INTERNSHIP REPORT

Location - TERI

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Class - MSc Part 2

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INTRODUCTION

As a part of the syllabus the students of MSc part 2 were sent on a one month internship according to the respective cluster chosen. My cluster was aquaculture and hence the internship for me and some of my classmates was conducted at The Energy and Resource Institute (TERI).

TERI is a research institute that specializes in the field of energy, environment and sustainable development. This institute was established in the year 1974 mainly as an information centre for the management of energy issues. However now in the recent years, the policies and technology solutions of this institute have helped in the transformation of the people's lives as well as the environment.

The belief of this institute is that, waste management and resource efficiency are the main solutions to sustainable and complete development. Their aim is to develop a cleaner and sustainable future by conservation and efficient use of energy and other resources and various ways to minimise and recycle waste. The work of the organization across different sectors is mainly focused on effective use of the existing resources, increasing the use of sustainable inputs and practices and reduction of harmful effects on the environment and climate.

The internship was held in the month of December and period of the internship was 1 month. Throughout the course of the intership we were mentored by the guidance of Dr. Elroy sir and Dr. Fredree sir. We had to work on 2 of the components of aquaculture as a part of this internship. These were aquafeed formulation and aquaponics.

OBJECTIVES

1. Formulation of fish feed using whole algae and deoiled algae.
2. Conduction of a feeding experiment and comparison of the growth of fishes fed with formulated fish feed and growell feed.
3. To set up a small scale aquaponics system.

WORK DONE

This internship course consisted of working on two of the components of aquaculture that is aqua feed formulation and aquaponics.

1. Aqua feed formulation

To begin with the feed formulation experiments, 3 different diets were prepared containing the different ingredients given below:

Diet 1a	Diet 1b	Diet 2
Deoiled algae	Deoiled algae	Whole algae
Fish meal	Fish meal	Fish meal
Wheat Bran	Wheat Bran	Wheat Bran
Groundnut oil cake	Groundnut oil cake	Groundnut oil cake
Vitamins and minerals	Vitamins and minerals	Vitamins and minerals
Binder	Binder	Binder

Diet 1b contained a different concentration of the deoiled algae as compared to diet 1 a. The different ingredients used for making the feed diets were collected and dried under the sun. After the drying of the ingredients, they were then weighed according to the amount required for making 1kg. All the weighed ingredients were then mixed together in a tray and a dough was made by adding 100 ml of water at a time. In total, for the making of the dough, about 800ml of water was added. The dough was then spread evenly on to the tray and kept for sun drying. The feed was turned after every 20 minutes to ensure its complete drying. After the feed was completely devoid of moisture, it was made into small pieces and powdered using a mixer. The three diets were then stored in air tight containers.

Dough making of the ingredients

Finished dough

Dough spread on the trays and kept for sun drying.

Flipping of the spread dough for complete drying

Finished diets powdered and stored In air tight containers

To carry out the feeding experiment, 12 tanks were cleaned and filled with water. Biofilters were then added into the tank. 3 tanks each were maintained for the diets and 3 tanks were maintained as control. About 200 Tilapia fingerlings were purchased from the green lake farm at Majorda along with Growell feed. The fishes were present in a big polythene bag so they were introduced in the tank in the following manner:

First, the polythene bag was washed from the outer side to remove any contaminants and dirt present. Then a bucket was filled with water and the polythene bag containing the fishes was immersed in this bucket. This was followed by opening the bag slowly so that the fishes can come slowly in the surrounding water. These fingerlings were then weighed. This was done by keeping a small bowl filled with water on the weighing machine. The machine was then tared and a single fish was transferred into the bowl with the help of the net. The exact weight of the fish was then noted.

Tilapia fingerlings purchased from The Green Lake farm

Polythene bag containing the fingerlings Opened in a bucket of water.

Transferring a single tilapia fingerling in the bowl

Weight measurement of a single fingerling

Segregation into groups according to the weight

The fishes were segregated into 3 different groups based on their weights. The group 1 consisted of fishes belonging to the weight range of 4-7g, 3-4g fishes in group 2 and group 3 contained fishes weighing from 0.5 to 2.8g. The largest number of fishes were present in the group 3. From this weight category, again the fishes were segregated and only the fishes in the weight range of 1.5-2.5 g were considered. The other fishes not in this weight range were rejected. Group 1 and Group 2 fishes were also rejected and therefore stored in 2 separate tanks. 6 fishes each from the selected weight category were introduced into the 12 tanks. In total about 72 fishes were used for this experiment. The period of the experiment was 14 days. On day 0, the fingerlings were fed with growell feed. The vials were filled with the prepared feed according to the diet plan for 14 days. The three control tanks were fed only with the growell feed. The

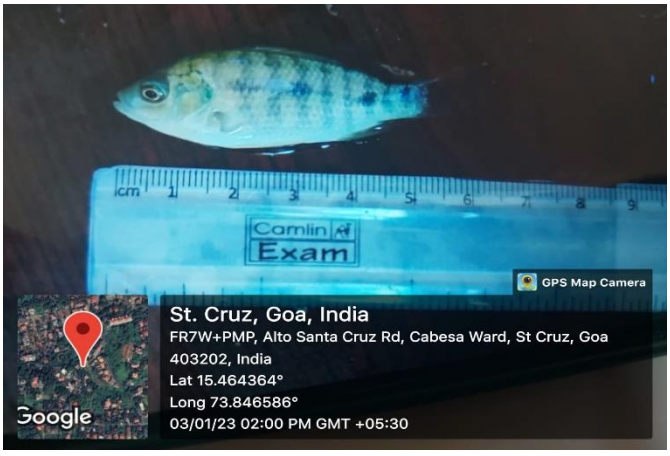
fishes were fed according to 6% of their body weight. Everyday a vial was introduced into each tank and this was continued for the next 14 days. On the 7th day each fish was weighed and its length was measured by using a scale. A similar procedure was carried out on day 14 for measuring the length and weight of the fishes.

Weighing of the feed

Vials filled with the feed

Introducing the feed vial into the tank

Measurement of weight



Length measurement

WEIGHT AND LENGTH OBSERVATIONS FOR DIFFERENT DIETS

1. **Control**

Day 0

Fishes in the weight range of 1.5g-2.5g were considered.

Day 7

Tank 1		Tank 2		Tank 3	
Length	**Weight**	**Length**	**Weight**	**Length**	**Weight**
5.5cm	3.29g	6cm	2.62g	6.1cm	4.55g
6cm	3.30g	6.5cm	4.91g	6.1cm	5.02g
6.6cm	4.49g	6cm	4.2g	6.8cm	4.42g
6cm	2g	5cm	3.28g	7.2cm	5.72g
5.6cm	2.90g	6cm	3.88g	6.2cm	4.8g
5.9cm	3.35g	6cm	1.75g	5.9cm	4.12g
Average -	3.22g	Average -	3.44g	Average -	4.77g

Day 14

Tank 1		Tank 2		Tank 3	
Length	**Weight**	**Length**	**Weight**	**Length**	**Weight**
6cm	3.37g	6.5cm	2.83g	6.0cm	4.15g
6.4cm	4.53g	6.7cm	6.04g	6.7cm	5.83g
7.1cm	4.50g	6.5cm	5.03g	7.4cm	7.41g
6.3cm	2.4g	5.5cm	4.0g	7.3cm	4.85g
5.9cm	3.1g	6.2cm	3.98g	6.5cm	5g
6.1cm	3.7g	6.3cm	2.5g	6.2cm	4.62g
Average -	3.6g	Average -	4.06g	Average -	5.31g

2. **Diet 1a**

Day 0

Fishes in the weight range of 1.5g-2.5g were considered.

Day 7

Tank 1		Tank 2		Tank 3	
Length	**Weight**	**Length**	**Weight**	**Length**	**Weight**
6cm	1.61g	5.5cm	2.73g	6.5cm	4.95g
6cm	2.40g	5.8cm	3.04g	6.2cm	4.01g
6cm	3.64g	5.5cm	2.65g	5.6cm	2.84g
6.1cm	1.97g	5.4cm	2.44g	6.5cm	4.32g
6cm	1.61g	6cm	2.72g	6.6cm	5g
6cm	2.00g	5.6cm	2.65g	5.5cm	2.68g
Average -	2.205g	Average-	2.705g	Average-	3.96g

Day 14

Tank 1		Tank 2		Tank 3	
Length	**Weight**	**Length**	**Weight**	**Length**	**Weight**
6.2cm	4.24g	6cm	3.41g	7cm	5.73g
6.5cm	4.83g	5.9cm	3.07g	7.1cm	4.55g
6.7cm	3.23g	5.5cm	5.19g	7cm	4.7g
6.3cm	5.33g	7cm	5.21g	6.9cm	4.50g
6.9cm	5.06g	6.1cm	4.5g	6.7cm	3.39g
6.7cm	4.06g	5.9cm	4.1g	7cm	3.98g
Average -	4.51g	Average -	4.24g	Average -	4.47g

3. **Diet 1b**

Day 0

Fishes in the weight range of 1.5g-2.5g were considered.

Day 7

Tank 1		Tank 2		Tank 3	
Length	**Weight**	**Length**	**Weight**	**Length**	**Weight**
6.3cm	3.91g	5.5cm	2.96g	5.9cm	3.90g
6.2cm	4.60g	5.5cm	2.75g	6cm	4.01g
5.5cm	2.66g	5cm	2.27g	6cm	3.44g
5.4cm	2.63g	5cm	2.41g	6cm	2.97g
6.3cm	3.44g	5.5cm	2.85g	5.8cm	3.24g
5.8cm	3.63g	5.5cm	2.60g	6.2cm	5.64g
Average -	3.47g	Average -	2.64g	Average -	3.83g

Day 14

Tank 1		Tank 2		Tank 3	
Length	**Weight**	**Length**	**Weight**	**Length**	**Weight**
5.5cm	2.95g	5.6cm	3.13g	6cm	3.86g
6.3cm	4.01g	5.6cm	2.87g	6.5cm	4.48g
6.7cm	4.31g	5.3cm	2.55g	6.5cm	4.23g
5.9cm	3.83g	5.2cm	2.67g	6.2cm	3.1g
5.6cm	4.89g	5.7cm	2.97g	6cm	3.44g
6.5cm	3.1g	5.8cm	2.85g	6.4cm	5.70g
Average -	3.84g	Average -	2.84g	Average -	4.135g

4. **Diet 2**

Day 0

Fishes in the weight range of 1.5g-2.5g were considered.

Day 7

Tank 1		Tank 2		Tank 3	
Length	**Weight**	**Length**	**Weight**	**Length**	**Weight**
5.8cm	3.23g	5.9cm	3.30g	6.3cm	3.94g
6cm	2.23g	6cm	3.26g	5.6cm	2.95g
5.9cm	2g	5.5cm	2.87g	6.5cm	4.46g
6.5cm	4.30g	5.9cm	3.41g	6.3cm	4.08g
5.9cm	3.30g	5.5cm	2.95g	6.2cm	3.83g
5.9cm	3.05g	5.5cm	1.60g	6.4cm	4.34g
Average -	3.01g	Average -	2.84g	Average -	3.93g

Day 14

Tank 1		Tank 2		Tank 3	
Length	**Weight**	**Length**	**Weight**	**Length**	**Weight**
5.9cm	3.30g	6cm	3.95g	6.5cm	4.62g
6.4cm	2.34g	5.9cm	3.5g	5.7cm	3.34g
6.2cm	3.03g	5.7cm	3.01g	5.7cm	5.24g
6.7cm	4.5g	6cm	3.60g	6.2cm	4.2g
6.1cm	3.51g	5.9cm	2.98g	6.4cm	3.98g
6cm	3.20g	5.9cm	2.1g	6.5cm	4.51g
Average -	3.31g	Average -	3.19g	6.5cm	4.31g

- **From day 0 to day 14, an increase in the weight and length was observed.**

Analysis of feed

The four different feeds were taken and 5g of the each of the feed was weighed. It was then homogenized with ethanol and the homogenate was added into four different centrifuge tubes. The tubes were centrifuged at 1500 rpm for 15 minutes. The supernatant obtained was used for the analysis of carbohydrates and proteins.

Test for carbohydrates

1ml of the supernatant from each of the centrifuge tubes was taken in four different test tubes and to that 5ml of the anthrone reagent was added. This was kept in a boiling water bath for about 20 minutes. After that the optical density was measured at 620nm using a spectrophotometer. The concentration of the carbohydrates was calculated from the standard curve for glucose.

Carbohydrate concentration obtained in the feeds was following:

Growell – 0.089mg/ml

Diet 1a – 0.0902mg/ml

Diet 1b – 0.091mg/ml

Diet 2 – 0.087 mg/ml

In conclusion diet 1b had the highest concentration of carbohydrates and diet 2 had the lowest concentration of carbohydrates of the four diets tested.

Test for proteins

Again 1ml of the supernatant from each of the centrifuge tubes was taken in four different test tubes and to that 5ml of Lowry's reagent was added. This was incubated at room temperature for 10 minutes. After that 0.5ml of Folin's reagent was added. This was followed by an incubation at room temperature for 10 minutes. After this the optical density was measured at 660nm using a spectrophotometer. The concentration of the proteins was calculated from the standard curve.

Protein concentration obtained in the feeds was following:

Growell – 615.957 micrograms/ml

Diet 1a – 624.680 micrograms/ml

Diet 1b – 600.42 micrograms/ml

Diet 2- 609.36 micrograms/ml

In conclusion diet 1a had the highest concentration of proteins and diet 1b had the lowest concentration of proteins among the four diets tested.

Analysis of the moisture content

Crucibles were obtained and the empty weight was taken. 1g of each of the diets were weighed and then taken into the crucible and this weight was noted. This crucible

along with the feed was kept in an oven at 105 degree celcius for 1 hour for the determination of the moisture content.

The moisture content of the feeds was found to be following:

Growell – 5.01%

Diet 1a – 2.40%

Diet 1b – 6.23%

Diet 2- 10.52%

In conclusion diet 2 had the highest moisture content and Diet 1a had the lowest moisture content among the four diets tested.

Feed analysis

Spectrophotometer

Taking readings using the spectrophotometer

2. AQUAPONICS

The second part of the internship was construction of an aquaponics system. Aquaponics system is the one which combines the maintenance of both fish and plants. It is a sustainable system. Inorder to build an aquaponics system, the first step was coming up with a simple design of the system. For this we read many reference articles and finally came up with the design. After this the materials required for the construction were listed out. They were purchased from the nearby stores. The different materials used for building the aquaponics setup were PVC pipes, aquarium pump, zip tags, end caps, hydroponic cups, rubber tubes, tank, biofilter, tilapia fingerlings and plant saplings.

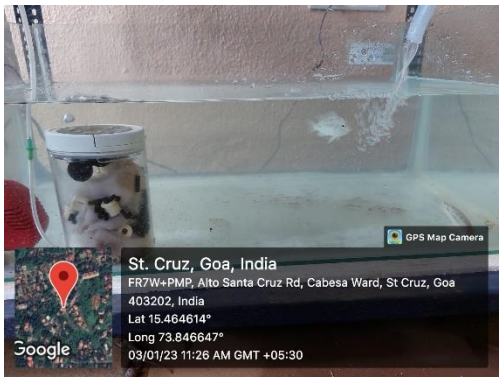
SETTING UP THE AQUAPONICS SYSTEM

1. First the stand for supporting the setup was cleaned and then placed near to the electric point so as to provide a socket for the operation of the pump.
2. Then circles were drawn on the PVC pipes as a reference to drill out holes for placing the plants.
3. Holes were then drilled on the PVC pipes and their size was according to the size of the hydroponic cups for placing the plants.
4. The pipes were then fixed on to the stand using the zip tags in a zig-zag manner.
5. Small holes were drilled into the end caps so as to pass the rubber tubes for the water flow.
6. The rubber tubes were fixed into the end caps with the help of m-seal.
7. The end caps were fixed finally on to the PVC pipes with the help of cement solvent.
8. The tank was placed down and the last rubber tube coming from the pipe was positioned in the tank for the clean water to flow.
9. A biofilter and an aquarium pump were also placed in the tank.
10. The ratio for placing the plants and the fishes in the aquaponics system was mentioned in one of the research articles as 2:1 and hence in this setup 5 Tilapia fishes were placed along with 10 plant saplings.
11. In the tank the fish excreta containing the ammonia was converted into nitrate by the bacteria present in the biofilter. This nutrient rich water was taken by the pump and passed through the pipes containing the plant saplings. In return the plants utilized the nitrate rich water as a fertilizer for their growth and then the clean water purified by the plants flowed back to the tank.

❋In this way a simple aquaponics system was setup at TERI

Aquaponics system setup at TERI

Plant saplings used in the aquaponics system



Fish tank of the aquaponic system with tilapia fishes

CONCLUSION

In the feeding experiment conducted we found that the fishes fed with growell feed showed a higher growth rate (weight and length) as compared to the fishes fed with experimental diets consisting of deoiled algae and whole algae. A small scale aquaponics setup was built using the commonly available materials.

LEARNING OUTCOME

In this one month internship period we learned the formulation of fish feed. We also attained a hands on training on the maintainence of tank, the fingerlings and measurement of the weight and length of fishes. Also this internship course helped us in gaining an experience on setting up a small scale aquaponics system.