.*

3. Problems of Fish Ponds with Acid Sulfate Soils:

The most common problems associated with fishponds built on acid sulfate soils are fish mortalities and slow growth of fish food organisms and stocked fish. These problems can be attributed to several causes like low pH (Nikolsky, 1963; Beamish, 1972 and IFP, 1974), toxicity of aluminum, iron (Nikolsky, 1963) and manganese (Karpevich and Shurin, 1973); and deficiency of phosphorus due to high phosphate fixing capacity of the soil (Hesse, 1963 and Watts, 1965). In specific, the productivity of these soils is rather low due to: (a) low pH *per se*, (b) toxic effects of iron and aluminum, (c) low nutrient status (especially phosphorus) and micro nutrient deficiencies, and (d) poor physical soil conditions.

Experts on acid sulfate soils have suggested that these soils probably cannot be made suitable for terrestrial crops (Bloomfield and Coulter, 1973). Thus, they maybe best suited for fish ponds. But the initial investment for pond establishment maybe beyond the economic reach of an average Asian farmer. Although occasional fish kills are caused by these soils in acute situations, chronic and sub-lethal effects that inhibit pond biota in general probably are more detrimental in the long run.

If properly reclaimed and managed, these soils may contribute to a large extent in food production and this unused vital resource can be utilized to the fullest extent.

Acid sulfate soils affect fish pond production in widespread areas in the Philippines. There is little evidence to support this because most regions have not been adequately surveyed to determine the extent of these soils. It seems reasonable to recognize the possibility that low production of milk fish in the Philippines (600 kg/ha per year) is attributable at least in part to the inhibitory influence of acid sulfate soils. Furthermore, Tang (1976) reported that at least about 60% of the Philippines fish ponds are affected by acid sulfate conditions.

4. Properties, Description and Identification of Acid Sulfate Soils

Acid sulfate soils are derived from marine and estuarine sediments, which upon drying and aeration show a definite and severe acidification due to the oxidation of sulfides (mainly Pyrite, FeS_2), which leads to the formation of sulfuric acid. Acid sulfate soils generally are found in low coastal areas where sulfides have accumulated in marine sediments as a result of baterial reduction of sea water sulfates. In the acidic state they contain concentrations of exchangeable aluminum and iron that are toxic to many plants.

Acid sulfate soils are extremely acid soils with a high content of sulfates. They have pH which is less than 3.5 in some layers in the upper 50 cm. of the profile for entisols and less than 4.0 for inceptisols. The acidity is due to the presence of sulfuric acid and iron and aluminum sulfates. These soils are high in pyrite and poor in bases. When submerged and anaerobic they are nearly neutral in reaction, but when the water recedes or the land is drained, the pyrites are oxidized to sulfuric acid and the soils become extremely acid (Brinkman and Pons, 1973; Bloomfield and Coulter, 1973).

Most brackishwater fishponds in southeast Asia are constructed in

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Edible Crustaceans in the Philippines*

17. *Ocypode ceratophthalma* (PALLAS)

English name: Horn-eyed ghost crab.

Philippine name: Biokoy or Bayokoy (Ilongo); Agokoy, Agoyokoy or Alagokoy (Cebuano).

In general this species grows larger than another ghost crab, *O. cordimana*. The carapace is rectangular and armed by unequal chelipeds or pincers. Eyes bear very long horn at the tip.

The entire body is whitish with some dark brown areas on the carapace with no hair.

At night, they creep back and forth actively across the sandy beach, thus the name, horn-eyed ghost crab. This species excavates deep burrows on sand beaches in tropical and sub-tropical areas. They are nocturnal in behavior, but are often found on the surface carrying sand out of a burrow during low tide in early morning.

Local people catch this crab by hand at night with the aid of a kerosene torch.

This species is widely distributed throughout the tropical Indo-Pacific region, from Hawaii and Tahiti, to Southern Japan and the Philippines, southward to New South Wales, Australia, and westward to the Red Sea, Arabian Gulf, and east and south Africa.

The people living near the shore cook the crab by frying it in oil (scale represents 10 cm).

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*by H. Motoh, 17th in a series

Management of . . .

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mangrove areas, where mangrove swamps and similar ecological areas are known to provide conditions ideal for the formation of acid sulfate soils.

An acid sulfate soil has been defined as a drained soil with free as well as absorbed sulfates, having yellow mottles of jarosite and a pH below 4 in water. An acid sulfate soil when wet may have high pH value, even near neutrality but when oxidized by drying or concentrated hydrogen peroxide, the pH should drop by about two to three units. This type of soils are classified as potential acid sulfate soils. Acid sulfate soils vary greatly in their chemical properties and hydrology.

Table 1. Distribution of Acid Sulfate soils in Southeast and East Asia.

Bangladesh	700	Bloomfield and Coulter, 1973; FAO-UNESCO, 1976
Burma	180	FAO-UNESCO, 1976
China	67	Van Breemen and Pons, 1978
India	390	Yadav, 1976; FAO-UNESCO, 1976
Indonesia	2,000	Driessen and Soepraptohardjo, 1974
Japan	21	Murakami, 1969
Kampuchea	200	FAO-UNESCO, 1976
Malaysia	160	Andriesse et al, 1969
Philippines[1/]	7	Van Breemen et al, 1977
	10	Ponnamperuma and Brinkman, 1980
	120	Tang, 1976
South Korea	3	Park and Park, 1969
Thailand	670	Vander-Kevie and Yenmanas, 1972; and Dent and Montcharoen, 1966
Vietnam	1,000	Tram and Lieu, 1975

[1/] Not adequately surveyed. Area (2nd col.) is in thousand hectares.

5. Formation of Acid Sulfate Soils

In mangrove swamps, the formation of acid sulfate soils is favored because of the abundant supply of sulfates and organic matter. The mangrove vegetation (especially dense fibrous roots) in these swamps facilitate the accumulation of inorganic and organic materials and help in the build up of sediments by trapping mud and in controlling erosion (Van der Kieve, 1973). Decomposition of organic matter depletes the oxygen, giving rise to anaerobic conditions and thus activating the sulfur-reducing bacteria. These obligate anaerobes decompose the organic materials and at the same time utilize the sulfates present in seawater for their respiratory processes producing sulfides (Campbell and Postgate, 1965). The resulting sulfides may accumulate in the sediments as hydrogen sulfide gas or combine with available iron to form insoluble black iron sulfide. Further transformation of the iron sulfide will produce pyrite, the mineral responsible for the formation of acid sulfate soil.

Pons (1969) and Richard (1973) proposed that the pyrite may be formed through the following reactions:

$$2CH_2O + SO_4^{=} \text{ --- } HCO_3 + CO_2 + H_2O$$

$$H_2S + Fe^{+2} \text{ ---- } FeS + 2H^+$$

$$FeS + S \text{ ------ } FeS_2 \text{ (Pyrite)}$$

The necessary constituents for pyrite formation are sulfate, iron, metabolized organic matter, sulfur reducing bacteria and aneroby alternated (in space and time) with limited aeration (Van Breeman and Pons, 1978).

The construction of fishponds on mangrove swamps leads to exposure and oxidation of pyrite, which results in highly acidic conditions. Thus, the quality of the overlying water is affected by the nature of the pond soils. Atmospheric oxidation of pyrite under moist conditions follows:

$$2FeS_2 + 7O_2 + 2H_2O \text{ --- } 2FeSO_4 + H_2SO_4$$

At a very low pH Fe^{+2} is oxidized to Fe^{+3} by *Thiobacillus ferroxidans:*

$$4FeSO_4 + 2H_2SO_4 + O_2 \text{ ---- } 2Fe_2(SO_4)3 + H_2O$$

The resulting Fe^{+3} is a more efficient oxidant for pyrite than free oxygen:

$$Fe(SO_4)_3 + FeS_2 \text{ ---- } 3FeSO_4 + 2S$$

$$2S + 6Fe_2(SO_4)_3 + 8H_2O \text{ --- } 12FeSO_4 + 8H_2SO_4$$

Thiobacillus tioxidans can oxidize sulfur to sulfuric acid:

$$S + 3/2\ O_2 + H_2O \text{ ------ } H_2SO_4$$

Basic ferric sulfate, the most common of which is jarosite $KFe_3(SO_4)_2(OH)_6$ is also produced during pyrite oxidation with the hydrolysis of ferric sulfate and oxidation of ferrous sulfate.

$$Fe_2(SO_4)_3 + 2H_2O \text{ ---- } 2Fe(OH)SO_4 + H_2SO_4$$

$$4FeSO_4 + 2H_2O + O_2 \text{ --- } 4Fe(OH)SO_4$$

The final pH of the soil, however, will depend on the amount of pyrite oxidized and the buffering capacity of the soil. The acidity can be neutralized by the bases coming from minerals, mainly, calcium carbonate, and the metal cations coming from the exchange complex. Thus, soils with low amount of bases will develop into strongly acid soils.

6. Problems of Aquaculture Arising from Acid Sulfate Soils:

Acid sulfate soils when used for aquaculture present various problems, which could be enumerated as:

1. Fish kills due to acidity
2. Poor fertilizer response
3. Low natural food production
4. Slow growth and fish mortalities
5. Erosion of pond dikes leading to acid water

End of Part I

Aquaculture Credit . . .

(From page 3)

and industrial counterparts, the government is providing several credit programs for aquaculture through the following credit retail outlets:

Institutions

1. Asian Development Bank - Laguna Lake Development Authority
   Fishpen estate development
2. Development Bank of the Philippines
   Inland fish culture projects
3. Development Bank of the Philippines
   Marine farming projects
4. Development Bank of the Philippines- International Bank for Reconstruction and Development of the World Bank
   Fourth Credit line for fishfarming
5. Land Bank of the Philippines
   Aquaculture projects
6. Land Bank of the Philippines - Masaganang Sakahan Inc.
   Fishpond estate development
7. Private Development Corporation of the Philippines
   Fishfarming projects
8. Philippine National Bank
   Fishpond and fishpen rehabilitation
9. Rural Banking System
   Fishfarm production and development
10. Rural Banking System - Central Bank
    Biyayang Dagat '79
11. Technology Resource Center - Overseas Economic Cooperation and Development
    Prawn farming projects

Financing Experience of Fishfarmers

The fragmentation of aquaculture communities in terms of (1) geographical location, (2) types of culture-system operation, (3) resources and markets, and (4) technology levels has established that fishing is not adaptable as a single financing package for nationwide promotion. The heterogeneity of the aquaculture industry has been the underlying constraint to a simplified and efficient form of financing farm operations.

About half of Filipino fishfarmers have availed of borrowing money to raise operating capital. The more advanced members of the fishfarm associations prefer the services of government credit programs especially DBP due to lower cost of capital. In contrast, the less informed farmers are in favor of borrowing money from relatives and friends, and through the rural banks as a last resort.

For those who utilize loans for the right purpose, the majority needed the money to improve or expand their fishpond and buy farm inputs. Nevertheless, it is not rare to observe farmers from diverting loan proceeds for unintended purpose. Reasons for wrong application of funds include (1) investment in other business, (2) studies for children, (3) payment of debts, and (4) purchase of utilities such as vehicles or appliances for personal use.

Although a number of credit programs is available for fishfarming, actual credit availments extended by the formal financial system are insufficient to meet the needs of the small-scale farmer. This inadequacy often arises as a result of the reluctance of banks to apportion a major share of their funds to high risk aquaculture investments. And in specific instances, loans were granted with the aid of doleouts or bribes, as reported by fishfarmers.

In the past, credit collection performance has been poor due to slow repayments. This problem is caused by poor production, lack of input supplies, management deficiencies, low level of technology, slow process of socio-cultural change, lack of qualified technical manpower and insufficient marketing infrastructure support.

While it may be true that the development of aquaculture credit facilities has been retarded by failure to pay sufficient attention to one or more of the above factors, the relatively slow growth of such facilities on a global basis may have other roots. Country reports have accused the causes of slow growth as reflective of the lags in technical, managerial and economic expertise on aquaculture operations. Without the backstop support of professionals who have the capability and efficiency to carry out the tasks of design, construction and operation, government credit programs may only be a futile exercise.

Unfortunately, institutions compete with each other for more profitable and economically feasible business ventures leaving the majority of the population in the aquaculture industry in a capital slack. In most cases, credit granted by the financial system has favored big borrowers and is biased against small farm holders who do not have adequate collateral even with relaxed government credit policy.

Experiences in Other Countries

To overcome such obstacles and to facilitate credit operations, some national banks in Indonesia accept in lieu of collateral security carefully prepared feasibility studies providing evidence of good prospects of success. In Nepal, the government guarantee loans to recent fisheries graduates who enter the industry. And in Europe and the United States, loans of various sizes and maturities can be raised by showing evidence of favorable past performance and insurance rating.

In considering the general strategy to be adopted in aquaculture development, the experience of Taiwan is an excellent preview of government services to come. The financial institutions cooperate with the research centers and fisheries cooperatives to foster specialized functions of check and balance in promoting the industry. The experience could have been repeated in the Philippines and Thailand, but the lesson in Taiwan is derived under a solid foundation of mutual trust.

As counterpart example, the socialist experience in China is fundamentally based on a more controlled and administered farming scheme, with less diversity and more equality. Each farmer has a sustained amount of assistance from government without the prejudice of the "estates" idea where the grass roots are down-graded to the position of an employee. As no private firms are involved in the operation, no apprehensions arise about returning to colonialist conditions.

The gathering momentum of aquaculture development efforts requires immediate adapting of institutional arrangements to give adequate support to such development. With funding as a main constraint in most countries, emphasis must be on creating, expanding, or strengthening aquaculture credit schemes that meet the industry's requirements for investment capital, input purchase, crop financing and essential consumption expenditures of the operator.

Next issue:

Recommendations and Alternative Strategies

New Fish Hatchery for Third World Research

A new £100,000 tropical fish hatchery was opened this month (Sept) at Scotland's newest university, Stirling. It is designed to play a pivotal role in the continuing research programmes to discover improved sources of high protein food for the developing world.

The hatchery will have a programme of research mainly funded by the Overseas Development Administration (ODA) -concerned initially with the rearing on a large scale of tilapias and other tropical fish suitable for human consumption.

The hatchery is also being used as a focus for financial and technical help in research projects likely to help developing countries being offered by major British manufacturing companies. Blue Circle Cement is, for example, putting up the money for a research facility into the possibilities of intensively fish farming tilapia to market size.

The hatchery will eventually be managed by an Institute of Aquaculture to be set up at Stirling University. The new Institute will allow for the development of the university's concern with aquatic pathobiology.

Stirling's existing teaching programmes attract students from 64 different countries while members of staff are involved in research projects in almost every continent.

The Institute's First director will be Professor Donal Roberts, present Head of the Aquatic pathobiology Unit. (British Information Services)

BOOK REVIEW

TROUT FARMING MANUAL
John P. Stevenson
Published March 1980
Price £9.75 −95p post/packing

84 illustrations
186 pages
size 210 x 148 mm
ISBN 0 85238 102 6

Trout farming is growing in economic importance throughout the world. The relative costs of marine caught fish compared with farmed trout in developed countries in particular will give added impetus to the demand for this fish -- prized for its excellent though delicate flavour, and standardised size and quality. Here, then, is a book to answer everybody's questions about the farming of brown or rainbow trout.

The TROUT FARMING MANUAL has been written as a practical guide for those without a great deal of experience who may be considering investing in a trout farm, in a hatchery, or in rod letting, and for those interested in working on a fish farm. However, it is so full of practical advice that it can help to improve productivity on existing trout farms; many an angler, too, will find much fascination in it.

This book is written by a scientist who has worked with so many fish farms that he is thoroughly practical in his approach. He has travelled extensively and has been able to draw upon experience and illustrations from many countries. His style is straightforward and easy to read, purely scientific details being reduced to a minimum or adequately explained. Where Dr. Stevenson feels existing literature is lacking, he goes into fuller detail -- for example, the stripping of eggs from sexually mature hens is fully described and well illustrated. In other matters the book is designed to give basic concepts designed to help in decision-making, to advise on desirable practices and warn on undesirable practices or conditions.

The TROUT FARMING MANUAL covers all practical, scientific and economic aspects of the subject, as can be seen from the contents which are listed:

Introduction; Water; Sites and installations; General farm practice; Marine culture; Hatchery practice; Biology; Parasites and disease; Transport; Markets and opportunities; Legislation; Glossary; Appendix; Index.

Dr. Stevenson is a micro-biologist and former head of the UK Fish Pathology Unit at Weymouth, who now acts as a consultant to fish farmers.

It follows that this attractively designed book will be of interest to anyone, world-wide, who is interested in any aspect of this subject. In particular the author hopes that it will provide most of the information necessary to think constructively about setting up a trout farm, to run it smoothly and turn it into a successful enterprise. As such, it will be the standard text in this field for many years to come.

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