

## CHAPTER 1

### Introduction

There is a need for suitable agricultural systems to meet the increasing demand for food and also to maximize the utilisation of the available limited resources without much wastage. Hunger and malnutrition remain amongst the most devastating problems facing the world's poor and needy (FAO, 2002). About 80-90 million people have to be fed yearly and most of them are in developing countries in Africa. While the most reliable source of protein for many people is fish, millions of people who depend on fish are faced daily with the fear of food shortage (World Fish Center, 2003). In this regard, integrated fish farming systems can accommodate both the demand for food and utilisation of limited resources.

Integrated fish farming systems are a diversified and coordinated way of farming, with fish as the main target along with other farm products (Ayinla, 2003). The integrated fish farming system focuses on an optimal waste or by-product utilisation efficiency in which the waste of one sub-system (livestock) becomes an input to a second sub-system (fish). In a livestock-fish integrated system, where the livestock (goats, pigs, chickens or ducks) are housed in pens constructed over the pond surface, for wastes to be deposited directly into the pond, space utilisation is improved (Edwards *et al.*, 1988), whilst land and labour are economised. The purposes of integrated farming systems on farms are: diversification, intensification, improved natural resource efficiency, increased productivity and sustainability (Lightfoot *et al.*, 1993; Prein *et al.*, 1995; Devendra, 1997; Dalsgaard and Prein, 1999; ICLARM, 2000).

Commercially orientated integrated aquaculture has been investigated in South Africa over the last two decades and intensive studies were done by Prinsloo *et al.* (1999) on the feasibility of duck-fish-vegetable integrated aquaculture-agriculture systems for developing areas, yet little is known about the concept of aquaculture in South African rural populations. It has, however, been shown that this integrated fish farming production system can provide the vital animal protein necessary to relieve much of the prevailing problems of malnutrition in rural areas (Steyn *et al.*, 1995).

The practice of intensive modern poultry production and processing tends to also focus on high quality by-products such as manure, with the intention of possible re-use of the by-products. The intensive poultry production system promotes the importance of poultry manure for integrated aquaculture systems because of their nutritional status. In addition, Knud-Hansen *et al.* (1991) indicated that among the different types of manure that could be used, chicken manure is preferred because it is readily soluble and has a high level of phosphorus concentrations. Furthermore, the manure from layer chickens has more nutritive value for fish systems than that from broilers per bird/day (Taiganides, 1979). Layers produce more calcium and phosphorus-rich excreta than broilers and the waste of replacement birds fed restricted diets high in fibre is correspondingly poorer than laying birds. Poultry raised on a balanced ration produce a higher quality, more nutrient dense waste than those fed a supplementary feed (Little and Satapornavit, 1995). However, the Agricultural and Aquatic Systems Program (AASP) (1996) reported that the relatively low nutrient density of wastes from scavenging poultry fed supplementary feeds explains the rationale for using them as partial inputs into fish culture. It has been reported that

soluble organic matter supplied to ponds by manure from layers stimulates phytoplankton growth and increases biomass of zooplankton and benthic organisms thus enhancing fish growth (Atay and Demir, 1998; Sevilleja *et al.*, 2001).

## **MOTIVATION**

Integrated fish-chicken farming has the potential to impact positively on the livelihood of rural populations because it can provide food, employment opportunities and recirculation of waste products for maximum utilisation (Gabriel *et al.*, 2007). The production from two farming enterprises integrated together, will therefore contribute much to poverty alleviation and provision of employment or income. There is however a need to identify a suitable layer breed that can best perform when used in an integrated fish farming system. Since the purpose of promoting this system is to provide food security and regular sources of income to the poor, the best performing layer breed will be able to produce enough eggs for consumption and selling while the fish will be sold to increase profit. The spent hens will also provide meat and an income to the farmer at the end of the production cycle. When compared to broilers, layers have more stable weights and produce fairly constant levels of waste and are easier to manage, while broilers' waste availability is cyclical. With an integrated livestock-fish farming system, the high feed costs of the livestock system will be compensated for by the low production costs and high returns of the fish. In addition, Ayinla (2003) indicated that integrated fish farming system reduces cost of inputs whilst achieving a diversified protein production of combined enterprises that improves profitability and farmer's socio-economic status. The products (manure) produced in an integrated fish farming system are used as either a source of feed or fertilizer (Chen, 1989).

## **PROBLEM STATEMENT**

Although integrated aquaculture is perceived as a viable solution to South African problems of poverty alleviation, protein malnutrition and unemployment, little information is available on the dynamics of the system especially in the South African rural communities where it is needed most. These communities are more commonly involved in layer production with indigenous breeds which produce fewer eggs compared to commercial breeds. One of the most important factors affecting profit of layers is genotype. Wiener (1994) reported that most production traits tend to differ among animals of the same breed or strain. In addition, egg number and egg weight traits are heritable and vary with strain of birds (Akinokun and Dettmers, 1977). Hyline-Silver hens were found to be ideally suitable for their egg laying ability and survival in an integrated agriculture-aquaculture venture (Prinsloo *et al.*, 1999). The Hyline-Silver breed is a commercial strain that might be costly for rural farmers to maintain for adequate production, hence there is a need to look at performance of other breeds (dual purpose and indigenous) under the same conditions. In addition, information on egg quality from the different breeds on integrated aquaculture systems is scarce. Likewise information on the comparative performance of different layer genotypes in the same ecological pattern, integrated with fish culture, is still limited. The aim of this study was to evaluate the different chicken layer breeds for use in integrated aquaculture-poultry production systems in Gauteng. For this purpose, different breeds were kept for five months in a cage system situated above a concrete dam filled with water and in a conventional cage system in a house. Various performance parameters were measured and compared between breeds.

## **HYPOTHESIS**

The null hypothesis of this study was that the production performance of laying hens from different breeds and strains, kept in an integrated layer-fish farming system and conventional battery system will not differ. The alternative hypothesis is that one or more breeds/strains of chicken will be more suitable to be used in an integrated layer-fish farming system than others.

## **OBJECTIVES**

The major objective of the study was to identify the best performing chicken layer breed for use in an integrated fish farming system.

The specific objectives were to:

- Compare the egg production, body weight, mortality rate, feed conversion ratio, feed intake and hen-day production (%) of different layer breeds kept in an integrated fish farming system with those kept in a conventional battery cage system.
- Compare the egg size, albumen height, Haugh unit, shell strength, specific gravity and the amount of meat and blood spots of eggs from different identical layer breeds kept in an integrated fish farming system with those kept in a conventional battery system.
- Determine the economic efficiency of the different chicken layer breeds in the two different housing systems.