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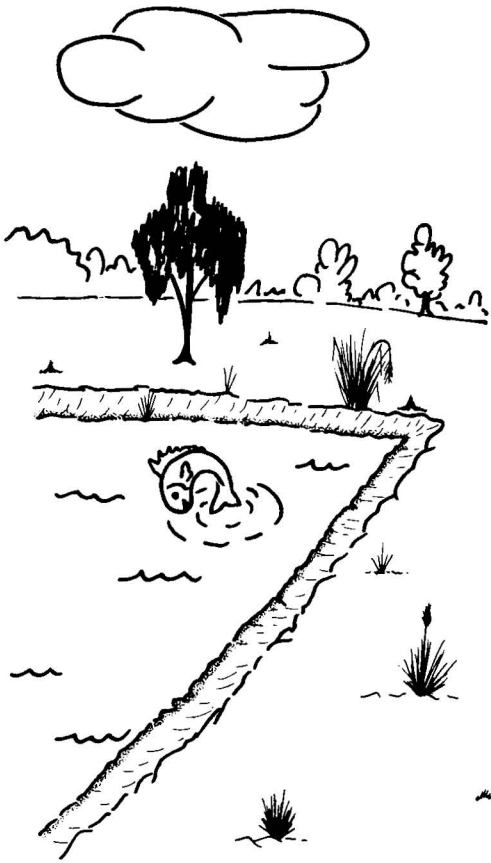
RESERVOIRS FOR FISH-RICE FARMING



Fish farming in the South Central States is a recent development. Restrictive acreage allotments have caused many rice farmers to investigate the possibility of supplementing their income with a cash crop by using their fields to raise fish when not under production for rice.

Unfortunately each type of crop has specific requirements, some of which do not completely lend themselves to application for the other. As a result, no one plan can be recommended for reservoir construction. However, certain physical features such as substantial levees, adequate clearing, good water supplies, and proper drainage systems are desirable in either operation.

A survey of fish farming operations indicates that successful fish farmers favor several types of reservoirs.

This brochure, based on that survey, is designed to point out some of the desirable components which might be considered when planning reservoirs for use in combined fish-rice rotations.

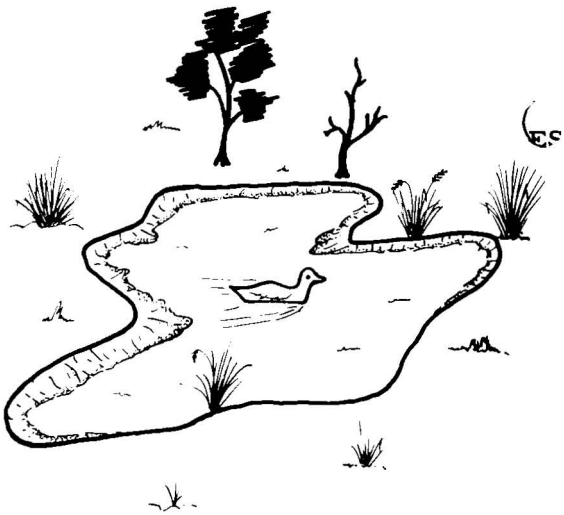
GENERAL

Many farmers flood wooded land to kill the timber in preparation for clearing the land. While such impoundments may provide a limited crop of fish and may be useful in a fee fishing enterprise, they should not be considered for intensive production of food fish. Flooded timber areas are exceedingly difficult to manage. Aquatic vegetation cannot be controlled, observations on the fish are difficult, certain diseases

such as blackspot are encouraged, and the area involved is usually so large that surface water is needed to fill the reservoir. The use of surface water introduces wild stocks of trash fish accompanied by additional parasites and diseases. These fish limit the growth of desirable species through competition and predation and probably contribute more than any other one factor to crop failures when reservoirs are drained.

In a fish-rice rotation the land is cleared and facilities provided for the easy removal of either fish or the rice crop. Additional features for harvest and drainage are required when fish are raised.

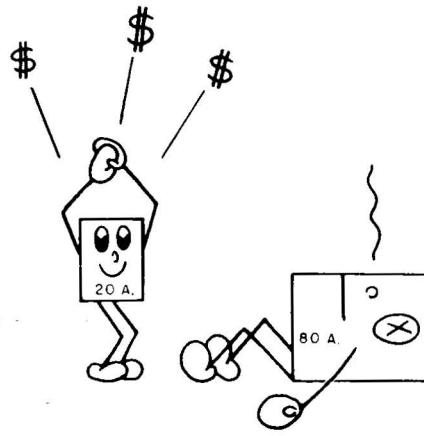
Fish farming operations utilize reservoirs of a great variety of sizes. In general, minnow raisers favor smaller reservoirs than do producers of food fish. The fields used in fish-rice rotations are usually larger than those used exclusively for fish. Successful fish farmers advocate the use of a number of reservoirs of



moderate size rather than a single large impoundment due to problems involving erosion, harvest, and water supply. Minnow raisers prefer ponds averaging less than 20 acres in area. For combined fish-rice operations reservoirs should be kept as small as would be practical for use with the machinery normally employed in rice farming. Larger reservoirs are subject to serious levee erosion and are difficult to manage for fish production. Problems of diseases and parasites may reach epidemic proportions in large impoundments before they are detected and an entire crop may be lost. The surface area of such fields requires such an extensive water supply that drainage is feasible only during seasons of the year when rainfall and run-off are available to help refill the impoundment. Also, the large volume of fish to be harvested at one time presents many additional problems. Concentration of the fish prior to harvesting requires a draw-down of the water level. This concentration of fish per unit of water volume and the resulting turbidity may deplete the oxygen supply. Such conditions, combined with the muddy pond bottom and the steep levee walls, are not ideal for harvesting large numbers of marketable fish or for salvaging small fingerlings for restocking. A sudden change in the weather at harvest time can have disastrous results.

Small reservoirs provide greater flexibility in the management of the water area, reduce the probability of a complete loss due to disease, lower the cost of treating individual ponds for parasites, and allow for a more gradual harvest with better care for the fish as they are removed. Also a pond can be drained and refilled at any season of the year provided

ground water is available to supplement surface water. Construction of such reservoirs may require a gradual development program due to increased costs. Added profits, however, offset this additional expense.



TYPES AND CONSTRUCTION OF LEVEES

Several types of levees are currently used in the fish farming industry. These include such structures as semi-permanent dikes which are levelled following a crop of fish and substantial permanent levees constructed with a dragline or bulldozer. In the first situation, soil for the levee is taken from a "borrow ditch" which may be either outside (Fig. 1) or inside (Fig. 2) the periphery of the reservoir.

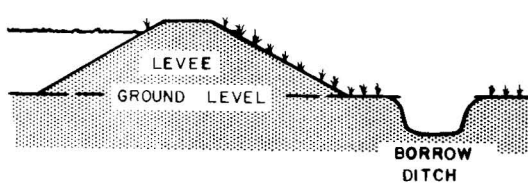


Fig. 1 Levee constructed with an outside borrow ditch.

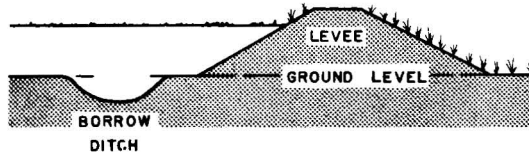


Fig. 2 Levee constructed with an inside borrow ditch.

Outside borrow ditches have several desirable features. Such a reservoir can be prepared with a level bottom sloped toward a harvest basin. (See Fig. 3)

In general, this provides excellent drainage and avoids pockets and depressions which may trap fish during draw-downs. In addition, a minimum of effort is required to convert to rice production.

Inside borrow ditches provide additional deep water for fish. Also, should it prove feasible to grow fish and rice simultaneously, this type of reservoir may be desirable. Disadvantages of inside borrow ditches include added engineering in construction since the ditches, as well as the floor of the impoundment, must slope toward the harvest basin if adequate drainage is to be provided. Such ditches also make it difficult to concentrate the fish adequately at harvest time since the fish cannot be surrounded effectively. The movement of heavy equipment needed for rice farming into and out of such reservoirs presents another problem.

Many farmers are constructing reservoirs without borrow ditches and use a bull dozer to push up levees around a field. Efforts are made to keep a level bottom in the reservoirs so that the field can be readily converted for raising rice.

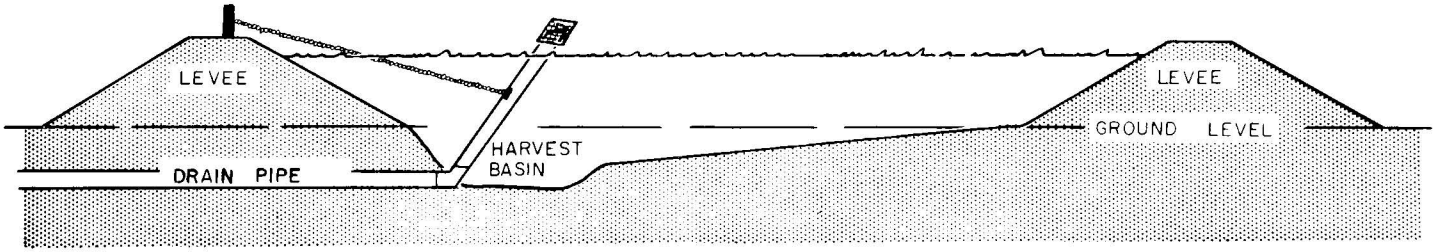


Fig. 3 Contour of a desirable fish producing reservoir.

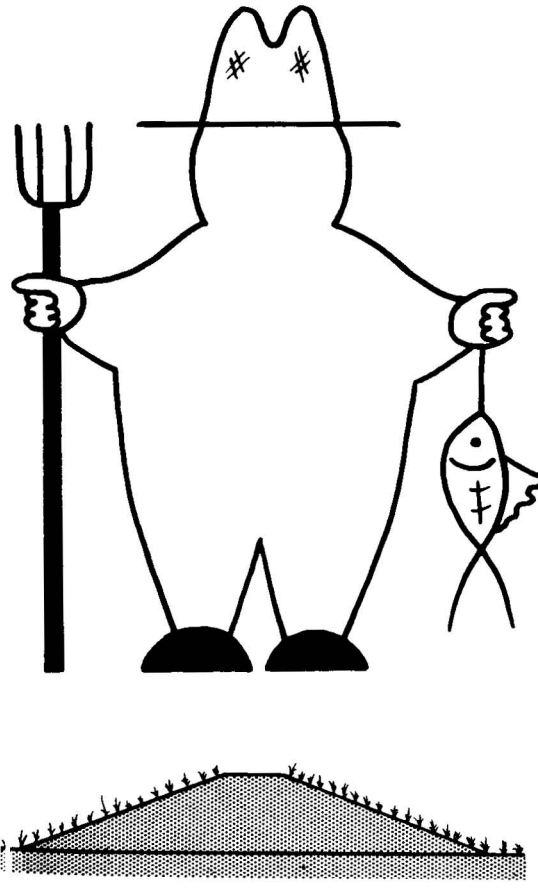
County agricultural agents, the So Conservation Service, and soil engi neers recommend that substantia earthen levees be constructed aroun a reservoir. While the different agen cies are not in complete agreement a typical recommendation is that th levees be eight feet wide at the to for good vehicle and tractor access with a $2\frac{1}{2}$:1 slope on the sides. (Se Fig. 4) Such levee walls discourag the growth of rooted aquatic vegeta tion and limit predation by wadin birds. Minimum depth of the wate should be no less than two feet, bu if water is available, a depth of mor than 2 feet is recommended to kee down emergent vegetation.

HARVEST BASINS

Properly constructed reservoirs con tain a smooth-bottomed harvest basi near the drain which is deeper tha the rest of the reservoir to concen trate the fish for harvesting. As th water level recedes during a draw down, the fish move into the deepe water provided by the basin. Such a area may be either a specially con structed portion or merely insid borrow ditches. Some farmers use combination of the two.

A circular harvest basin is the mos suitable since it is possible to sur round the fish readily. Borrow ditche are difficult to seine and permit th fish to escape entrapment mor easily.

A satisfactory harvest basin contain approximately 10% of the total are of the reservoir. Water depth, whe the rest of the impoundment is drained should average about 18 inches the outside ground slopes away fro the outlet to permit gravity drainag of the basin.



A properly constructed levee with a 2½:1 slope.

WATER SUPPLY

face evaporation in the South Central States approaches 48 inches per ar. Such a pronounced water loss kes it imperative that fish farmers re an available supplementary water pply throughout the year. Fish rmers with large impoundments st fill them with surface water in late winter when rainfall and n-off are available. Relift pumps e used to move the water over the

levees cheaply and efficiently. Draw ing water from surface sources, how ever, should be avoided if at a possible for reasons stated earlier.

Wells are a more desirable sourc of water. Most rice farmers alread have wells used for flooding thei fields and these can be used in fis farming. When the size of individua reservoirs is kept low, wells can b used as the sole source of water.

DRAINAGE DEVICES

Proper drainage devices prevent th entry of trash fish into a reservoir Successful farmers use two types Most preferred is a metal pipe whic is provided with an elbow at the pon bottom and which extends through th levee (Figure 5). The top is fitte with a screen to limit passage of fis in either direction. By lowering th surface end of the pipe, the wate level can be manipulated effectively A second type is a form of concret standpipe by which the water leve is regulated by a series of wooden dividers connected to a drain pip through the levee.

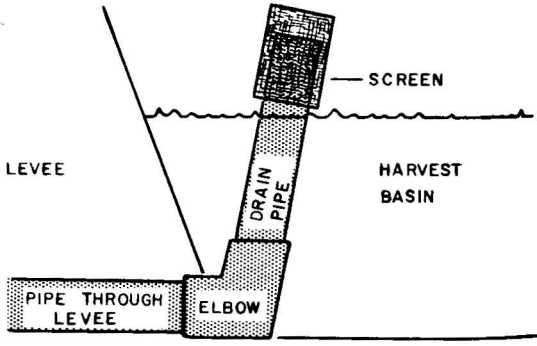


Fig. 5 Detailed view of commonly used drain pip

Some manufacturers now fabricate a metal half-round riser pipe, constructed with stop-log slots for attachment to their corrugated pipe. It costs less than a concrete riser and is easier to install.

RESERVOIR LAYOUT

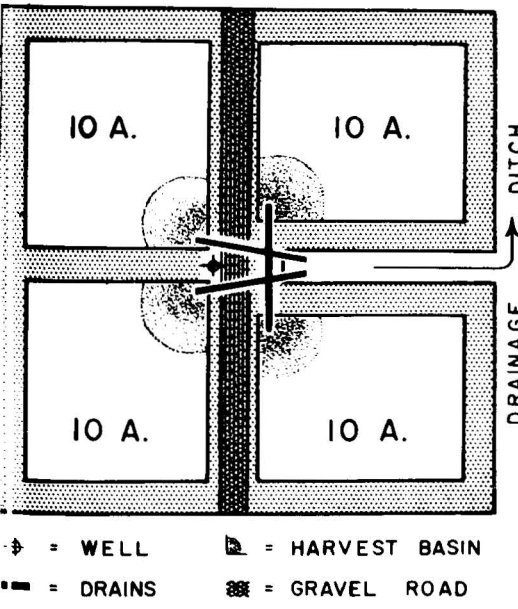


Fig. 6 A possible plan providing maximum utilization of water supplies and drainage facilities. (Arkansas Game and Fish Commission).

Note: The use of cut-off valves in the drain pipes will permit the transfer of water from one reservoir to another. Re-lift pumps also can be used conveniently for this purpose.

In planning a fish-rice farming operation it is best to study the available areas well in advance of construction. With careful planning, a successful operation can be constructed with a

minimum of material for transportin
water or for drainage systems. I
Figure 6, a plan is presented whic
provides a single water source fo
four reservoirs, a centralized harves
and drainage area, and facilities fo
moving water from one reservoir t
another. Modifications of such a pla
can be adapted to any type of farm.

ing.

DEPARTMENT OF THE INTERIOR

U. S. Fish and Wildlife Service

Bureau of Sport Fisheries and Wildlife

Fish Farming Experimental Station

Stuttgart, Arkansas

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