



Chapter 1

Introduction to aquaculture

Introduction

The definition of aquaculture is the farming of aquatic organisms, including fish, mollusks, crustaceans and aquatic plants. Farming implies some sort of intervention in the rearing process to enhance production, such as through regular stocking, feeding or protection from predators. Farming also implies individual or corporate ownership of the stock being cultivated.

The definition does not include fisheries, which is the harvesting of organisms from the wild of which there is no ownership or intended intervention to increase production. Hydroponics is the culture of terrestrial plants in water instead of soil and is not considered as aquaculture.



Egypt is the largest aquaculture producer in Africa. This farm produces tilapia in ponds and in tunnels.

Compared to agriculture which is thought to have started about 10 000 years ago, the practice of aquaculture has only been around for about 2 500 years. The first records of aquaculture are from China where carp (*Cyprinus carpio*) were cultured. Aquaculture in Africa has been practiced since the time of the ancient Egyptians who farmed tilapia in ponds adjacent to the Nile River.

At present, the contribution of aquaculture to worldwide food production is considerably

less than that obtained from captive fisheries, although this is changing as feral stocks become depleted. For example, in 1999 the worldwide aquaculture production of animals and plants was 43 million metric tons compared to 94 million metric tons from fisheries. As many of the world's fish stocks are in serious trouble due to over-fishing, aquaculture has been identified as a practice to provide protein that would otherwise have come from the ocean. In 1999, the contribution of aquaculture in sub-Saharan Africa to the total world aquaculture production was less than 1% in terms of tonnage produced. Aquaculture in sub-Saharan Africa has immense potential as a means of increasing food security, and the aim of this manual therefore is to provide information to prospective local fish farmers. In areas such as the Phillippines and Indonesia, China, Vietnam and Israel, aquaculture now produces a substantial and ever-increasing proportion of the fish consumed by their respective populations, together with a percentage that is exported to other countries.

Aquaculture should not be seen purely as a way of producing food. There are many forms of aquaculture that produce a marketable commodity that is not eaten, but sold for cash, that can in turn be used to purchase food. A flourishing example of this is the ornamental fish trade, where fish are produced for sale to the international pet trade. Often one or more species of fish are produced by small-scale family-owned farms which operate at a low technological level, but whose markets are guaranteed by the setting up of cooperatives that purchase the total farm production for an agreed price, and do all the further marketing. This enables these small-scale operators to have an assured income, resulting in food security for their families.

Another often ignored form of aquaculture is the production of quality seed for sale to other fish farms in the form of fingerlings. It is undeniable that one of the causes of repetitive failure in African pond aquaculture since 1945 is the widespread use of poor-quality founder stock. A frequent problem is the use of inbred



Aquaculture in Africa has traditionally been carried out in extensively managed large ponds, using either fertilization or some supplemental feeding of the fish.

fish found in local ponds and then further inbred by so-called hatcheries and distributed to local production farms in the belief that the stock quality did not matter. There is a need for producing quality fingerlings with traits for fast growth, cold tolerance and even colour-enhancement to obtain greater market acceptance and value, as has been done in the Philippines, with their GIFT tilapia (genetically improved farmed tilapia), a red-coloured and fast-growing strain of *Oreochromis niloticus* which outperforms the wild strains and is now almost universally used in aquaculture.

If water is available to grow fish, aquaculture offers more choice than farming on land. This is because there is almost always a suitable species of fish that can be cultured in the available conditions. However, it is important that only species with requirements compatible with the region's environmental conditions are cultured. For example, trying to grow a coldwater species such as trout in warm water will not work; however, tilapia or catfish would do well in warm water.

Some of the reasons why a farmer or small land owner might start fish farming:

- Fish are an important source of high-quality food
- Fish farming can help a farmer make better use of his/her land
- Fish farming can provide extra money.

Types of aquaculture

The practice of aquaculture varies widely and differs in the intensity of culture, level of water exchange and structures used, with each method having its own set of benefits and problems. Aquaculture can be broadly grouped into three intensities:



Deciding on the way in which you intend to make money out of aquaculture requires planning and expert advice.

Extensive – This uses large stagnant ponds that allow only a low stocking density and rely on natural production to feed the animals (i.e. there is no supplemental feeding). Management and skills input are low.

Semi-intensive – This is much like extensive culture, however there is a greater degree of intervention either through feeding and/or improvement of water quality through aeration and partial water exchange. This allows for an increase in the production of livestock when compared to extensive systems. Management and skills input occur at a medium level.

Intensive – Livestock are maintained at high stocking densities and feeding comes solely from introduced feeds. The culture systems tend to be highly technical and rely on electricity to operate. The space required is relatively small and the system is designed to optimize water use and quality. Management and skills input are high.

In some parts of the country, where climatic factors are against the year-round production of warmwater fish species, there is still potential for either coolwater aquaculture, or seasonal production as with any other 'crop' in agriculture. For example, there is no reason why, if fingerlings are available, that harvests of tilapia (or other warmwater species) at the end of summer should not be followed by that of trout at the end of winter. There are many parts of the country where summer water temperatures are ideal for warmwater species for seven months of the year, and for coolwater species for the balance. With a little imagination and careful planning, a similar system to those farmers who currently grow a crop of winter wheat, followed by maize or other summer crop, may also be used for fish rearing. All it takes is the belief that it is possible, and some careful planning of the production methods.



Fish can be produced in intensive systems (far left) requiring pumps, tanks and other equipment, or in ponds (left), as commonly used in most parts of Africa.

The history and present status of freshwater aquaculture in South Africa

During the late 1960s and 1970s various government agencies promoted freshwater aquaculture. Well-equipped hatcheries were constructed in many parts of the country to supply fingerlings to both private and government projects. Of the 13 government hatcheries then existing, the three remaining are operating at reduced capacity and efficiency. Most of the hatcheries and rural projects remain 'mothballed', with the basic infrastructure still there. What are the reasons for this reduced activity in aquaculture since the 1980s, and why did the fish projects not succeed?

- There was little planning and support;
- Training in basic fish biology, husbandry skills and marketing was lacking;
- Stock was randomly selected from locally available fish, with no attention to improved strains or selection for favourable traits such as fast growth or cold tolerance.

If these obstacles can be overcome then most of these facilities can be revitalised and made operational without starting from scratch. The purpose of this manual is to avoid the mistakes made in setting up or running these former projects and to guide interested parties along routes that, if followed, will ensure success.

In the warmer coastal parts of both the Eastern Cape and KwaZulu-Natal, warmwater aquaculture has high potential due to the relative abundance of water in these regions and the milder winter temperatures. Further inland, at higher altitudes, and in the Free State and North West provinces, a lack of water or extreme seasonal temperatures make aquaculture difficult. In these regions, a possible focus on seasonal 'crops' of warmwater and coolwater species at different times of year should be sought. In all provinces, the potential for producing ornamental fish is high, especially where this can be done utilizing tunnels or climate-controlled buildings, or by seasonal production during the warmer months.

In neighbouring countries there are many examples of successful aquaculture ventures. Zimbabwe (at Lake Kariba), Zambia and Malawi all have successful tilapia farms, both large and small scale. On almost every hotel menu and in most food outlets in these countries you will find freshwater fish for sale which has been cultured locally. South Africa should be no different.

