

**Study plan for a PhD degree in Aquaculture- (Genetic  
improvement of cultured Fish)**

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## **The importance of aquaculture:**

Aquaculture is currently one of the fastest growing food production systems in the world, most of global aquaculture output is produced in developing countries, and significantly, in low income food-deficit countries. From ancient times fishing has been a major source of food for humanity and a provider of employment and economic benefits to those engaged in this activity (FAO,1997). Frankic and Hershner (2003) summarized the benefits of aquaculture in:

- 1- increase household food supply and improve nutrition.
- 2- increase household economy through diversification of income and food sources.
- 3- strengthen marginal economy by increasing employment reducing food price.
- 4- improve water resources and nutrient management and household or community levels.
- 5- preserve aquatic biodiversity through re-stocking and recovering of protect species.
- 6- reduce pressure on fishery resources if done suitable.
- 7- improving and enhancing habitats.

Aquaculture has shown a worldwide rapid expansion in recent years. This is mainly due to the world continuing population expansion that put capture fisheries under increasing pressure with many of the world's natural fisheries already over exploited.

Hence, there is a great challenge for aquaculture to expand to meet the future shortfall in fish supplies.

### **Tilapia culture:**

In the view of cultured fish species, tilapia is one of the most commercially important and widely used fish in global aquaculture production particularly in tropical and subtropical areas (Gjedrem, 2005; Elsayed, 2005).

Tilapias are known to be an important component of subsistence fisheries for thousands of years, and are being described as the second most important farmed fish next to carps, and also as the most important aquaculture species of twenty-first century (Shelton, 2002).

There are over 70 species of tilapias (Anon, 1984). There are now many strains of the parent species along with many hybrid strains available to growers (Rakocy and McGinty, 1989).

Nile tilapia (*Oreochromis niloticus*) is the main cultured species in many parts of the world (Pullin, 1997).

*Oreochromis niloticus* is by far the most important tilapia species and distributed throughout the world (Bentsen et al., 1998; Pillay and Kutty, 2005; Elsayed, 2005).

The importance of *Oreochromis niloticus* seems from its biological characteristics:

Fast growth, high food conversion ratio, readily accepting artificial feeds, ease of breeding in captivity, disease resistance,; social reasons:

Good table food quality, good market price; and physiological reasons:

Tolerant to a wide range of environmental conditions (El sayed. 2006; Ashagrie et al., 2008), therefore, determination of different factors such as feed quantity, stocking density, and strain variations for cultured tilapia is essential to maximize it's production, profitability and sustainability (Gjeddrem, 1997).

Aquaculture, especially of tilapias has the potential to play a leading role in the fight against food insecurity, malnutrition, and poverty in Africa (BÉNÉ and Heck, 2005). It's widely accepted that successful aquaculture development in Africa requires improvements in feed quality and availability, business and marketing models, and technical capacity. Another important factor that should be considered is the effective utilization and management of fish genetic recourses (Lind et al., 2012; Ponzoni et al.,2011) specially improved strains that are faster growing resistant to disease, and suited for culture in a variety of fish farming conditions (Greer and Harvey,2004).

### **Tilapia Genetical Improvement:**

(Pononi et al., 2007) showed that genetic improvement is one of the most powerful and least expensive means of increasing the efficiency of aquaculture.

Genetically modified organisms now offer the opportunity to improve both the production and characteristics of conventional animals and plants currently exploited in agriculture and aquaculture (Owusu et al., 2005).

During the approximately 40 year history of intensive culture of tilapia, the genetic resources of tilapia have been poorly managed.

The genetic problems now manifesting themselves are the loss of pure species through the mismanagement of inter specific hybridization (Mc Andrew 1993).

A second problem is high levels of inbreeding depression. In recent years attention has focused on a single species *O. niloticus*, and research has begun to overcome some of the main problems research has associated with farming this species (Pullin and Capili, 1988, Tave, 1988).

Genetic improvement is a technique which has been used to produce all male- fry which have a higher growth rate in production system (Hickling 1960, Hulata, et al.1983). Large scale genetic improvement programs have been established for *O. niloticus* in Asia (Eknath et al.,1993), and genetic methodologies to control sex have now resulted in the reliable production of all-male Fry to help overcome the problems associated with excessive Fry production in on-growing ponds (Mair et al .1995).

El-sadig (2005) recommended mono-sex culture of Nile tilapia for its better growth performance and economic result.

The future research will aim to improve the performance and expand the environmental tolerance of this species into areas of lower temperatures and higher salinities.

To support genetic improvement of tilapia, an international effort has begun to compile a map of the *O. niloticus* genome (Kocher, 1997). The genetic improvement of Farmed tilapia (GIFT) project started in 1988 in the Philippines (Eknath and Acosta, 1998).

## **Aquaculture in Sudan:**

Sudan with its vast resources (land, water, suitable weather) has a great potential for aquaculture.

Nevertheless, aquaculture development faces many challenges. One of the most serious constraints in this respect is unavailability of quality fish seeds for commercial Farms. Another important drawback is the problematic over-reproduction of tilapia (the major suitable culture species in the country) in grow-out ponds leading to production of stunted fish that never reaches the marketable size. The production of farmed tilapia in Sudan is very weak and it's less than 5% of the total production (36,000 tons) (FAO, 2013). Therefore, fish production needs to be increased in Sudan, this increase can be obtained by increasing fish farming by using good fish farming Technology (FAO, 2013). Such as (Genetic manipulation, Hybridization, sex reversal...etc) which will be solving the problems of fish culture in Sudan.

And for non-development of fish culture in Sudan with a lack of Research results, beside the availability of different elements of Aquaculture (land, water, farmed fish), It had to be thinking in its development because of economical importance of this project, which will help the development of the national income and food security of Sudan. For all of these reasons I choose this side of study (Aquaculture).

### **The study objectives include:**

1- to stimulate research and technology development and increase education for providing the basic culture information to develop Aquaculture in Sudan.

- 2- to help to reduce pressure on fisheries resources through restocking and recovering of protect species.
- 3- to improve the genetic quality of farmed Fish with characteristics of increased growth rate to market size and improved the survival in culture, and supply the farmer with genetically pure fry and fingerlings in future.
- 4- To encourage investment in the field of aquaculture to improve individual and national income by providing the job opportunity for community, and provide protein at low prices.

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