species composition, and ages of various species etc... are of great importance for planning the future development of our fisheries.

A second phase of the project will help the achievement of:

Complementary prospect in the best fishing grounds spotted during the first phase to relocate and accurately estimate the extent of the concentrations of fish and shrimp and their potential productivity.

Improvement of the technical skill and the scientific expertise of the personnel of our Fisheries Institute.

Planning and supervision of the development of the future offshore fishing fleet, and related questions.

Training of officers and crewmembers (in various specialities) to be employed aboard the new vessels.

B. – Inshore fisheries

Most of our fishermen with their 50,000 powered fishing boats are exploiting the inshore fishing grounds. Fishermen now build larger boats, use all kinds of nets made of synthetic fibers particularly trawl nets, purse-seines, gillnets, and adopt efficient fishing techniques. Added efficiency may lead to over fishing and its detrimental effects. Fish catches are increasing every year and an improvement of the existing marketing system and methods of preservation is under experimentation. However the new marketing system meets the opposition of middle men and wholesale dealers. These men provide advance loans to fishermen and receive fish afterwards. They also sell fish on credit to the retailers in all markets throughout the country.

Shrimp catching is now considered a good business and many hundred fishing boats are trawling day and night to get shrimps for export. However the economies of this fishery needs to be examined in detail.

II – INLAND FISHERIES AND FISH CULTURE

With more than 4,000 km of water ways network and the south west region (Plain of Reeds) flooded every year by the Mekong River, the inland fisheries have a production that represents about 1/6 of the total catch of the country. Fishermen and farmers have also adopted efficient methods to catch fish and now use small outboard boats to transport their catch to market faster.

Fish culture development, both in fresh and brackish water, is being enhanced. Government hatcheries distribute freely or sell at low price fingerlings to the farmers. Technical advice and appropriate loans to construct fish ponds for fish culture purpose have also been provided to fish farmers. In some areas where conditions are suitable (river, stream) fish rearing in floating cages is practiced. Thousands of acres of mangrove swamp and low lands in the south west are now under reclamation for Chanos chanos and shrimp culture.

III – FUTURE PROJECTS

The following measures are now under execution to increase production of both marine and inland fish:

To find new off-shore fishing grounds

To build off-shore fishing fleet

To improve the techniques of catching

To train fishermen and cadres

To provide sufficient (and in due time) loans to fishermen for better equipment

To gather data which can be used to protect aquatic fauna against overfishing at sea as well as in inland waters.

To dredge the river estuaries and build new landing facilities thus improving access to fishing ports.

To organize a chain of refrigeration facilities for fish preservation.

To improve the existing marketing system

To encourage local and foreign investment in fishing and related industries.

To assist fish culture technically and financially.

IV – DIFFICULTIES

In order to develop our fisheries rapidly, we have to overcome some difficulties, such as:

The lack of adequate fisheries technicians (fishery biologists, fishery technologists, fishery economists, statisticians, etc....)

The lack of statistical data and a basis investigation of the present situation and future prospects of our fisheries.

THE OTHERS

SEAFDEC/SCS.73: S-3

Preliminary Observations on the Utilisation of Pig-Dung Effluent for Fish Production

by
P.C. Seow and George Tay

Freshwater Fisheries Laboratory
Primary Production Department
Singapore

Abstract

In developing Singapore where agricultural land is making way for urbanisation and industrialisation, carp culture is being looked upon from a new perspective. It is obvious that the wanton discharge of animal waste will

eventually result in polluted streams, reservoirs and coastal waters. In view of the above, preliminary investigations were carried out to evaluate the use of cess-pit effluent of pig dung for carp production. Initial results indicate that the carp pond can serve as a buffer zone where organic wastes can be cheaply and profitably removed, thereby minimising the subsequent pollution of our inland and coastal waters. However, further investigations are necessary to substantiate the use of carp ponds not only for fish production but also to serve as a reservoir for the biological reduction of organic pollutants.

INTRODUCTION

The process of industrial development in the island Republic of Singapore has brought about some changes inland utilisation. As more land is gradually developed for industrial purposes, agricultural activities decreased on a corresponding scale. Hence the various forms of such activities must be intensified for maximum land utilisation.

Pig rearing has been one of the main farming activities in Singapore. For the past decades before urbanisation, animal waste from such activities were washed and drained into streams directly or into ponds for carp production before discharging into streams. The hazards associated with this traditonal method of mixed farming of fish and pigs are obvious. The unregulated discharge of pig washings usually results in over-fertilisation, excessive proliferation of blue-green algae and may even lead to mass mortality of carps. When this occurs, the only alternative is to discharge the foul pond water into the nearest stream. Such a practice would constitute a source of pollution as well as a health hazard.

The adverse effects of pollution on various lakes and coastal waters in different parts of the world are well-known. Singapore is aware of such problems and strict laws have been legislated against environmental pollution. The more dynamic aspect of the anti-pollution law is the conservation of the reservoirs and the coastal areas which are important potential resources for aquaculture development. Although the use of cess-pits has been introduced to the pig farmers the effluent from these cess-pits can still contribute to environmental pollution, perhaps to a lesser extent. However, if regulated amounts of pig dung effluent were discharged into ponds which serve as a 'buffer zone', not only will it further minimise the effects of organic pollutants but also will provide a good source of organic fertiliser to the ponds for carp production. With these dual objectives in mind preliminary investigations on the utilisation of cess-pit effluent for fish production were carried out.

UTILISATION OF ORGANIC WASTE FOR FISH PRODUCTION

The traditional method of Chinese carp culture incorporates the direct discharge of pig dung into fish ponds. The principle behind this is to enrich the water with pig dung so as to increase fish production. Such a practice usually causes intense proliferation of undesirable algae and overfertilisation, and may result in mass mortality of fish.

Other methods of organic waste utilisation have been reported. Slack (1972) has successfully cultivated fish in sewage stabilisation ponds. Similarly in India, diluted sewage is released into fish ponds as a fertiliser (Jhingran 1972). Chan (1972) has stated the possibility of culturing fish using sewage effluent after digestion. These methods appear to be an improvement over the traditional Chinese method as the sewage has gone through a certain period of biodegradation before being used.

For the present investigation carried out at the Freshwater Fisheries Laboratory, Singapore, 110 fingerlings of bighead carp (*Aristichthys nobilis* Richardson), silver carp (*Hypopththalmichthys molitrix* Val.) and grass carp (*Ctenopharyngodon idellus* Cuv. & Val.) stocked in the ratio of 5:5:1 respectively in a pond of 550 m^2, attained a total weight of 78 kg within 6 months. No supplementary feeding was given. This production represents a projected yield of 1.4 tons/ha/6 months.

EFFECTS OF PIG DUNG EFFLUENT ON FISH POND

Chemistry of Effluent and Pond Water

Table I illustrates the results of the chemical analysis of the effluent. Inspite of the detention period in the cess pit, it contained substantial amounts of nutrients and a high biological oxygen demand (990 mg/1). With the introduction of 182 litres of effluent into the carp pond at two weeks intervals the nutrient levels of the pond water increased markedly (table II). Total dissolved phosphate values were raised from 0.24 to 0.94 mg/1 while alarger amount would be expected to be fixed by the bottom mud as observed by Watts (1965) and Oren and Ravid (1969). However pH values were observed to remain around 6.5 even after the addition of the effluent. With the increased influx of dissolved solids from the effluent, alkalinity values increased from 0.31 meq/1 to 0.55 meq/1. Dissolved oxygen values in the pond water was also raised and this led to an increase in the primary productivity of the pond from 0.7 mgC/hr/lit to 2.4 mgC/hr/lit after the introduction of the effluent (Table III). In qualitative terms, all these changes point towards a more fertile pond.

Table I. Chemical analysis of cess-pit effluent

	Mean Value in mg/l	Range in mg/l
Total Solids	1920	150 – 5170
Calcium	77.9	48.0 – 123.6
Potassium	178.0	80.0 – 305.0
Sodium	104.0	20.0 – 400.0
Total Phosphate	251.1	175.0 – 325.0
Sulphate	11.2	2.5 – 17.9
Chloride	74.3	17.5 – 105.0
Ammoniacal Nitrogen	188.7	69.8 – 331.6
Nitrate Nitragen	8.0	7.5 – 10.0
Biological Oxygen Demand	990	100 – 2200

Table II. Chemical analysis of pond water before and after introduction of cess-pit effluent.

	Mean Value mg/l Before Introduction	Mean Value mg/l After Introduction
Total Suspended Solids	12.9	26.4
Total Dissolved Solids	49.7	68.9
Calcium	2.7	6.4
Potassium	3.6	10.3
Sodium	4.7	6.9
Total Dissolved Phosphate	0.24	0.94
Total Benthic Phosphate	1.3	4.2
Sulphate	NOT DETECTED	4.8
Chloride	8.7	15.1
Ammoniacal Nitrogen	0.31	0.79
Nitrate Nitrogen	4.7	9.5

Table III. Physico-chemical analysis of pond water before and after introduction of cess-pit effluent.

	Mean Value Before Introduction	Mean Value After Introduction
pH	6.5	6.5
Alkalinity meg/l	0.31	0.55
Dissolved Oxygen		
(Top sample) mg/l	5.9	11.4
(Bottom sample) mg/l	5.6	6.5
Light and Dark Bottle Measurement		
D.O. in Light Bottle mg/l	7.0	13.6
D.O. in Dark Bottle mg/l	5.1	9.8
Primary Productivity mgC/hr/lit	0.7	2.4
Biological Oxygen Demand mg/l	6.5	11.5

Productivity of the Carp Pond

It is apparent that the addition of pig-dung effluent increases the nutrient load in a fish pond. This has been shown to bring about a corresponding increase in the productivity of the pond (Basu, 1965, Beeton and Edmondson, 1972). As the eutrophicity of the pond increases, plankton composition will also change. During the investigations however, the water did not show any trends of becoming soup-like in consistency (Prowse 1964) as we would expect in the traditional carp ponds where blue-green algae proliferate. Examination of the plankton revealed some changes in constitution following the introduction of the effluent. With the introduction of the effluent, green algae decreased from 55.1% to to 45.0% whilst euglenoids increased from 34.4% to 51.2%. Although plankton composition remained generally the same with a co-dominance of euglenoids and green algae, BOD values of the pond water showed an upward trend from the initial value of 6.5 mg/l to 11.5 mg/l after the introduction. Although such an increase may cause alarm, what is more striking is the drastic reduction of the BOD of the effluent once it has been discharged into the pond. The effluent with an initial BOD of 990 mg/l caused a comparatively minimal increase in the pond water. This shows that fish ponds can act as a sto-gap to buffer the deleterious effect of direct discharge of the effluent into the water systems. It must however be remembered that the dilution capacity of the pond is an important consideration at this juncture.

CONCLUSION

As sewage contains substantial amount of nutrients, it constitutes a pollution hazard to the water-systems, reservoirs and coastal waters if directly released. The high biochemical oxygen demand, suspended material, pathogens and parasites (Jhingran, 1972; Chan, 1972) are the sources of pollution associated with raw sewage. However if raw sewage is allowed to undergo a period of biodegradation and self-purification, and be discharged subsequently with proper control, it may be harnessed for aquacultural production. Although the effluent has a high BOD it has been found that the partially digested sewage is suitable for carp culture. Unlike raw sewage the introduction of the effluent into the fish pond has not brought about the usual proliferation of blue-green algae. But what appears more promising in the use of the effluent, is the drastic reduction of BOD values once the effluent is discharged into the pond. The minimal rise in BOD of the pond water after the introduction shows the capacity of the fish pond to absorb the nutrient load. Primary productivity values obtained during the investigations seem to agree with this.

It is apparent that the effluent even after the storage period is still not suitable for direct discharge into streams. The high BOD value and the dissolved nutrients, especially phosphates, can cause eutrophication. To conform with the anti-pollution requirements at discharge, would necessitate the effluent to be further processed, which is very costly. The fish pond has been shown to offer a very profitable alternative. It can be used as a very important 'stop-gap' or 'buffer zone' for the efflent before discharge. Initial investigations reveal that the pond stil retains acceptable BOD and productivity levels even after the introduction of the effluent. Hence it appears that the carp pond is not only productive but also serves as biological control for organic pollutants before the effluent is discharged into the streams.

From the results of the preliminary investigation, further studied need to be carried out before a standardized method on the integration of carp production and the biological control of animal sewage pollution of inland and coastal waters can be evolved.

ACHNOWLEDGEMENTS.

The authors wish to express their gratitude to the Director, Primary Production Department for permission to publish the paper; to Mr. Chen Foo Yan for his invaluable assistance in reading and criticising the manuscript and to Mr. Nah Keng Cheng for analysing the cess-pit effluent.

Reference

Basu, A. K. 1965. Observation on the Probable Effects of Pollution on the Primary Productivity of the Hooghly and Mutlah Estuaries Hydrobiologia, 25, 302–316.

Beeton, A. M. & Edmondson, W. T. 1972. The Eutrophication Problem. J. Fish. Res. Bd., Can., 29, 673–682.

Chan, George L. 1972. The Use of Pollutants for Aquaculture – Conditioning of Wastes for Aquaculture. 15th Session IPFC Wellington. FAO Bangkok.

Jhingran, V. G. 1972. A critical appraisal of the water pollution problem in India in relation to Aquaculture. 15th Session IPFC Wellington. FAO Bangkok.

Oren, O. H. & Ravid, Rosa. 1969. Phosphate in Lake Kinnereth. Verh. Intern. Verein. Limnol., 17, 334–341.

Prowse, G. A. 1964. Some Limnological Problem in Tropical Fish Ponds. Verh. Intern. Limnol., 15, 480–484.

Slak, E. B. 1972. Sewage and Aquacultural Production. 15th Session IPFC Wellington. FAO Bangkok.

Watts J. C. D. 1965. The Chemical Analysis of Muds from the Pond Systems of the Tropical Fish Culture Research Institute. TECRI, Malacca. Investigational Report No. 3

SEAFDEC/SCS.73: S-30

The Seaweed Industry of the Philippines

by

Priscilla Caces-Borja

Bureau of Fisheries
Department of Agriculture and Natural Resources
Republic of the Philippines

INTRODUCTION

Until 1966 the seaweed industry in the Philippines was a regligible item in the country's economy. Seaweeds were mainly used locally. Only a few species were exported. One of these was *Digenea simplex* a uermifuge source, which used to be exported years ago but is now no longer in demand, although there have been occasional inquiries as to their sources. *Galidium* and *Gracillaria* were exported to Japn as sources of agar. With the discovery of *Eucheuma* as a source of Carrageenin for industrial purposes, our natural grounds were exploited and our export of seaweed in 1966 was some 800 tons. In the next five year, our exports dwindled to a mere 318 tons in 1970. This indicated an over-exploitation of our *Eucheuma* weeds so that culture of this weed had to be started. The 1972 statistics now show that exports have gone up to about 570 tons valued at P1.6 million *pesos*.

The greatest bulk of our seaweed exports go to the United States of America which received 270 tons in 1970. Japan bought 26 tons, France 5 tons, 17 tons went to other countries in this same year.

There are two known exporters of seaweeds in the Philippines: the Marine Collids (Phil.) Inc. at # 7 Masunurin St., Sikatuna Village, Quezon City and the Kah Development Corporation of Cebu City. Marine Collids (Phil.) buys and exports dried *Eucheuma* as raw material.

Some local factories which produce processed *gulaman* bars are the Nomer Chomical Products Inc., in Caloocan City, the Rizal Agar-agar Factory in 47 K Manalo St., San Juan and the Goodwill Products Corporation in 28 Capitan Tiago St., Malabon, Rizal.

What part is *Eucheuma* and what part is *Gracillaria* is not reported but it has been observed that there is a growing demand for *Gracillaria*. Hence, studies are now being initiated on the culture of *Gracilaria* in addition to *Eucheuma*.

COMMERCIAL USEFUL SEAWEED

There are many species of seaweed found in Philippines waters owing to its warm seas and shallow areas. These are described in the order of their importance.

1. *Eucheuma* (gozo)

Eucheuma, locally known as "gozo" in Visayan, is a red alga which is now the most important commercial seaweed in the Philippines. This alga grows on coral reefs and in the rocky and sandy bottom of marine intertidal or aubtidal zones where the water is very salty, clear and fastmoving. The soft body is light brown to light green with erect or prostrate branches. There are various species found in Philippine waters. Of these, *S. striatum* and *E. spinosum* are found best suited for cultivation At one time (1965–66) it constituted the biggest single marine export commodity of the country. Due to poor conservation practices by gatherers, who take all the available seaweeds of the area and leave nothing to grow, the yearly export of this product has been diminishing for the past five years. For this reason it is necessary to culture this particular genus of seaweeds in order to have a steady supply, as it is badly needed by all developed countries.

Uses: In the Visayas and Mindanao areas, it is common to see *Eucheuma* together with other species of seaweeds offered for sale in the market. They are eaten raw as salad. *Eucheuma* is commercially important due to its demand for industrial uses. From this alga is taken or extracted "carrageenin", a valuable substance used in products that need gelling, suspending, thickening or water-holding