

MADRAS FISHERIES DEPARTMENT.

CARP-GROWING IN GERMANY

BY

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Report No. 5 (1917),

Madras Fisheries Bulletin, Vol. XI, pages 151 to 160.

MADRAS:

PRINTED BY THE SUPERINTENDENT, GOVERNMENT PRESS.

1917.

PRICE, 1 anna 6 pies.]

[2 pence.

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HONORARY DIRECTOR OF FISHERIES, MADRAS.

The paper printed below was contributed in 1908 to the *Madras Mail* and is now republished by kind permission. It should have found place in bulletin No. I but was accidentally omitted.

Its origin accounts for the merely popular form in which it is written, but it appears to embody useful facts and suggestions. The intelligent industry of the ordinary German peasantry yields a remarkable lesson for our own folk, but the methods are not confined to Germany or even to Europe, but are very highly developed in China and Japan.

While carp have been solely dealt with in this paper, it should be noted that better fish, yielding as good results in weight and better results as food, will shortly be available; this Department has, since the paper was written, introduced tench and gourámi (*Osphromenus olfax*) to our low-country waters, and when these have sufficiently increased they may be issued for private culture.

The curing yards will also probably be able to supply cheap food for artificial feeding, since there is considerable refuse from all classes of fish-curing, whilst masses of manurial fish (sardines and "podimin") caught in excess can frequently be dried, ground up, and sold at extremely low rates. But in most cases the local sources of refuse and wild foods, as additions to those found in the ponds themselves, must be relied on for the artificial feeding of fish.

Some of the most pleasant days of a recent tour in Europe were spent in visiting peasant holdings in Bavaria where the farmers grow crops of cereals and of fish, mostly carp, alongside of one another. There are many thousands of these carp ponds in this small kingdom and, as one farmer said, they are more profitable than an equal area of good land. The ponds visited which are typical, are purely natural drainage ponds lying in low bottoms

and fed by the melting of the snow, etc., and by the drainage from the fields. They lie nearly empty throughout the winter, so as to kill off noxious animal life and useless vegetation. Once in every ten years or oftener, the ponds are kept dry throughout the summer, and cultivated with cereals (oats), which then produce a heavy crop. This process sweetens the pond beds and destroys noxious growths. It is usual to dig out during winter a quantity of the pond mud, and this mixed with lime, is an admirable manure for the arable land. The pond vegetation is, in general, natural, such as "water roses" (lotuses and lilies), *Vallisneria*, *Festuca fluitans* (water rice), various sedges, etc. Shade in Germany is not generally desirable, for the one aim of the carp grower is to get and keep the water as warm as possible during the summer. A very few degrees of heat make a vast difference in the crop. Yet in parts of Germany, as in France, it is found necessary to temper the extreme heat which in shallow ponds sometimes raises the water almost to blood heat, by properly selected and encouraged vegetation. This not only shelters the fish but oxygenates and purifies the water and the bed. In India owing to the great heat, external shade would probably be desirable while the droppings from the marginal trees would provide useful food. The first farm visited comprised an area of about 180 acres, of which half was shallow water, half somewhat poor light sand. The homestead contained a neat house and excellent farm buildings (everywhere in Germany one is struck with the completeness of the latter), while the cow stable had about a score of cows in splendid condition, as clean as washing could make them, and floors of wood lightly covered with litter and sloping gently to a central drain. The litter is daily removed with solid excreta to the manure pit and fresh litter is put in; most of the fluids, however, are intentionally drawn off by a central drain through a pipe direct to the main pond of about 50 or 60 acres, in order to assist in the growth of fish food. The merit of these Bavarian carp growers is that they utilize land habitually covered by water in the bottom of valleys too wet for ordinary cereal growth, and that they assist the growth of the fish by manuring the water, just as they would manure the land, and occasionally by giving small quantities of boiled or raw cereal food or domestic refuse. The ponds are in general surrounded by and receive the drainage from the cultivated lands, which whether pasture or arable, are all manured; hence a considerable quantity of the manure is used indirectly by the fish and not by the grass or cereal crops. All

agree that the droppings of cattle are among the best foods for carp, not in general directly but because they promote small life abundantly, both animal and vegetable, and on these the carp feed. On testing such ponds with a dipper it was found that the water, especially at the margin and near the inlet from the farm-stead, was fairly alive with "water fleas" and various animalculae, while the water of unmanured ponds was far less prolific.

Taking this and other farms together, the general practice is that in April and May a few reproducers, usually one female to 2, 3 or 4 males, are placed in special small breeding ponds in which branches, especially those of juniper, or other simple arrangements for the attachment of the adhesive eggs, are placed. These can either be removed at once with the adherent eggs or allowed to remain till the eggs hatch. The arrangement is similar to that in Japan as described in a note on Japanese Fisheries. If the pond owner has no spawners he can either buy them for spawning in his pond, or he can buy the ova, or fry ready hatched. There is a regular trade with carefully designed casks or vessels for the transport of spawners, ova, or fry. When the fry are about a fortnight old the breeding ponds are slowly drained, fine meshed baskets or nets in which the fry are caught being placed at the outlet; these are then transferred to the main ponds. In more scientific arrangements small rectangular ponds have nicely figured beds sloping to a central ditch from which it is easy to net out the small fry so that they are not crushed in the basket by the rush of the water. The removal of the fry is necessary in order both to prevent the parent carp from devouring them and to give them room and food to develop. By November they have reached the fingerling stage, weighing one or two ounces and are then retained in deep wintering ponds. At the end of the next summer, they may be 1 lb. or more and at the end of the third summer, $2\frac{1}{2}$ to 3 lb. They are usually sold at this age as the larger and older ones are coarse; spawners (females) are kept up to 10 years, but are then worth less than half-price as food. A little cereal food such as maize, boiled or raw, is sometimes given if available, or any house refuse, etc., carp being omnivorous; lupin seed or cake is a favourite food of carp and is not only cheap but contains about one-third of albuminoids. But in the Bavarian ponds food is not in general given to any great extent, the owners relying chiefly on the natural or acquired resources of the ponds. It will be observed that the main ponds contain, in each year, a number of first, second, and third year fish

of which the first have been newly hatched in separate ponds while the others have been retained from previous years, hibernating during the winter. In November of each year the ponds are almost entirely drained and the pools are then netted for their contents ; the marketable ones are culled out and sold to contractors from the cities and towns, while the others are returned to the pools for the winter ; those purchased for consumption are stored by the contractors in reservoirs or special pools till needed ; and since carp hibernate they need no food, and practically lose no weight, while in storage.

The price at present is comparatively low, viz., a little over $7\frac{1}{2}$ annas per pound. The produce per acre is smaller than I expected, though the owners do not seem dissatisfied. My chief informant wished that all his land were water as giving more profit and less trouble than arable land. His live weight produce on 88 acres averages 100 German centners or 11,000 lb. English or 125 lb., worth Rs. 60 per acre, which is slightly better than the general Bavarian average of 110 lb. per acre. On another set of ponds the outturn of 200 acres was 22,000 lb. worth 14,000 marks, of which 4,000 are allowed for cultivation expenses ; net profit 10,000 marks, or 50 marks (Rs. 37-8-0) per acre, but from this must be deducted an allowance for bad years (owing to drought, floods, disease, etc.) and so forth. Still the average net profit is obtained with some certainty and a minimum of trouble. In India it is believed, as will hereafter be shown, that the outturn per acre of available water may be far greater.

In another part of Germany a visit was paid to a leading carp and trout culturist, who courteously showed not only his own establishment but a large experiment now in progress for utilizing a large area of waste and barren heath land of no present value for cereal crops ; a similar and successful experiment was seen in Belgium. This low lying marshy land has been fashioned into ponds fed from a navigation canal which borders them ; the system is similar to that known as Dubisch's system, the spawning taking place in very small breeding ponds whence, after a few days, the fry are collected and placed in larger ponds (nurseries) and thence transferred, after about six weeks, to the growing ponds. The object in this treble and even quadruple transference is to apportion the food to the number and growth of the fish ; only a certain number of fry in the alevin stage are placed in the nurseries at the rate of about 12,000 to the acre. After a few weeks the food

remaining in the pond is insufficient for the growing survivors, and they are therefore turned into larger and deeper ponds at the rate of about 500 per acre, and thence again into larger ponds. The system is desirable only where the waters are not incessantly and largely under renewal, are not rich in natural food, and are not supplied with artificial food; otherwise the periodical transference is unnecessary, since it is merely adopted to regulate the food supply which enables the fish under this system to grow twice as quickly as they do in ponds under the ordinary system, and to be more healthy, since they are not starvelings crowded promiscuously together, but well fed carplets with plenty of room and nutriment. In Geeste where the waters are naturally very poor, this method is essential; the soil in which the ponds are dug is of the poorest, and the ponds are merely filled occasionally with canal water and are not continually changed by a continuous flow.

The object of the construction is to reclaim hitherto useless heath land by alternately growing carp and oats or other hardy cereals or grass. The dry bed of a pond is manured in the usual way and a crop taken; it remains more or less dry (frozen) during the winter, after which the water is let in and a crop of carp taken. These subsist on the fish food in the water, which is rendered more prolific by the balance of the unassimilated manure and the leavings of the cereal crop; the next crop of oats is benefited by the excreta, etc., of the animal crop; gradually the soil is enriched, and with it the successive crops.

The ponds are nicely arranged to avoid undue labour; the breeding and nursery ponds are rectangular with proper sluice arrangements and with central and cross ditches in which, when the ponds are drained, the fry or fish collect and are therefore easily netted, while the growing ponds are just large expanses of water of irregular shape. The canal water is let in by a main sluice, and to prevent predaceous fish from entering with it, the water is strained by having to pass through a semi-circular wall of road metal, which effectually filters it of anything so large as fish fry. From April to November operations continue as above described; a little artificial food is occasionally given such as dry fish powder from Gesstemunde, etc., but this is not relied upon. The resulting fry as seen in July were remarkably vigorous and healthy and gave every promise of a successful crop; they were certainly much better than those of similar age seen two weeks earlier in Bavaria. In November the ponds are drained and the

young fish placed in deep winter ponds for hibernation ; in the following spring they are placed in large ponds where they mature till fit for market.

In one pond an experiment was being conducted in the method of leaving the fry and the parent fish in the same pond throughout the season, natural vegetation being encouraged for the protection of the fry. While, on the one hand, the parents probably eat a certain proportion of the fry, on the other hand they destroy a vast number of noxious insects, beetles, etc., which kill an immense number of the fry ; moreover the expense of transferring the fry is saved. It is a question of comparative advantages. Apparently the one advantage that this particular experiment has over the ordinary Bavarian method is that only a given number of spawners, and consequently a given quantity of fry, are allowed to a given area.

The results both in gross outturn and net profits are considerable ; the balance sheets including all charges, cost of manure, etc., etc., show a very useful net profit, which is surprising when the waste and wretched nature of the land is considered.

The giving of artificial food has been mentioned and it is obvious that since the success of the Dubisch system depends mainly on its proportioning the fish under cultivation to the amount of food naturally available, it is possible by supplying extraneous food to increase the weight of fish grown per acre and per annum, especially as carp respond readily and rapidly to high feeding.

Dr. Hofer of Munich has shown by actual experiment that it is possible so to feed carp that specimens weighing $1\frac{1}{2}$ lb. in spring weighed 5 lb. by the end of July, while Prof. Zuntz of Berlin found that a three-year old carp can be made to triple its weight during one summer. In the hotter parts of America such as California, Mexico, Texas, etc., where the water is warm and full of fish food, carp have attained the weight of 15 lb. in 3 years and have increased at the rate of 1 lb. per month. In China a weight of 30 lb. in 5 years is obtained by supplying abundant food, and in Japan it is common to sell large carp in their second summer, while carp hatched in April grow to 10 inches in length by October when placed in the rich paddy fields in June. The growths obtained by Messrs. Hofer and Zuntz are abnormal being in non-tropical climates and of fish not ordinarily growing to large size ; the voracity and excellent digestion of the carp were taken advantage of to stuff them, and they were as unhealthy as Strasbourg geese and died, or would have died, of liver and fatty heart. In tropical

climates, however, carp naturally grow large and fast with the abundant food found in warm waters.

Now artificial feeding can only be resorted to if the prices of the food and of the resulting fish permit, and since it requires 5 to 7 lb. of artificial food, plus any natural food in the water, for every pound of live carp, the food must be exceedingly cheap. Still it is found possible to use some foods and the experiences of Wittingau in Bohemia are interesting. This royal establishment has nearly 200 ponds covering about 25,000 acres, worked mainly under the Dubisch system plus that of artificial feeding. It is here found that carp which, under the ordinary system, weigh 1 lb. at the end of the second summer, weigh $2\frac{1}{2}$ lb. when artificial feeding is added. The food supplied is at the rate of about 6 lb. per pound of carp fished, nearly 60 per cent being lupin seed and 35 per cent meat powder, chiefly waste from Liebig factories. In Bavaria I found that the seed of the yellow lupin was frequently given; it is usually steeped in water for a day or two and then used. Maize cake boiled, steeped or raw—in which last case it is roughly pounded up—was also given. In Geeste I found an excellent preparation of sea fish (undersized haddock, etc., which it is illegal to place as such in the market) which are ground up, bone and all, into a fine meal and desiccated; this was supplied at just over 1 penny per pound, but being too costly is seldom used except for trout. Potatoes, edible oil cakes of various sorts such as groundnut, bran and rice poundings (tavidu), pounded fish scrap, i.e., the flesh of herring, etc., after expression of the oil, vegetables unfit for table use, and so forth, are largely used; as has been already mentioned, the drainage of cattle stalls and manure heaps and the miscellaneous scraps of farms and households are all acceptable to carp, as well as the worms, insects, small molluscs and crustacea found in the fields and in the ponds and ditches.

One is led to enquire whether there is scope for carp growing operations in the Madras Presidency similar to those conducted in Germany. Is there water? Will carp grow successfully in these waters? What methods are available? Will people take the trouble? Well, there is plenty of water, even neglecting the rivers, in the canals, tanks, village ponds, irrigation wells, and paddy fields. True that most of it is non-permanent and dries up in the hot weather; but even this is not a bar to the production of a great crop of food; the rains last only six or seven months, from June to December, but this suffices to grow cereal crops or even two of

them, and with knowledge and some care carp can be grown of marketable size in a few months, with the certainty that whereas a cereal crop is almost useless and unproductive if a severe drought happens, the fish crop will be of material value at any stage, while its in-gathering is even facilitated by the dryage of ponds. The public waters of this class are now engaging attention in view to their better utilization, but there are many which should be dealt with by village bodies or by private effort, such as the village irrigation tanks, village ponds, irrigation wells, and even paddy fields. There are more than 25,000 irrigation tanks in the Presidency, many of great size and some of almost permanent character. The majority have water for a period sufficient to raise a paddy crop and, being mainly fed by surface streams from the cultivated fields, are more or less manured and are known to be full of fish food. The village ponds in many districts are of considerable number, size, and permanence. Half a dozen, ranging from 1 to 3 or 4 acres, were noticed on a short road journey in a district of the Northern Circars almost full of water at the end of last February, and since they adjoin the village-site and cattle stand and are the drinking and bathing sources for cattle, they are full of fish food and literally swarm with small life. In these cases fish would not only grow with rapidity but would greatly improve the character of the water and vastly minimize the growth of mosquitoes.

The permanence of such ponds would be greatly increased by a small expenditure of village hot-weather labour, at present unemployed, in deepening the ponds by a foot or so annually for three or four years, the rich mud, full of vegetable and animal debris, being utilized, as in Germany, for the surrounding fields. The same method is equally applicable to irrigation tanks all of which are heavily silted with washings from the arable area of their catchment basins, further enriched by the exuviae of tank life. In both cases the double benefit is obtained of increasing the tank capacity and of returning to the fields the loamy and humic matters which have been washed out of them. Irrigation wells aggregate a large area of permanent or semi-permanent water and might be largely utilized for household use. The paddy fields of this Presidency are of vast area, and in many cases contain a good supply of water for many months together. These waters are rich with food, and in Japan the practice of stocking them with carpling is common, the carp being hatched for the purpose in April, transferred in June when 1 inch or 2 inches long to the fields—often many miles distant

—and marketed at a size of 8 inches to 10 inches in October when the paddy crop is over, the rapidity of growth being due to the warmth and abundant supply of fish food in the well-manured fields.

As a matter of fact, there are many places which, already swampy or damp, as under canal banks or at the tail end of the irrigation sources, might be converted with little expense into fish ponds, thus turning useless and even miasmatic areas into profitable and wholesome food-producing waters. Travelling recently along the Kurnool canal for about 100 miles, many places were noted below the artificial bank which were quite unutilized for crop growing, being too marshy for dry crops and unsuited, without much preparation, for paddy. Very slight excavation and banking would turn these into permanent ponds, more productive in food and money than the best paddy lands. In areas bordering other canals, e.g., in Kistna, the ground-water level even in areas not actually commanded for irrigation purposes by the canals, is often so high that almost permanent water may be reached at 4 or 5 feet, and the supply could be readily increased by a very low lift, e.g., by cheap windmills, either from the canals or from wells. In Bengal water is occasionally bought for fish ponds from irrigation sources. Where mere percolation-water is not available this plan is often possible under our canals and tanks either by flow or low lift according to the nature of the ground. There is then already plenty of water in this Presidency which may be cultivated with fish instead of merely growing, at best, a haphazard wild crop of fish, and which can be increased in area and permanence by the expenditure of slight capital and labour, and in production by the adoption of simple methods of cultivation.

The remarks just offered as to the nature of Madras waters themselves dispose of the second question, viz., whether carp will grow successfully in such waters. To some extent they are there already, but they merely grow and are not cultivated, while predaceous fish unduly predominate. The waters are precisely those most suited for omnivorous carp. They are full of the matters which, as already mentioned, are those deliberately introduced into German, Chinese, and other fish ponds, while under tropical conditions rapidity of growth is even more probable than in Japan and China. The carp of tropical countries are usually larger and grow far more rapidly than those of European waters. Carp of a single summer may easily exceed 1 lb. in weight since in the warm parts of the United States of America 3 lb. or 4 lb.

per year is a general rate and they have been known to grow 1 lb. in a month. In China 4 to 5 lb. per annum is common, and in Madras water 1 lb. in 70 days is on record. Again, Mr. Thomas has recorded steady takes of 4,000 lb. per annum, without any artificial feeding, from a pond of 4 or 5 acres that had been wholly dried and emptied of all life and restocked with a couple of measures of fry. Hence the chances of really large carp returns from protected areas of the classes mentioned, are excellent. This subject has been treated more at length in paragraphs 179 to 184, 196 to 209, and 232 to 234 of a "Note on Japanese Fisheries" and is engaging the attention of the Fisheries office.

The main point for consideration is what methods of aquiculture are best adapted for such waters. But this would demand a small treatise, which is now under preparation. Meanwhile references may be made to previous articles and to the "Note on Japanese Fisheries" for some indications. Suffice it to say that after a pond has been cleared, as far as possible, of predaceous fish, a few spawners may be introduced and left to themselves or the fry may be bred in separate ponds and introduced in numbers proportioned to the area.

In the case of village or private ponds and wells, growth may be assisted by additions of cheap and available food, viz., leaves and grass such as carp will eat, the berries of the wild fig and other edible fruits such as those of the prickly-pear, the chaff of grain (tavidu), insects collected from the fields and trees by children, silkworm pupæ if available, any cheap edible oil-cake, surplus grain or food from the homestead, spare cattle manure, etc., while a few water plants are valuable as shelters both for fish and for the small life on which fish feed.

Will private enterprise take the trouble to improve existing waters, to form new ponds, to utilize water not merely for irrigation and drinking but incidentally and additionally for indirect food production? Capital is not needed to any appreciable extent even where private persons form ponds for the purpose. A little energy and personal labour, a little trouble in practising a new business, a little patience and intelligence, are the main factors of success in India as in Germany and Japan. The returns in each individual case may not be very great, but neither will be the expense nor the trouble, and the enterprise will not only be purely swadeshi but a distinct and valuable addition to the industries, to the food production, and to the wealth of the country.

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