

Chapter 1. Introduction

Aquaculture is the cultivation of aquatic species under controlled or semi-controlled conditions. The origins of aquaculture date back millennia. The tomb of Ktihatop (about 2500 BC) contains a bas-relief which appears to show men removing tilapia from a pond (Landau, 1992). In addition, tilapia may have been the fish Saint Peter caught in the Sea of Galilee, and pond culture of tilapia may have been responsible for Christ's "miraculous" feeding of the masses (Borgese, 1977). In China, aquaculture's roots go back to between 1135 and 1122 BC when Wen Fang, besides being the founder of the Chou Dynasty, was reportedly the first to build aquaculture ponds and raise carp. Fan Li wrote the first treatise on carp culture, titled *Yang Yu Ching (Treatise on Fish-breeding)*, in 475 BC (Borgese, 1977; Landau, 1992).

Contemporary aquaculture systems can be categorized based on sources of nutrients/food used to raise the culture organisms. Aquaculture classified by food source falls into the three different culture techniques of extensive, semi-intensive, and intensive. Extensive aquaculture occurs where naturally occurring microflora and fauna supply all nutritional requirements. Semi-intensive culture occurs when ponds are intentionally fertilized with nutrients (e.g., manures, urea, phosphates) to stimulate natural food production, or when supplemental feed is added. Intensive culture is when the entire nutritional requirement is derived from external sources, such as complete moist pelleted feeds (Landau, 1992).

This book focuses exclusively on semi-intensive culture through the intentional addition of fertilizers to increase natural food production. This type of culture system is common throughout tropical Asia, Africa, and to a lesser degree, Latin America and the Pacific Islands. These systems are limited geographically to these tropical and semitropical regions because of the dual requirements of sufficiently high water temperatures and ample sunlight. It is important to keep in mind that the purpose of pond fertilization is to maximize/optimize natural food production without creating harmful environmental conditions for the culture organisms.

As will be discussed in following sections, natural food production is directly related to the rate of growth of tiny microscopic plants called algae—the greater the algal rate of growth, the greater the rate of natural food production. Natural foods include living

algae, microscopic animals which feed on algae, and detritus (particulate organic matter colonized by attached algae, bacteria, and fungi) formed upon the death and decay of algae, higher plants, and animals. Within environmental constraints, the growth rate of the culture organisms increases proportionally to increasing rates of natural food production. Insufficient light and cold water generally retard the growth of warmwater algal species, so the utility of pond fertilization decreases outside tropical regions of the world. Nevertheless, some of the most economically and nutritionally poor countries on the planet are in the tropics where efficient fertilization can have the greatest economic impact.

As the pursuit of sustainable development reaches a global scale, it is imperative that aquaculture farmers in these lesser-developed regions utilize the most nutrient-efficient, cost-effective, and environmentally friendly fertilization strategy(ies) to maximize both fish yields and personal incomes. Traditionally, fertilization research has been essentially trial-and-error studies evaluated primarily by yield comparisons, rather than focusing on actual dynamic processes which really determine the effectiveness of a particular fertilization strategy (Anderson, 1993a). Consequently, recommendations and conclusions based on such research are frequently too general and sometimes contrary to established ecological relationships.

Each pond is unique and will respond differently to identical fertilizations. By understanding basic principles of pond ecology and the limited number of identifiable variables which impact fertilization responses, the farmer can make intelligent decisions on a pond-by-pond basis as to what fertilizer(s) to use, the frequency and rate of application, when not to fertilize, how to most efficiently utilize available natural resources, and how to maximize fish yields while minimizing expenses and environmental degradation. Empowering aquaculture extension workers and fish farmers with this knowledge is the overriding objective of this book.