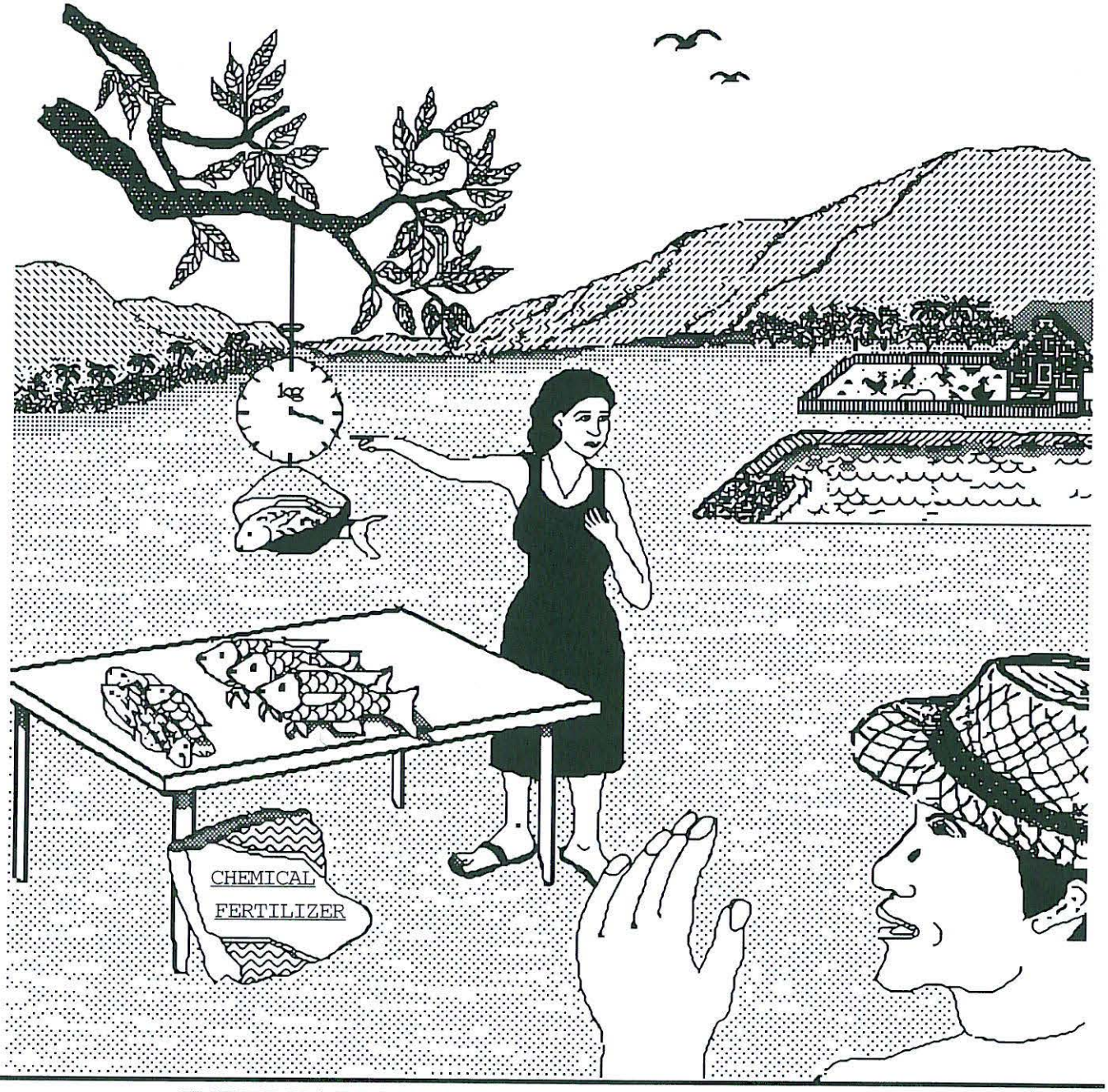
WATER HARVESTING AND AQUACULTURE
FOR RURAL DEVELOPMENT

INTRODUCTION TO FISH POND FERTILIZATION



INTERNATIONAL CENTER FOR AQUACULTURE
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INTRODUCTION

A fish pond is a unique environment created by man. It must be managed properly to achieve good fish production. For centuries fish farmers have increased fish yields in ponds by using inorganic or chemical fertilizers and organic fertilizers or "manures."

Figure 1: Fertilizers increase fish yields.

WHY FERTILIZE PONDS?

Microscopic green plants called algae or "phytoplankton" form the base of the food chain for fish. All green plants need light, proper temperature and nutrients for growth. If sufficient light and proper temperature are present, the nutrients in chemical fertilizers (nitrogen, phosphorous and potassium) are readily assimilated by phytoplankton and their abundance increases. Manure contains the same nutrients. They are released and become available to phytoplankton during and after decomposition. As phytoplankton assimilate fertilizer nutrients and reproduce to form dense communities pond water turns a greenish or brownish color. This is called a phytoplankton bloom.

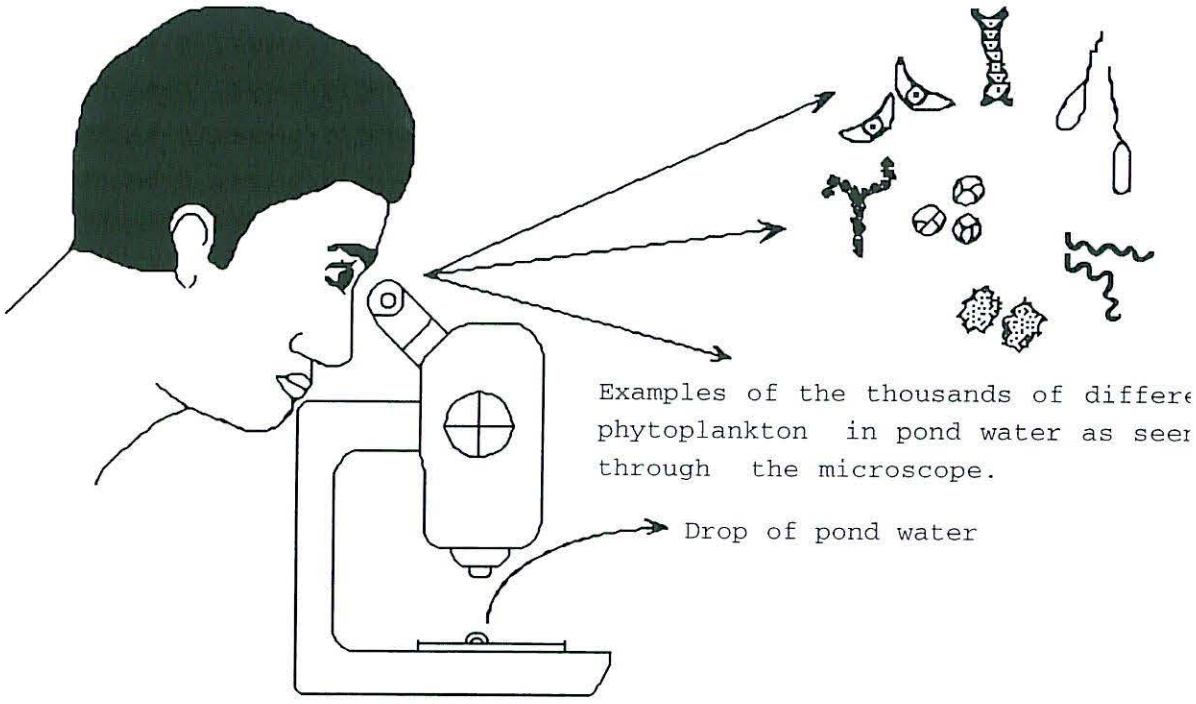

Figure 2: Viewing phytoplankton in a drop of pond water under a microscope. As phytoplankton multiply they are eaten directly by some fish or by other mostly microscopic aquatic animals called "zooplankton".

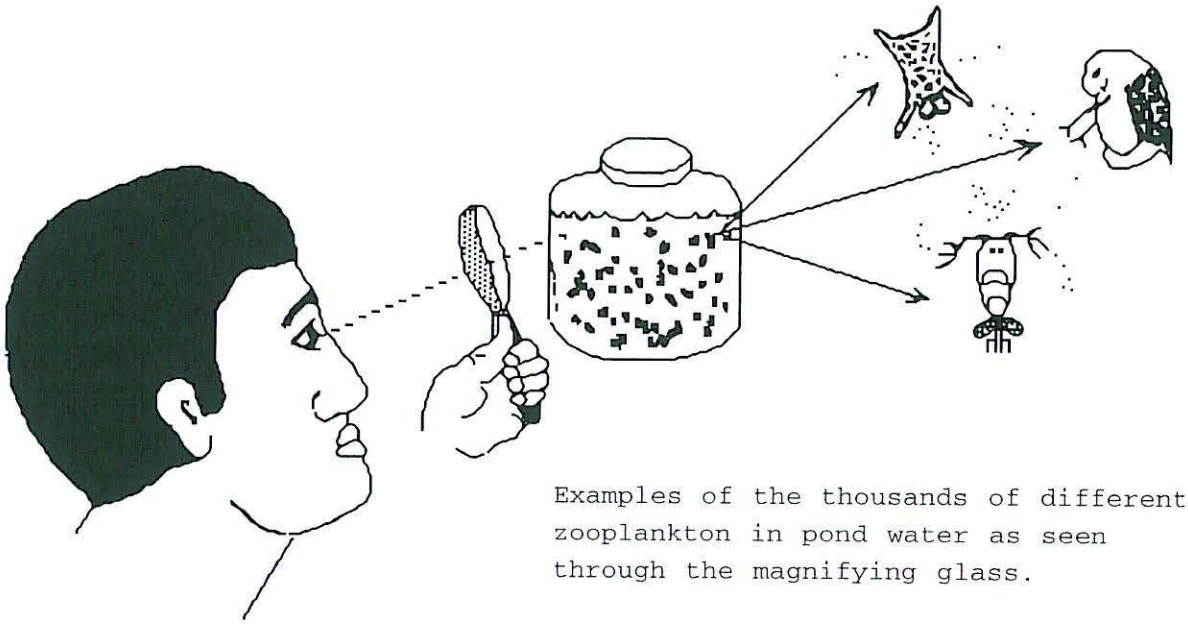

Figure 3: Viewing zooplankton in a jar of pond water through a magnifying glass.

Phytoplankton and zooplankton (collectively called "plankton") also serve as food for larger aquatic organisms.

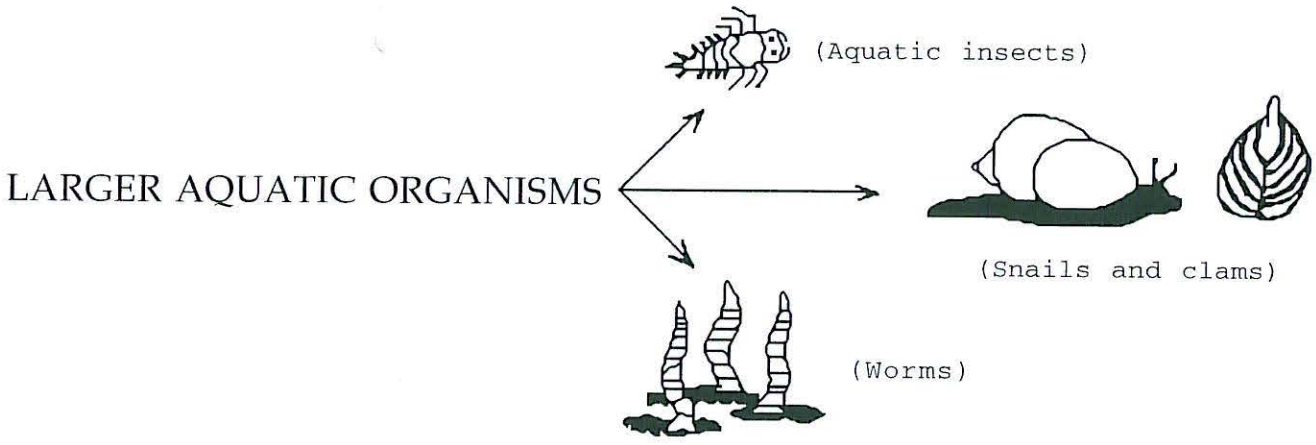

Figure 4: Larger aquatic organisms consumed by fish.

Through a complex chain of interactions fertilizers increase production of natural food organisms eaten by fish. Different fish may have different food preferences. Some can filter plankton, others eat aquatic insects and others may feed on decomposing material. The following diagram illustrates this.

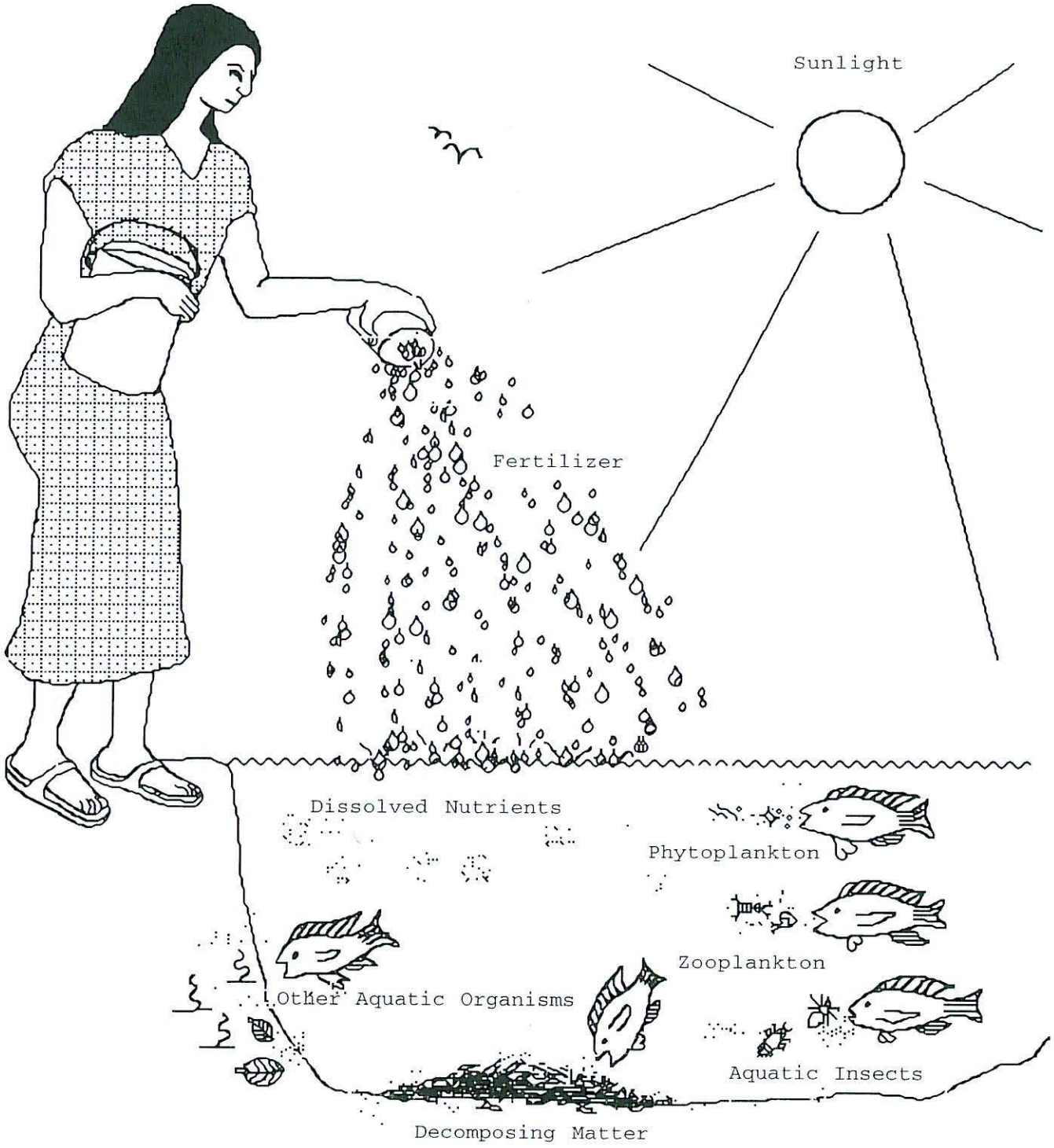

Figure 5: Fertilization increases the abundance of natural fish food

MEASURING THE EFFECT OF FERTILIZATION

Response to fertilization can be measured by the abundance of phytoplankton. When phytoplankton is abundant, it makes water a turbid green or brownish color. If the pond water is not very muddy, the turbidity caused by phytoplankton can serve as a measure of phytoplankton abundance.

A Secchi disk is a standard way to measure visibility in water. The disk measures 20 cm in diameter and is painted black and white in opposing quarters as shown below. A simple disk can be made from a round can lid. The disk is attached to a wooden stick or a rope marked off in centimeters. Measure plankton density by lowering the disk into the water with your back to the sun while viewing the disk from directly above. The depth at which the disk just disappears from sight is the Secchi disk reading.

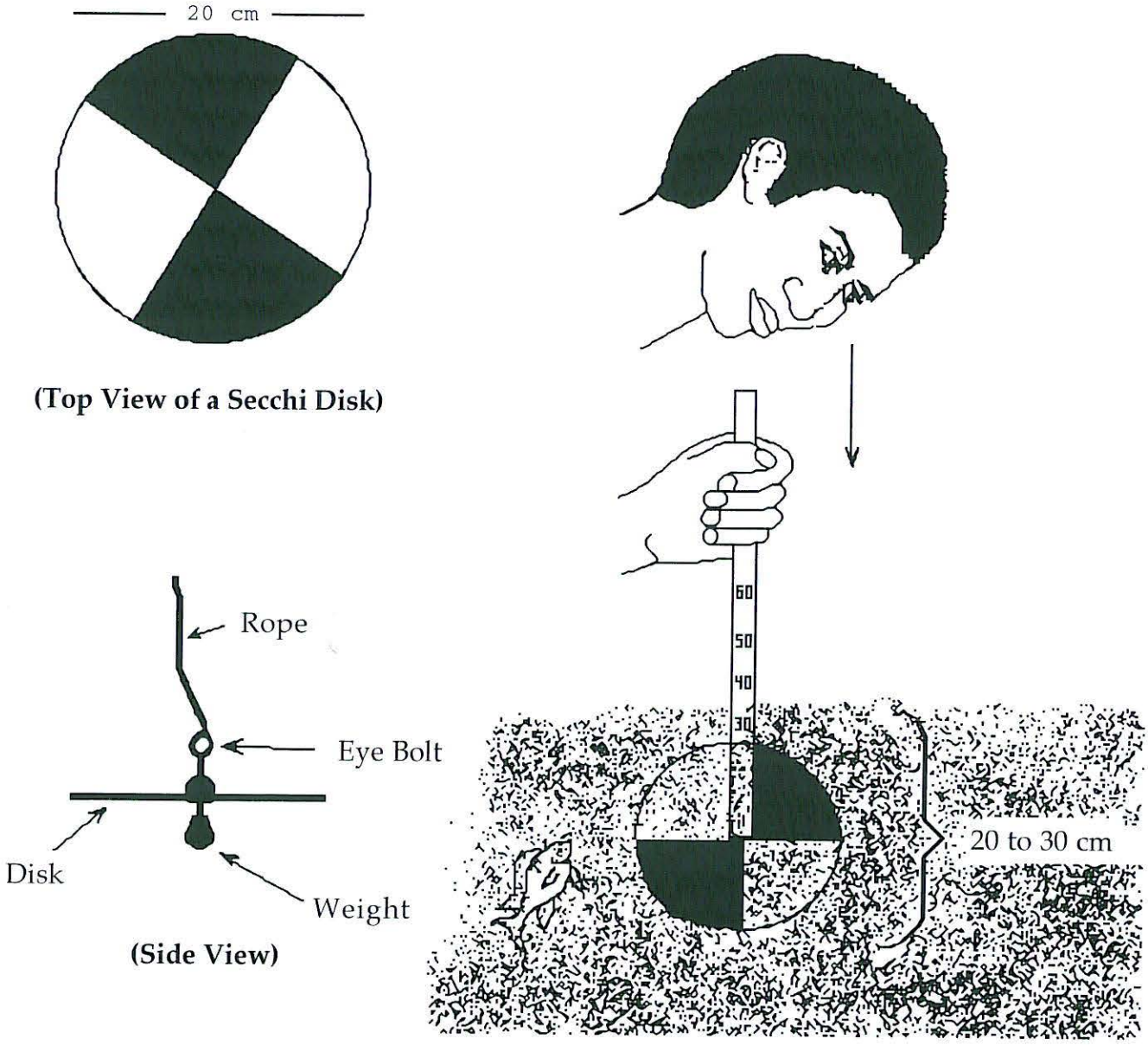

Figure 6: Making and using a Secchi disk.

It is often easier for a farmer to use his arm and hand instead of a Secchi disk. The principle is the same. The person's arm becomes a meter stick and the upturned palm of the hand becomes the disk as illustrated below. Rules on how to interpret the results of either Secchi disk or arm and hand and what management actions to take depend on what fish is being cultured and on what fertilizer is being used.

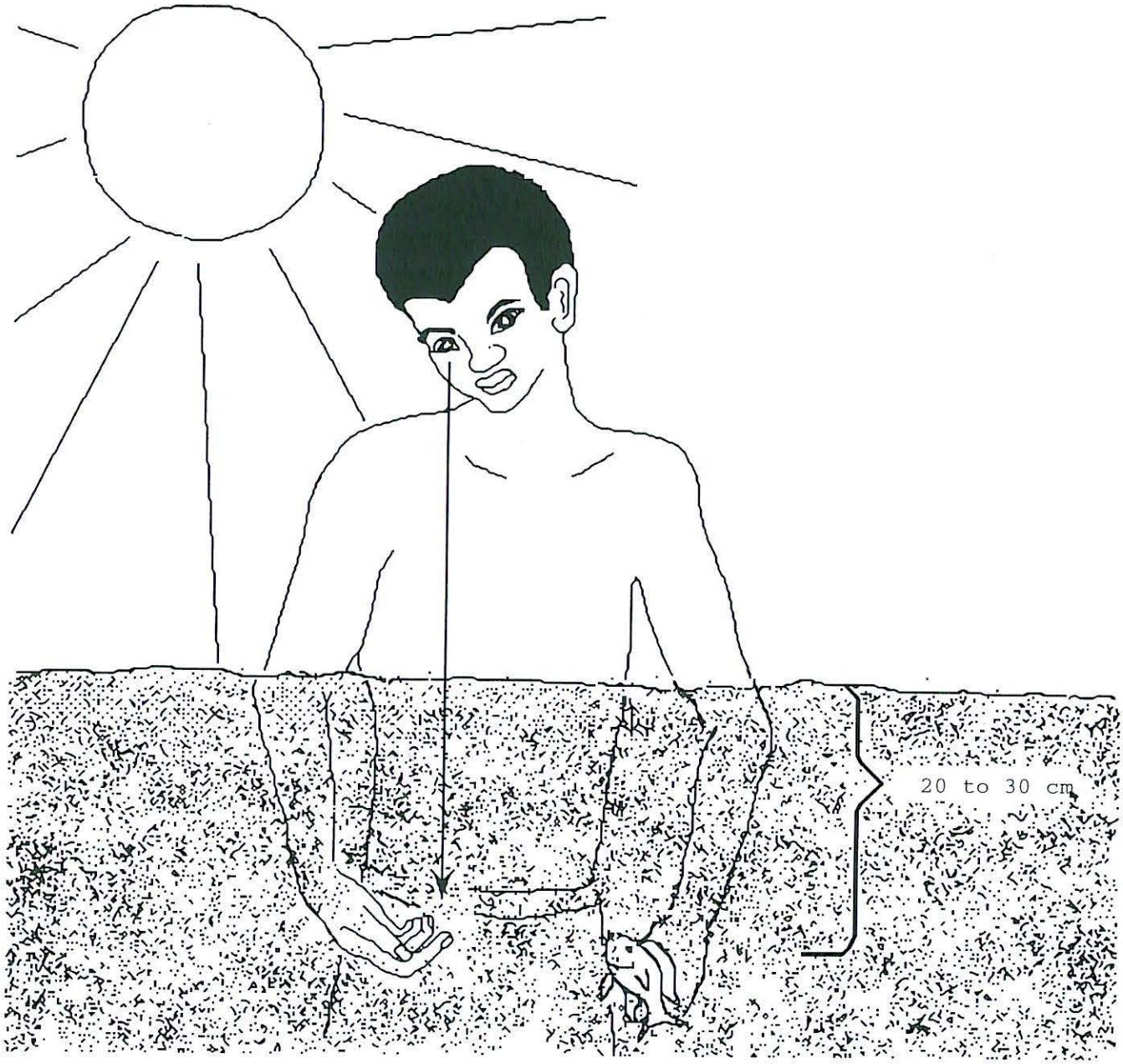

Figure 7: Measuring phytoplankton abundance by arm and hand.

DIFFERENCES BETWEEN CHEMICAL FERTILIZERS AND MANURES

Chemical fertilizers are concentrated nutrients for green plants. The qualities that have made them popular in modern agriculture are: 1) they can be stored for a long time, and 2) relatively little is needed since the nutrients are in a concentrated form. These are important advantages over manures if labor and transportation are costly. Two disadvantages of chemical fertilizers, especially for isolated farms operated on a limited budget, are that they are usually expensive and available only from commercial suppliers.

Another important consideration about chemical fertilizers is their potential for being wasted. Adding chemical fertilizer to a pond initially stimulates phytoplankton growth. However, if too much is added plankton can become so dense that sunlight penetration through the water is restricted. When this happens algae cells may have more than enough nitrogen and phosphorus available in the water, but they do not receive sufficient sunlight. No additional plankton will then be produced. Keeping phytoplankton abundance within the limits suggested for Secchi disk or arm measurement helps ensure that excess fertilizer is not applied.

Chemical fertilizer may not be eaten directly by fish. Manure, however, can serve several roles. It releases nutrients for phytoplankton through decomposition; certain fish can digest specific components of manure; fish may digest the bacteria, fungi and other organisms contained in manure even though the manure itself may have no nutritional value.

Large quantities of manure are needed to fertilize ponds. This is its main disadvantage. There is a danger in adding too much manure to a pond at one time. Decomposition may deplete oxygen in the water or cause harmful substances to accumulate. Fish may die as a result. However, with proper management this problem can be avoided or corrected and where manures are available they are often the fertilizer of choice.

FOOD CHAINS

Nutrients in chemical fertilizers are "food" for green plants, and have no direct food value to fish. When chemical fertilizers are added to a pond phytoplankton become more abundant. They may then be eaten directly by fish or by zooplankton and insects which are subsequently eaten by fish. This step-by-step process is called a food chain.

A step in the food chain can be eliminated by adding manure instead of chemical fertilizer to a pond because many fish will consume manure directly. Manure may also be eaten by zooplankton or insects which are later eaten by fish or it may be decomposed by bacteria and other organisms. Decomposition releases nutrients for assimilation by phytoplankton. A simplified food chain illustrating direct and indirect consumption of fertilizer nutrients by fish follows.

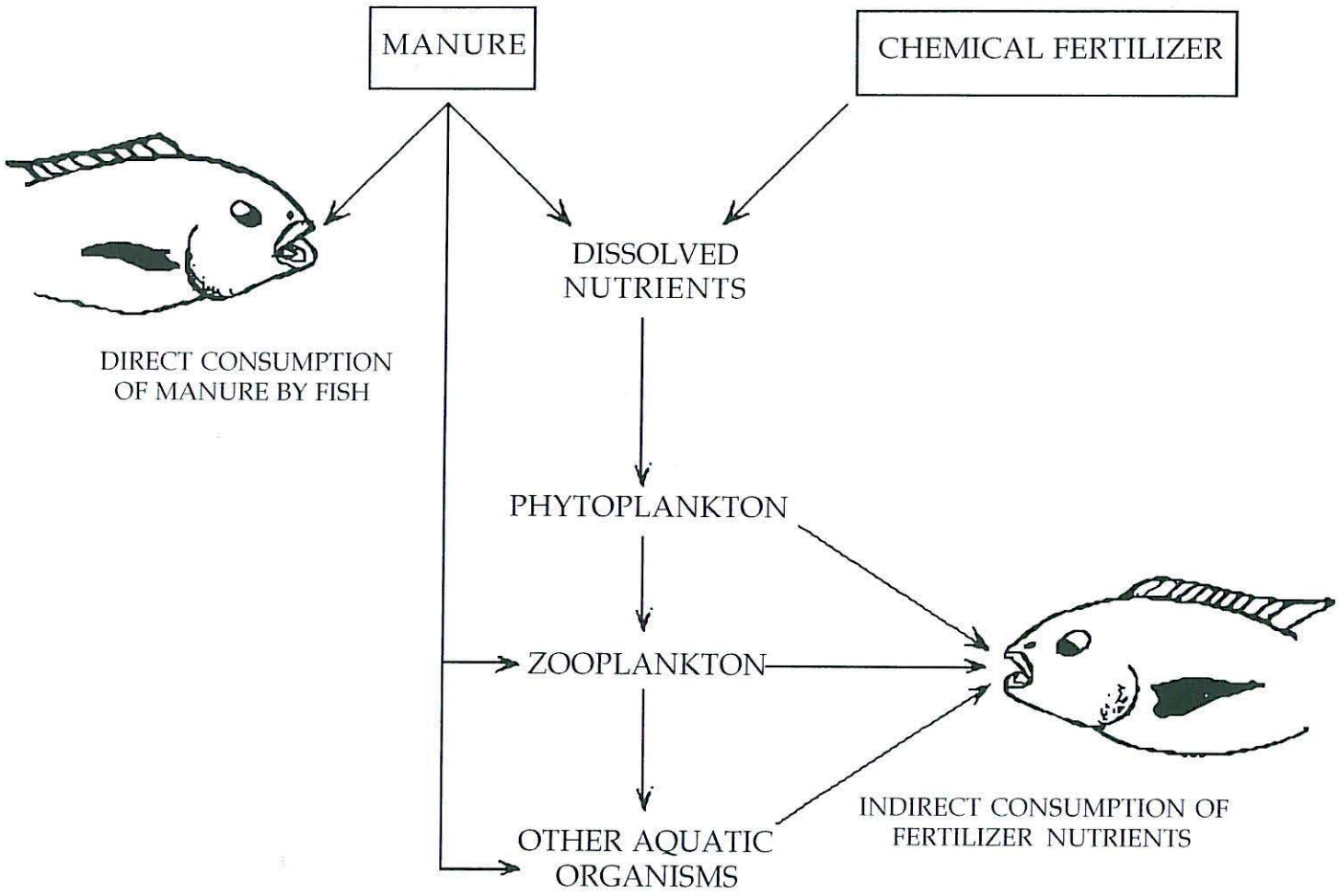

Figure 8: Simplified food chain showing pathways through which fertilizer nutrients areturned into fish flesh.

CONCLUSION

Both chemical fertilizers and manures are used to increase fish yields. Different results may be obtained under different conditions. The choice of which fertilizer to use will be influenced by local availability, cost and other factors. Read *Chemical Fertilizers for Fish Ponds* and *Organic Fertilizers for Fish Ponds* for more detailed information on fertilizer use.

GLOSSARY OF TERMS

assimilate - to take in and appropriate as nourishment.

chemical/inorganic fertilizers - manufactured fertilizers containing nitrogen, phosphorous and potassium in varying proportions.
decomposition - the decay or breakdown of organic materials into simple compounds available for assimilation by phytoplankton.

fertilizer - a substance added to water to increase the production of natural fish food organisms.

food chain - the pathways through which nutrients added to a pond are converted into fish flesh.

manure/organic fertilizer - animal or plant matter used as fertilizer in ponds.

microscopic - invisible to the eye without the aid of a microscope or magnifying glass.

natural fish food organisms - plankton, insects and other aquatic organisms that fish eat.

organic fertilizers/manure - fertilizers composed of animal or plant materials which must be decomposed to release their minerals and nutrients.

oxygen depletion/low oxygen - a condition, normally occurring at night, in which oxygen dissolved in pond water has been depleted mainly because of the decomposition of organic matter and respiration of organisms in the pond.

phytoplankton - the plant component of plankton.

phytoplankton bloom - an increase in phytoplankton abundance resulting from fertilization.

plankton - the various, mostly microscopic, aquatic organisms (plants and animals) that serve as food for larger aquatic animals and fish.

Secchi disk - a circular disk measuring approximately 20 cm in diameter which is used to measure the abundance of plankton in water.

turbidity - an opaque or unclear appearance imparted to water by the presence of suspended foreign particles (soil, plankton, etc.)

zooplankton - the animal component of plankton.

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