EFFECT OF ORGANIC FERTILIZER (BROILER LITTER) AND INORGANIC FERTILIZER (DIAMMONIUM PHOSPHATE) ON GROWTH OF COMMON CARP (*Cyprinus carpio* Linnaeus, 1758)

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Submitted To
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DECLARATION

I hereby declare that the work presented in this thesis has been done by myself, and has not been submitted elsewhere for the award of any degree. All sources of information have been specifically acknowledged by referenced to the author(s) or institution(s).

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This is to recommend that the thesis entitled **"EFFECT OF ORGANIC FERTILIZER (BROILER LITTER) AND INORGANIC FERTILIZER (DIAMMONIUM PHOSPHATE) ON GROWTH OF COMMON CARP (*Cyprinus carpio* Linnaeus, 1758)"** has been carried out by **Mr. Barun Kumar Pandit** for the partial fulfilment of Master's Degree of Science in Zoology with special paper **"Fish and Fisheries"**. This is his original work and has been carried out under my supervision. To the best of my knowledge, this thesis work has not been submitted for any other degree in any institutions.

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On the recommendation of supervisor **"Asso. Prof. Dr. Archana Prasad"** this thesis submitted by **Mr. Barun Kumar Pandit** entitled "**EFFECT OF ORGANIC FERTILIZER (BROILER LITTER) AND INORGANIC FERTILIZER (DIAMMONIUM PHOSPHATE) ON GROWTH OF COMMON CARP (*Cyprinus carpio* Linnaeus, 1758)**" is approved for the examination and submitted to the Tribhuvan University in partial fulfilment of the requirements for Master's Degree of Science in Zoology with special paper **"Fish and Fisheries"**.

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LIST OF ABBREVIATIONS

ALCOM	Aquaculture for local Community Development programme
CF	Condition factor
DAP	Diammonium phosphate
DO	Dissolved oxygen
DWG	Daily weight gain
et al.	and his associates
FAO	Food and agriculture organization
FDTC	Fisheries development and training centre
FIGIS	Fisheries Global Information System
MAP	Mono-ammonium phosphate
MBL	Mean body length
MFL	Mean final length
MFW	Mean final weight
MIL	Mean initial length
MIW	Mean initial weight
MWG	Mean weight gain
NPK	Nitrogen, Phosphorus and Potassium
PWG	Percentage weight gain
SGR	Specific growth rate
SR	Survival rate
TW	Total weight
UNDP	United Nations development programme

ABSTRACT

This work was conducted in the region of Terai, Aurahi gaupalika 2 (Parbaha), Dhanusha distric in the Janakpur Zone, south-east of Nepal to investigate the effect of organic and inorganic fertilizers on the growth performance of *Cyprinus carpio communis*. The fries were stocked @ of seven fries/m^2 in 12 cages. Cages were made up of Polyester cloth of one metre length, breadth and height. Treatments were carried out in four different ponds with three replications. Pond A was fertilized with Broiler litter at the rate of 5 g/m^2/week (@ 2,597 kg/ha/yr). Pond B was kept as control pond i.e. without any treatment. Pond C was treated by broiler litter (@ 5 g/m^2/weekly) and Diammonium phosphate (5 g/m^2/biweekly). Pond D was fertilized with Diammonium phosphate (@ 5 g/cage/biweekly). Next day of cage setting it was limed at the rate of 19 g/cage (@ 200 kg/ha). After ten days, fertilization was carried out as treatments required and after ten days fries were stocked in each cage. Length, weight measurement and water quality analysis were carried out before fertilization in each 15 days from stocking to harvesting (90 days). Growth response of Pond A, Pond B, Pond C and Pond D were Mean Initial Weight (0.09 g, 0.09 g, 0.09 g and 0.09 g), Mean Final Weight (3.6 g, 2.4 g, 19 g and 2.53 g), Mean Initial Length (1.7 cm, 1.68 cm, 1.6 cm and 1.63 cm), Mean Final Length (6.43 cm, 6.01 cm, 8.54 cm and 5.7 cm), Specific Growth Rate (1.78 %/day/fish, 1.58 %/day/fish, 2.58 %/day/fish and 1.6 %/day/fish), Percent Weight Gain (3900 %/Fish, 2566 %/Fish, 21011 %/Fish and 2711 %/Fish), Daily Weight Gain (0.039 g/fish/day, 0.025 g/fish/day, 0.21 g/fish/day and 0.027 g/fish/day), Condition factor (1.35 , 1.1, 3.05 and 1.36), r (0.96, 0.99, 0.82 and 0.98), Total Weight (54 g, 36 g, 285 g and 38 g) and production 741.61 kg/ha/year, 494.41 kg/ha/year, 3,914.1 kg/ha/year and 521.19 kg/ha/year. The mean water quality parameters, as temperature, transparency, pH and DO of pond A, Pond B, Pond C and Pond D were (23.3°C, 23.5°C, 23°C and 23.2°C), (33.35 cm, 57.5 cm, 20.5 cm and 25.5 cm), (7.02, 8.35, 6.25 and 7.30) and (4.94 mg/l, 5.20 mg/l, 4.6 mg/l and 5.02 mg/l) respectively. Growth performance of Common Carp is found better in combined use of Organic fertilizer (Broiler litter) with Inorganic fertilizer (DAP) than other treatments, Broiler litter, Diammonium phosphate and control respectively.

Keywords: Organic and inorganic fertilizers regime, growth response, Common Cap.

1. INTRODUCTION

1.1 Aquaculture

Farming of aquatic organisms, such as fishes, molluscs, crustaceans and aquatic plants involves aquaculture. It implies some form of intervention in the rearing process to enhance production. Aquaculture also plays an important role in regular stocking, feeding, and protection from predators. Fish raised in semi-intensive, fresh water system provide the major proportion of farmed, global production which economizes on land, labour and water requirements for both poultry and fish. With the emerging technologies of aquaculture and upgradation of traditional methods, aquaculture production is rapidly increasing world-wide (Sinha, 1993).

1.2 Aquaculture system

Aquaculture systems can be broadly classified into three groups on the basis of feed/fertilizer input as – i) Extensive system - rely on natural feed produced without intentional pond inputs in the form of feed/fertilizers. ii) Semi-intensive system - depend on fertilization to produce natural feed in the pond and also on feed given to the fish to complement the natural feed which develops in the pond. iii) Intensive system **-** depend on nutritionally complete feeds, either in moist formulations or in dried pellet form, with fish deriving little or no nutrition from natural feed production in the pond (Edwards, 1990).

1.3 Pond Fertilizers

Fertilizers are natural or synthetic substance that is used in ponds to increase the production of the natural food organisms to be eaten by fish. Pond fertilizers form two distinct groups- mineral or inorganic fertilizers and organic fertilizers (Coche *et al*., 1996).

1.3.1 Organic Fertilizer

Poultry litter or Broiler litter is a mixture of poultry excreta, spilled feed, feathers, and materials used as bedding in poultry operation. It is a source of detritus and plays direct role in nutrition of the fish (Schroeder, 1978; Colman and Edwards, 1987). The chemical composition of organic manure varies greatly according to the animal from which it originates- namely the species, age, sex, the nature of its diet and according to the way the manure is handled. Chicken dropping are the richest in nutrients. In some cases, total wastes made of dung and urine is available, while in others only solid wastes can be collected. Coche *et al*., (1996) found that it is best to use fresh cattle and pig manures, whereas, chicken and duck manures can be stored (PLATE II, Photo 7).

1.3.2 Inorganic Fertilizer

An inorganic fertilizer contains mineral nutrients and is manufactured industrially to be used in agriculture for improving crop production. Fertilizers are commercially known as NPK with grade on each fertilizer container by the percent of nitrogen (N), phosphorus (P) as phosphoric acid (P_2O_5) and potassium (K) as potassium monoxide (K_2O). Therefore, 20-20-5 grade fertilizer (NPK) contains N, P_2O_5, and K_2O while incomplete fertilizers contain only one or two of these elements. Common incomplete fertilizer sources are normal superphosphate (0-20-0), triple superphosphate (0-46-0), Di-ammonium phosphate (18-46-0) and liquid ammonium polyphosphate (10-34-0). Examples of common complete fertilizers are 13-13-13, 20-20-5, and 4-12-12.In recent years, fertilizer formulations which contain all three nutrients have become popular as a result of their effectiveness. In a dry, flour-like form, the 12-48-8 formulation produces excellent phytoplankton blooms which vigorously stimulate fish growth.

Since liquid fertilizers nutrients are more rapidly available to the phytoplankton in promoting rapid growth of plankton algae in farm ponds, so considered generally superior to the traditional granular form fertilizers. Smaller applications of liquid fertilizers (more as concentrates) can be used which reduces the cost and labour of application but still improve the effectiveness of pond fertilization. Common grades of liquid ammonium polyphosphate fertilizer are 10-34-0 and 11-37-0. Nutrients are found in a ratio of about 1:3 in liquid fertilizers **(**Chappell, 2008).

1.4 Plankton

Plankton includes free floating minute plant and animal organism that have very feeble locomotory organs and simply drift with water currents (PLATE V). Phytoplankton includes organisms with chlorophyll (*Microcystis, volvox* etc.) and non-photosynthetic bacteria and fungi. Zooplanktons are minute animals like protozoans (radiolaria, foraminifera), rotifers, and crustaceans (Khanna, 2000).

1.5 Taxonomic and General features of common carp

Common Carp belongs to the Class-Osteichthyes (the bony fishes), the order-Cypriniformes and the Family- Cyprinidae. Sinha (1993) mention three phenotypes of Common Carp- Scale Carp (*Cyprinus carpio communis*), Mirror Carp (*Cyprinus carpio specularis*) and Leather Carp (*Cyprinus carpio nudus*).

Scale carp the native wild populations are considered vulnerable to extinction by the IUCN, but the species has also been domesticated and introduced into environments worldwide, and is often considered a destructive invasive species, being included in the list of the world's 100 worst invasive species. Still, it is one of the most widely cultured freshwater fish species in the world, the optimum water temperature for growth and propagation is 20°C–25 °C. (Welcomme, 1988; Hasan *et al*., 2007; FIGIS, 2011). It occurs within the temperature range of 3°C–35°C (Froese and Pauly, 2011).

They can live in vivid aquatic habitats but prefer larger, slower-moving bodies of water with soft sediments (Froese and Pauly, 2002; Page and Burr, 1991) i.e where water is shallow (only a few meters deep) and the bottom is muddy. The colour of the body varies from gray through silver to bronze with a yellowish or reddish belly. It has one long dorsal fin which possesses 2–3 hard and 17–22 soft rays. The first (largest) hard ray is sharp and is serrated on its posterior margin. Additional morphological characteristics include 2–3 anal spines, 5–6 anal rays and 36–37 vertebrae. The mouth is large and opens in an accordion-like fashion. There are two pairs of barbels, one pair on the upper lip and the other pair at the corners of the mouth. There are 5–5 molar-like pharyngeal teeth serving to grind the food (Page and Burr 1991).

Usually Carp attains 30 to 60 cm in length and 0.5 to 4 kg by weight (Tomelleri and Eberle 1990) but 15 to 20 kg also has been recorded frequently (McCrimmon 1968). Males have larger ventral fin than females. Carp are characterized by their deep body and serrated dorsal spine (Nelson 1984). Color and proportions are extremely variable, but scales are always large and thick. *Cyprinus carpio communis* (scale carp) has regular concentric scales (McCrimmon 1968).These are benthic omnivores and feeds on invertebrates that live in the sediments (Lammens and Hoogenboezem 1991). Newly hatched carp feed on rotifers, copepods, and algae the zooplanktons (McCrimmon 1968). Later by one year young carp less than 10 cm in length feed on a variety of macroinvertebrates including chironomids, caddis flies, mollusks, ostracods, and crustaceans (McCrimmon 1968). Adult carp are known to eat a wide variety of organisms including, insects, crustaceans, annelids, mollusks, fish eggs, fish remains, and plant tubers and seeds (McCrimmon 1968, Lammens and Hoogenboezem, 1991). Carp feed by sucking up mud from the bottom ejecting it and then selectively consuming items while they are suspended (McCrimmon 1968; Sinha, 1993). Carp are an important food fish throughout most of the world (McCrimmon 1968; Banarescu and Coad 1991). There is a report of a common carp living for 13-20 years in wild whereas 47 years in captivity (Froese and Pauly, 2002).

1.6 Objectives

1.6.1 General Objective

- To investigate the effect of organic fertilizer (broiler litter) and Inorganic Fertilizer (Di-ammonium Phosphate) on the growth of Common Carp.

1.6.2 Specific Objectives

- To determine the effect of broiler litter on the growth of Common Carp.
- To determine the effect of Diammonium phosphate (DAP) on the growth of Common Carp.
- To analyze the combined effect of broiler litter and Diammonium phosphate (DAP) on growth of Common Carp.

1.7 Significance of the study

Common Carp is omnivorous, resistant, and tolerable to wide variation of abiotic and biotic factors of environment. It is flexible, opportunistic feeder and prefer to alternative diets according to the food available. It is coprophagous which stairs the food with the tail which again mixed up in the water and become food available for surface and column feeder. High demand of protein would be fulfilled, using waste product. Reusing the waste product would minimize the production cost as well as labour costs in integrated aquaculture. Organic fertilizers decrease the dependency on artificial formulated feed. This work would create a job opportunity and help to uplift the economic status of the farmer in the semi-intensive polyculture farming. The environmental pollution would be minimized by using waste product of broiler in the semi-intensive aquaculture.

2. LITERATURE REVIEW

Semi-intensive aquaculture is primarily a manure based culture practice where supplementary feeding is avoided or of very limited use with the concept of total utilization of different trophic and spatial niches of a pond in order to obtain maximum fish production per unit area. Carrying capacity of pond is higher than that of extensive culture and ensures higher production of fish. ALCOM (1994) semi-intensive farming was defined as a fish farming practice where feeding is carried out at least two times per week and fertilization once per week. The semi-intensive condition gave 1.45 times greater fish production than the simple extensive one (Jasmine *et al*., 2011). The bioturbation activity of bottom feeders such as common carp induced a greater release of phosphorus from bottom sediment, which resulted in higher plankton production (Sahu and Jana, 1996).

Some of the feed stuffs from chicken digested tract are excreted out before full digestion. It is found that about 80% of the feed stuffs are utilized and digested by the poultry (count by dry material) therefore, 20% undigested feedstuffs from the chicken manure (Jian, 1985) can be used on the integrated fish farm. The component of broiler litter shows as dropping (62 %), bedding materials(31 %), wasted feed (3%), feathers (2%), foreign matter (2%) in average (Muller *et al*., 1959b). Broiler litter is most valuable animal waste due to its high protein content, of which about (45– 67) % is present as true protein, (13-18) % as uric acid and (12 -17) % as ammonia. A small amount is represented by Creatine (2-4) % and other N constituent. Muller (1976b) the broiler poultry litter whose nutritive value are crude protein (25.3%), Crude fiber (14.6%), Lignin (8.9%) and Ash (10.1%). The 100 kg dropping of chicken contains- moisture, organic matter, nitrogen, P_2O_5, K_2O, calcium, others and with 56 kg, 26 kg, 1.6 kg, 1.5 kg, 0.9 kg, 2.4 kg and 3.5 kg (Jhingran, 1997). The proportion of bedding materials to layer excreta is somewhat higher layer litter than in broiler litter, so that more fiber and other indigestible are inevitably accumulated in this waste. The usual level of crude protein ranges from (16-22) %, the main crude protein components being uric acid (about 55%), protein bound (36%) and ammonical protein (9%) (FAO, 1980).

The fertilizing efficiency of chicken manure in fish ponds, either alone or in combination with cattle manure, has been done by Banerjee *et al*. (1969), who observed that a combination of chicken and cattle manure worked better than the cattle manure alone in fertilizing nursery ponds. It has also been reported that poultry manure is a complete fertilizer, with the characteristics of both organic as well as inorganic fertilizers (Banerjee *et al*. (1979). Ray and David (1969) found that chicken manure produced a large population of rotifers quicker than cattle manure. A fish yield of 670 kg/ha/90 day has been reported by Banerjee *et al*. (1979), using poultry manure and no supplemental feeds. Poultry droppings contain higher quantities of soluble salts, inorganic substances and organic products than cow dung, ensuring quick zooplankton production (Pathak *et al*., 2000).

Experiments on monoculture of common carp (*Cyprinus carpio*) conducted at two different salinity levels (0.3%–0.9% and 6.0%–7.0%) using four different organic fertilizers (cow dung at 24,000 kg and 20,000 kg, poultry at 1,500 kg, duck at 6,000 kg and sheep/goat at 1,500 kg ha ^{1} y ^{1}) have revealed the highest fish growth to be in poultry-treated ponds, followed in decreasing order by duck and sheep/goat wastes. Similar trends in fish production were observed both in fresh- and salt-water ponds.

However, fish production was lower in ponds having higher salinities (> 7.5%). Nevertheless, these studies indicated that inland saline waters can be utilized for fish culture. With minor modifications in the existing technology of fish culture in stagnant freshwater fish ponds, animal wastes could be used to fertilize brackish water fish ponds (Garg, 1996).

Effect of duck manure level on the growth traits of common carp was investigated in which twelve ponds (n=270 fingerlings/pond) were divided into four groups (three ponds/group) and assigned to the four treatments: 0, 500, 750 and 1250 kg dried duck manure/1050 m^2. The actual means of body weight and body length of common carp increased successively with time, from stocking up to 180 days post-stocking. Condition factors fluctuated with time, but showed a generally decreasing trend. Specific growth rate was fastest for fingerlings in fish ponds manured with 1250 kg duck manure/1050 m^2, followed, in decreasing order, by fish ponds manured with 50, 500 and 0 kg per 1050 m^2. A negative association between condition factors and the body weights and body lengths was found in most of the stages (Afifi *et al*., 2000).

Chauhan (2014) reported the effect of poultry litter on growth of Common Carp (*Cyprinus carpio*) in at which fifty fingerlings were stocked in each of four rectangular tanks. The fishes in the tank T_1 were fed with control diet D_1 (0 % poultry dropping) and the fishes in tanks T_2, T_3 and T_4 were fed with test diets D_2 (10% poultry dropping), D_3 (15% poultry dropping) and D_4 (20% poultry dropping), respectively. All diets contained around 30%. Highest specific growth rate (0.26%/day) was recorded in tank T_2 where fishes were fed with 10% poultry dropping incorporated diet. The experimental fishes recorded the value of exponent ‘n’ in the range of 3.37 to 3.57, coefficient of correlation ‘r’ in the range of 0.9938 to 0.9987 and coefficient of determination ‘r_2’ from 0.9876 to 0.9974. The Condition Factor ‘K’ from 1.94 to 2.0 of experimental fishes indicated the wellbeing and good condition of fishes.

EI-Ebiary (1998) reported that poultry manure the ponds with supplementary feeding possessed the highest growth performance and production parameters as well as survival rate compared with those using supplementary feeding with or without cow manure Whereas the application of Buffalo manure can enhance a fish production up to minimum three-folds compared to the control ponds (Ghanim *et al*., 2015).

Additions of phosphorus in ponds usually provide a much greater increase in fish production than from either nitrogen or potassium. However, nitrogen in combination with phosphorus is sometimes better than phosphorus added alone **(**Chappell, 2008). Inorganic fertilizers (Nitrophos) treated pond showed 4.97 times greater net fish production as compared to that of control pond , applied at the rate of 0.2g N/100g fish body weight of major carp (Asghar, 2001).

A study was carried out on the optimal dose of inorganic fertilizer used in carp polyculture system over a period of 10 months. Three treatments were assigned: without inorganic fertilizer, with the application of 100 kg/ha/month inorganic fertilizer and 150 kg/ha/month inorganic fertilizer as T1, T2 and T3, respectively. Each treatment had three replications. The average water area of the experimental ponds was 0.11± 0.01 ha and average depth of water in all ponds was 1.26 m. The treatments showed no effect on water temperature, dissolved oxygen, alkalinity and pH. The fish production was significantly higher ($P>0.05$) in both the treatments T2 and T3 than that of T1 where no inorganic fertilizer was used. But there was no significant difference between T2 and T3 and T2 was with lower dose inorganic fertilizer (100 kg/ha/month) than T3. Therefore, 100 kg/ha/month inorganic fertilizers may be suggested in carp polyculture system for better production (Sayeed *et al*., 2007).

Ammonium sulphate and superphosphate applied once every 2–3 weeks at 60 kg/ha, manure application 6 days/week, at a daily dry organic matter loading rate equivalent to about 3 % of the fish biomass (field dry chicken manure at a rate of 100 kg organic matter/ha/day) in Israel and the fish yield was 1-5 kg/ha/day in control pond, 10-15 kg/ha/day in chemically fertilized pond and maximum 32 kg/ha/day in chemical fertilizer plus organic manure pond (Schroeder, 1980).

The effect of weekly applications of similar quantities of nitrogen and phosphorus from three different sources on the production of *Oreochromis niloticus* (10,000/ha) was studied in 0.1-ha earthen ponds. Layer chicken litter (500 kg total solids /ha), dairy cow manure (1020 kg TS/ha) and chemical fertilizer (46-0-0 at 30.6 kg/ha and 0-46-0 at 62.6 kg/ha) were applied weekly. Mean total net production after 150 days was greater with chicken litter (1,759 kg/ha) as reported by Green *et al*. (1989). In Thailand, chicken manure applied weekly at 200-250 kg dry weight/ha together with urea and triple super phosphate (TSP) at 28 kg N and 7 kg P/ha/week, respectively, produced a net harvest of 3.4- 4.5 ton/ha in 150 days at a stocking density of 3 fish/m^2 or an extrapolated net annual yield of 8- 11 ton/ha. In Honduras where there is sufficient dissolved phosphorus in the culture water, weekly application of chicken manure at 750 kg dry matter/ha and urea at 14.1 kg N/ha yielded 3.7 ton of tilapia/ha when stocked at 2 fish/m^2. Grow-out tilapia ponds in Indonesia are fertilized with urea, TSP, and manure at 2.5 g/m^2/week, 1.25 g/m^2/week and 250 kg/month, respectively, together with a feeding regime of commercial tilapia feeds (Ng and Leger, 2016).

The effect of chicken manure and inorganic fertilizer (single super phosphate and urea) on growth performance viz. increase in body weight, length, specific growth rate (SGR), condition factor (CF), survival rate and proximate composition of *Cyprinus carpio*. Experimental water in tubs was treated in duplicates with low (PT_1) @ 8,000 kg/ha/yr , medium (PT_2) @10,000 kg/ha/yr and high (PT_3) @12,000 kg/ha/yr doses of chicken manure and also with low, medium and high dose of inorganic fertilizer(urea + SSP) @ 104 kg/ha/yr + 155 kg/ha/yr (IT_1), @218 kg/ha yr + 310 kg/ha/yr (IT_2) and 322 kg/ha/yr +470 kg/ha/yr (IT3) respectively, along with control. At the end of the experiment, *C. carpio* showed maximum growth in PT_2, with significant higher SGR and CF. Survival rate ranged between 93.3 to 100 % in all the treatments (kour *et al*., 2016).

Carp polyculture can be utilized using huge amount of organic wastes such as cowdung or poultry droppings and production levels of 1-3 ton/ha/year can be obtained with application of both organic and inorganic fertilizers alone. Provision of feed enhances the fish production significantly and production levels of 4-8 ton/ha/yr are obtained using a judicious combination of both the feed and fertilizers.(Mixph, 2013).

The abundance of phytoplankton and zooplankton is responsible for the determination of colour of an aquatic body and green, bluish green/ brown greenish colour of water indicates good plankton population hence, well for fish health (Delince, 1992). The study indicated that higher phytoplankton abundance are attained with DAP fertilized tanks and zooplankton diversity were higher in chicken manure applied tanks. Therefore, it is recommended that for better growth and survival in aquaculture practices, catfish fry should be raised in DAP or chicken manure fertilized tanks at low stocking density (Mosha *et al*., 2016).

Common carp is essentially a cold water fishes but being very hardy, it easily adapts itself to warm water condition at the tropics. It can be cultivated up to 1000 m altitude but growth is retarded below 150 m and above 600 m. The optimal water temperature ranges between 20°c and 25°c and under the favorable condition growth rate is 2.5 – 5cm/month (Pandey, 1998). The daily growth of Common Carp can be 2-4% of the body weight. It grows well to about 76 cm length and weight of about 6.5 kg. It attains the weight of 1kg at the end of 1st years and near about 2kg at the end of 2nd year (Shah, 2012). It spawns generally in confined waters of ponds in the spring when water temperature rises above 18°C. Under normal conditions, a typical female (about 45 cm) may produce 300,000 eggs, with some estimates as high as one million over the breeding season. A healthy female may yield ripe eggs to the extent of about 20% of its own body weight. The eggs measures 0.9 to 1.6 mm in diameter (Sinha, 1993). The growth and activities of the fish depends on its body temperature which varies according to the water temperature. A relatively low water temperature affect adversely. It slow down the development of their eggs, growth of juveniles and older fish, delays and even prevents their maturation and spawning. Food intake is decreased and in turn increases their susceptibility to infections and diseases (Coche *et al*., 1996).

Nutritional requirements for growth, reproduction and normal physiology are similar to the requirements of other domesticated animals. However, fish mainly differ from other animals in their demand for proteins, so usually they are fed with 25 to 45% of raw proteins (Tiwari *et al.,* 2006). The daily requirement of Common Carp for protein is about 1 g/kg body weight for maintenance and 12 g/kg body weight for maximum protein retention. The efficiency of nitrogen utilization for growth is highest with a protein intake of 7 to 8 g/kg body weight/day. Crude protein levels ranging from 30 to 38 % appear to satisfy the fish optimally (Watanabe, 1982). It can effectively utilize both lipids and carbohydrates as dietary energy sources. The enrichment of the digestible energy content from 13 to 15 MJ/kg diet by addition of lipid at levels of 5%–15% to diets did not result in higher growth rate or improved net protein utilization (Takeuchi *et al*., 1979a). Increasing dietary lipid seems to increase its body deposition. From the essential fatty acids, it requires both Omega-6 (n-6) and Omega-3 (n-3) fatty acids. Supply of 1% of each of these fatty acids leads to best growth and feed efficiency in juvenile Common Carp (Takeuchi and Watanabe, 1977).

Amylase activity in the digestive tract and the digestibility of starch in fish are generally lower than those of terrestrial animals. It being omnivorous has an intestinal activity of amylase that is higher than in carnivorous fish. It was found that the ratio of intestinal length to body length in carp is 1.8–2.0, i.e. four times greater than that of Rainbow Trout (*Oncorhynchus mykiss*) and Japanese Eel (*Anguilla japonica*). This accounts for the better utilization of carbohydrates by Common Carp. The optimum range of dietary carbohydrate may be considered to be 30–40 % for Common Carp, as proved by many studies in this field (FAO, 2017). The dietary requirements for folic acid and vitamins B_{12}, D and K have not been determined, but it is supposed that some of these vitamins can be synthesized by the intestinal microflora in Common Carp, as in other freshwater fish (Lovell and Limsuwan, 1982; Hepher, 1988).

The vitamin requirements of Common Carp are affected by various factors, such as size of fish, water temperature and diet composition. For example, fingerling or adult Common Carp do not require vitamin C because they can synthesize ascorbic acid from D-glucose. The vitamin E requirement may increase corresponding to the level of polyunsaturated fatty acids in the diet. Common Carp requires cobalt, copper, iron, magnesium, manganese, phosphorus and zinc. Common Carp lacks an acid-secreting stomach essential for digesting and to dissolve various compounds containing both calcium and phosphorus. It was also reported by Ohta and Watanabe (1996), that the digestible energy requirements for maximum growth were 285, 548 and 721 kJ/kg body weight/day (at feeding rates of 1.83%, 3.60% and 5.17 % of body weight/day, respectively.

The unique method of feeding employed by common carp has important ecological implications. The feeding of carp has been shown to decimate macrophytes and decreases overall water quality (Drenner *et al*., 1997). Carp tend to reduce macrophyte biomass in three ways- 1) Bioturbation- Carp often uproot aquatic macrophytes when feeding, 2) Direct consumption- Carp have been known to feed on tubers and young shoots, 3) Indirectly by increasing turbidity which in turn limits the available sunlight (Lougheed *et al*., 1997, Fletcher *et al*., 1985). Carp have been shown to decrease water quality by increasing turbidity and increasing the amount of nutrients in the water column (Lamarra, 1975; Brabrand *et a*l., 1990). Carp increase turbidity directly by resuspending sediments and indirectly by increasing nutrients and thus increasing phytoplankton in the water column. Carp increase nutrients in the water column in two ways- A minimal amount of nutrients are introduced into the water column directly by sediment resuspension but the majority of carp introduced nutrients are acquired by excretion (Lamarra, 1975; Brabrand *et al*., 1990; Rahman, 2005). Carp act as "nutrient pumps" when they consume the nutrient rich benthic sediments and then excrete those nutrients back into the water column in a form that is available to other organisms (Drenner *et al*., 1996). This tendency to cause a general decay in water quality and the high fecundity of the carp has caused them to be generally regarded as a nuisance (McCrimmon 1968; Page *et al*., 1991; Smith 1991).

The physico-chemical characteristics of both soil and water changes with the introduction of fish species, provision of supplementary feeds, manures and fertilizers and other inputs. Both the soil and water qualities parameters of pond ecosystem undergo complex changes due to all these factors, as a sequence disrupting the aquatic life in pond (Ali *et al*., 2006). According, to Delince (1992) 30-35°C is tolerable to fish. Bhatnagar *et al*., (2004) suggested the levels of temperature as 28-32°C good for tropical major carps and less than 12°C is lethal but good for cold water species. Temperature less than 20°C is sub lethal for growth and survival for fishes and greater than 35°C is lethal to maximum number of fish species. According to Santhosh and Singh (2007) suitable water temperature for carp culture is between 24°C and 30°C.

Water ranging in pH from 6.5 to 8.5 at sunrise are generally the most suitable for pond fish production and most cultured fish will die in water pH below 4.5 and pH equal to or greater than 11 (Coche *et al*., 1996). Fish have an average blood pH of 7.4 but 7.0 to 8.5 is more optimum and conducive to fish life. Fishes can become stressed in water with a pH ranging from 4.0 to 6.5 and 9.0 to 11.0 and death is almost certain at a pH of less than 4.0 or greater than 11.0 (Ekubo and Abowei, 2011). According to Santhosh and Singh

(2007) the suitable pH range is 6.7 - 9.5 for fish culture. Ideally, an aquaculture pond should have a pH between 6.5 and 9 (Wurts and Durborow, 1992: Bhatnagar *et al*., 2004).

Mineral and humic turbidity reduce the amount of light penetration in the water and high mineral turbidity can affect fish directly by injuring their breathing organs, reducing their growth rates or preventing their reproduction. Secchi disc transparency is less than 40 cm, there is too much plankton and fish are in danger at night. Transparency between 40 cm to 60 cm the fish production will be the best and over 60 cm, there is too little plankton, and fish do not have enough natural food to eat (Coche *et al*., 1996). Clay turbidity 30 cm or less may prevent development of plankton blooms and 30 to 60 cm generally adequate for good fish production (Boyd and Lichtkoppler, 1979). There is an increase in the frequency of dissolved oxygen problems when values above 60 cm, as light penetrates to greater depths encourage underwater macrophyte growth, and so there is less plankton to serve as food for fish. According to Bhatnagar *et al*., (2004) turbidity range from 30-80 cm is good for fish health and 15-40 cm is good for intensive culture system and less than 12 cm causes stress. According to Santhosh and Singh (2007) the Secchi disc transparency between 30 and 40 cm indicates optimum productivity of a pond for good fish culture.

The oxygen requirements of fish are determined by three basic factors- fish species, size of the fish and water temperature (Coche *et al*., 1996). The solubility decreases with factors like- increase in temperature, increase in salinity, low atmospheric pressure, high humidity, high concentration of submerged plants, plankton blooms (Bhatnagar and Garg, 2000).

Banerjee (1967) reported DO above 5.0 ppm in ponds is productive but high concentration of DO may lead to a state of super saturation sometimes becomes lethal to fish fry during the rearing of spawn in nursery ponds. Tropical fishes have more tolerance to low DO than temperate fishes. In contrast, Bhatnagar *et al*., (2004) and Bhatnagar and Singh (2010) reported that DO level greater than 5ppm is essential to support good fish production. Bhatnagar *et al.,* (2004) also suggested that 1-3 ppm has sublethal effect on growth and feed utilization while 0.3-0.8 ppm is lethal to fishes. DO greater than 14 ppm is lethal to fish fry, and gas bubble disease may occurs. DO less than one ppm leads to death of Fish and in less than five ppm though the fish survives but its growth is slow. 5 ppm and above is considered to be ideal for fish. According to Santhosh and Singh (2007) catfishes and other air breathing fishes can survive in low oxygen concentration of 4 mg/l. Ekubo and Abowei (2011) recommended that fish can die if exposed to less than 0.3 mg/l of DO for a long period of time and 5.0 mg/l to be adequate in fishponds.

3. MATERIALS AND METHODS

3.1 Study period

The experiment was conducted in four private earthen ponds at Parbaha, Aurahi gaupalika 2, Dhanusha district, from 14 March - 14 July, 2016 (1 Chaitra, 2072 to 30 Ashad, 2073). The raising period of Common carp was 90 days but the cages were set up 30 days prior to stocking.

3.2 Study area

The experiment was carried out in four private ponds (pond A, pond B, Pond C and Pond D) located at Parbaha, Aurahi gaupalika 2, Dhanusha district of Nepal, at 26 41 15 N latitudes and 86 0 0 E longitudes. They are situated on the northern side of Hulaki Road as well as 500 m away from Railway line and about 5 Km away from India boarder. It lies 8 Km far away from Janakpur in the south-east. Janakpur is one of the most popular cities in Nepal, located in the Terai region. It is the headquarters of the Dhanusha district and is located at a distance of 135 kilometers from Nepal's capital, Kathmandu. The city has a rich historical and cultural background and also known as Janakpurdham by the local people.

Figure 1. Study area (Source- https://www.google.com/maps/d/u/0/viewer?ll).

The ponds are lies in the T-shape whereas pond A, B and D lies in columns. Pond A lies behind the northern side of Hulaki Sadak (one of the oldest road of Nepal) whose water occupying area is 12 kattha. Pond B lies 50 m away from pond A in the northern side whose water occupying area is 10 kattha. Pond C lies in the eastern side of pond B about 30 m whose water occupying area is 7 kattha and pond D which is situated 100 m away in the northern side of pond B whose water occupying area is 9 kattha.

3.3 Pond selection

The ponds were selected by randomly for each four treatments. Pond A was selected for organic fertilizer treatment as Broiler litter. Pond B was selected for control pond. Pond C was selected for combined fertilizing (Broiler litter and DAP) and Pond D was selected for inorganic fertilizing as DAP (Figure 1).

3.4 Cage setting

Cages were made up of Polyester cloth. The number of cages was twelve with the dimension of 1m length, 1m breadth and 1m height in which 15.24 cm (6 inch) of height was held above water surface. The cages were made of Polyester which was kept in water, above the ground about 15cm and all eight ends of each cages were tied with separate poles in pond. Cages were covered with mosquito net to prevent from predators and escaping. Three replication of each treatment were used in four separates pond (PLATE I, Photos 1, 2, 3, and 4).

3.5 Fertilizing the cage

The Cages were setup in the early morning on 14 March 2016. The three cages were fixed in each four ponds (Pond A, Pond B, Pond C, and Pond D) for each four treatment in experimental ponds. Before starting the experiment, cages were prepared which involved removal of aquatic weeds and undesirable biota. Aquatic weeds were removed manually then each ponds were treated with agriculture lime on 15^{th} March at the rate of 150-200 kg/hector to kill unwanted organism and to increase the pH of the water, so at the rate of 19 g/cage CaCO3 was used (PLATE II, Photo 9). The cages were first fertilized on 25 March after 10 days of liming. The cages of Pond A were fertilized with Broiler Litter (5.0 g/m^2) weekly (PLATE II, Photo 7). The cages of Pond B were considered as a control so no fertilizer was used. The cage of Pond C was fertilized with both fertilizers i.e. Broiler litter (5.0 g/m^2) weekly and inorganic fertilizers Di-ammonium phosphate (5.0 g/m^2) biweekly. The cages of Pond D were fertilized with Diammonium phosphate (5.0 g/m^2) biweekly (PLATE II, Photo 8). The cages were fertilized with organic or inorganic fertilizers when at least one of the following conditions was maintained (appendix 3 and 4).

3.6 Experimental fertilizers composition

The component of Broiler litter shows following breakdown such as dropping, bedding materials, wasted feed, feathers, foreign matter and the average value are 62%, 31%, 3%, 2%, 2% respectively. The composition of 100 kg dropping of chickens are moisture (56 kg), organic matter (26 kg), nitrogen (1.6 kg), P_2O_5 (1.5 kg), K_2O (0.9 kg), calcium (2.4 kg), others (3.5 kg). The different nutrient composition of Broiler litter (appendix 1).

Di-ammonium phosphate (DAP) is nitrogenous fertilizers which contains nitrogen as pure N (18-21) % which is highly soluble in water (PLATE II, Photo 8) and phosphorus P, as the equivalent in phosphoric acid P_2O_5 is (48-52) % or P_1 (21.1-22.9) %, (where P_1 to be multiplied by 2.29 to obtain P_2O_5 equivalence). Potassium is absent in DAP (Coche *et al.*, 1996).

3.7 Experimental fish

The fry of Scales Carp (*Cyprinus carpio communis*), with rather small scales completely covering the body was selected for experiment. They were stocked with an average initial length of 1.65 cm and an average initial total weight was 0.09 g for all treatments.They were supplied from Fishery Development and Training Centre Janakpur. On 25 Chaitra 2072, bill no. 3612 about 200 fry were brought at the rate of 250 rupees per 1000 fry (PLATE II, Photo10). It cost 50 rupees for the fry and 30 rupees for double packing plastic bag (PLATE II, Photo 5).

3.8 Measurement and stocking density

When the fry were brought from Fishery Development and Training Centre Janakpur, it was left in shade to rest for twenty minute (PLATE II, Photo 6) and in water thirty minute then the fry was released from plastic bag left in pond. The fry were released in extra cage on 20th March from plastic bag. The measurement of length and weight was first taken on 5th April and then fry were kept in experimental cages. The number of fry per cage were seven, all together for one treatment, the total number of fry were 21. There were three cages for each of the four triplicate treatments. The remaining fry were left in extra cage for emergency uses.

3.9 Analytical methods

3.9.1 Growth Response of Fish

Growth performance of experimental fish was evaluated biweekly by measuring length (PLATE III, Photo 11, 12 and 13) and weight (PLATE III, Photo 14, 15 and 16).

A. Percent weight gained (%/fish)

$$\mathbf{PWG} = \frac{\textbf{mean final weight} \quad \textbf{mean initial weight}}{\textbf{mean initial fish weight}} \times \mathbf{100}$$

B. Daily weight gain (g/fish/day)

$$\mathbf{DWG} = \frac{\textbf{mean final weight} \quad \textbf{mean initial weight}}{\textbf{days}}$$

C. Specific Growth Rate (%/Day)

$$\mathbf{SGR} = \frac{\textbf{logewt} \quad \textbf{logew0}}{\mathbf{t}} \times \mathbf{100}$$

Where wt is the final weight of the fish, w0 is the initial weight of fish and t is raising days. This gives the average percentage increase in body weight per day over any time interval (Dheke, 2013).

3.9.2 Length and Weight Relationship

A. The growth of the fishes was calculated by using the formula of condition factor which is given by Fulton (1904). Length is not only the component of Common Carp's size because increase in length is almost invariably accompanied by increase in weight.

$$\mathbf{K = \frac{W}{L^3} \times 100}$$

Where,
K= Fulton's condition factor
W= Weight of fish in gram
L= Length (usually total length) in centimeter

This formula has given rise to an indicator of a physical well-being (condition or 'k' factor) which although not applicable to fry, provides a useful guide for older Parr and matured fish. If weight and length can be measured, both figures inserted into the formula then the resulting figure greater than 1 indicates a fish in better than average condition while a figures of less than 1 suggest otherwise (Sharma, 2001). A scaling factor is usually applied to bring the factor close to 1 (Froese, 2006).

B. The relationship between weight and length of Common Carp was calculated by using Co-efficient of correlation formula given by Karl Pearson (Gupta, 1988).

Coefficient of correlation (r) = $$\frac{N.\Sigma XY - \Sigma X.\Sigma Y}{\sqrt{(N.\Sigma X^2) - (\Sigma X^2)(N.\Sigma Y^2) - (\Sigma Y^2)}}$$

Probability error (P.E.) = $$\frac{1 - r^2}{\sqrt{N}} \times 0.6745$$

Where,
r = Coefficient of correlation
x= Deviations of various items of first variable
X = Average of deviation of various items of first variable i. e. of x
Y= Corresponding deviation of second variable i. e. of y
N= Number of variable

3.9.3 Productions-

It would expressed in term of kg/ha/year (Hossain *et al.*, 2008)

Production (P) = No. of Fish harvested × average final weight

3.9.4 Survival Rate (%)-

$$\mathbf{SR = \frac{No.\,fo\ fish\ harvested}{No.\,of\ Fish\ stocked} \times 100}$$

3.10 Water Quality Analysis

Physical and chemical parameter was observed in the field from 6 AM to 6 PM and parameters were analyzed using the standard methods given by Trivedy and Goyal (1984). The temperature, alkalinity, turbidity, dissolved oxygen are four water characteristics that are of particular importance for fish pond management (Coche *et al.*, 1996).

3.10.1 Physical Parameters

The physico-chemical factors like temperature, light, depth, turbidity, carbondioxide, oxygen, pH, alkalinity, hardness, calcium etc. of the pond water are important from the view of planktonic production, which in turn is directly related to fish production. The four water characteristics- temperature, turbidity, oxygen and alkalinity are of particular importance for fish pond management (Coche *et al.*, 1996) which was investigated in the present study.

Temperature

The temperature was recorded with the help of alcoholic thermometer ranging from -10°C to 110°C. It was taken three times. The surface temperature was taken by dipping thermometer bulb several centimeters into the water. Bottom temperature was not considered because the cases were not deeper than one meter (PLATE IV, Photo 21).

Transparency

Transparency was measured with the help of Secchi disc. It was measured at noon. It was marked at two points where it disappeared as and where it appeared. The mean value of these two points gave actual transparency (PLATE IV, Photos 17 and 18).

3.10.2 Chemical Parameters

pH (Hydrogen ion concentration)

The pH of water was measured on the field by pH meter scale (HANNA instruments HI 9025 pH meter kit). It was measured at early in the morning. The water sample was collected in a beaker then the pointer of pH meter was dipped into the water for two minutes and reading was recorded (PLATE IV, 19).

Dissolved Oxygen (DO)

The dissolved oxygen was determined by Winkler's method precaution given by Boyd (1979) were followed. Water samples were collected in 300 ml BOD bottle, avoiding any kind of bubbling and trapping of air bubbles placing the stopper to the collected sample (PLATE IV, Photo 20). About 2 ml of $MnSO_4$ solution was released in water with pipette at the bottom which resulted white precipitation, due to presence of dissolve oxygen and then 2 ml of potassium iodide was added. Then the sample was shaken several times upside down and the brown precipitate was allowed to settle. After few minutes, 2 ml of concentrated H_2SO_4 was added to dissolve the precipitate. The starch indicator was added in the sample which turned into blue. Then 50 ml of sample was taken in conical flask and titrated with sodium thio-sulphate ($Na_2S_2O_3$) till the blue colour disappears. The total amount of titrant used in the process was noted and the final calculations were made by following formula.

DO mg/l = Used volume of titrant (ml) × 8 × 0.025 ×1000) ÷ V (V_1 –V_2) ÷V1

Where,V = Volume of sample titrated, V_1 = Volume of BOD bottle, V_2 = Volume of fixative (KI + $MnSO_4$), 8 is the molecular weight of Oxygen and 0.025 N is normality of sodium thio-sulphate.

3.11 Statistical Analysis

Statistical analysis was carried out to evaluate growth rate of Common Carp's fingerling on fertilizing the pond with organic fertilizers as broiler litter and inorganic fertilizers as DAP fertilizer. The length- weight relationship of fingerlings was calculated by using the formula of condition factor (Fulton,1904) and the analysis of covariation between weight and length of Common Carp was calculated by using Co-efficient of correlation formula given by Karl Pearson (Gupta, 1988).

4. RESULTS

4.1 Fish Growth

4.1.1 Mean Weight Gain (MWG)

The fry of average weight (0.09 g) were stocked in each of replicated pond A, pond B, pond C and pond D at the stocking day of the experiment. The raising days were of 90 days in which mean final weight of pond A, pond B, pond C and pond D were 3.6 g, 2.4 g, 19.0 g and 2.53 g respectively. The MWG of Pond A, Pond B, Pond C and Pond D were 2.15 g, 1.25 g, 6.04 g and 1.77 g respectively.

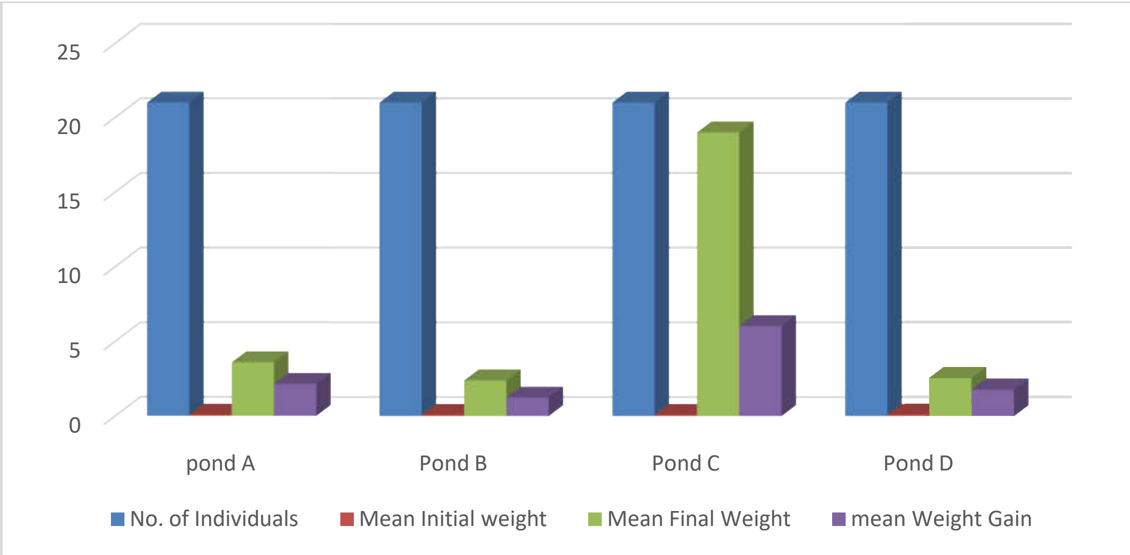

Figure 2: Mean weight gain in all experimental ponds.

4.1.2 Mean Body Length (MBL)

The mean initial length of fry at the stocking day of pond A, pond B, pond C and pond D were 1.7 cm, 1.68 cm, 1.6 cm and1.63 cm respectively. The mean final length of pond A, pond B, pond C and pond D were 6.43 cm, 6.01 cm, 7.8 cm, 5.70 cm and mean length gain after raising days of pond A, pond B, pond C and pond D were 4.86 cm, 3.92 cm, 5.76 cm and 4.55 cm respectively.

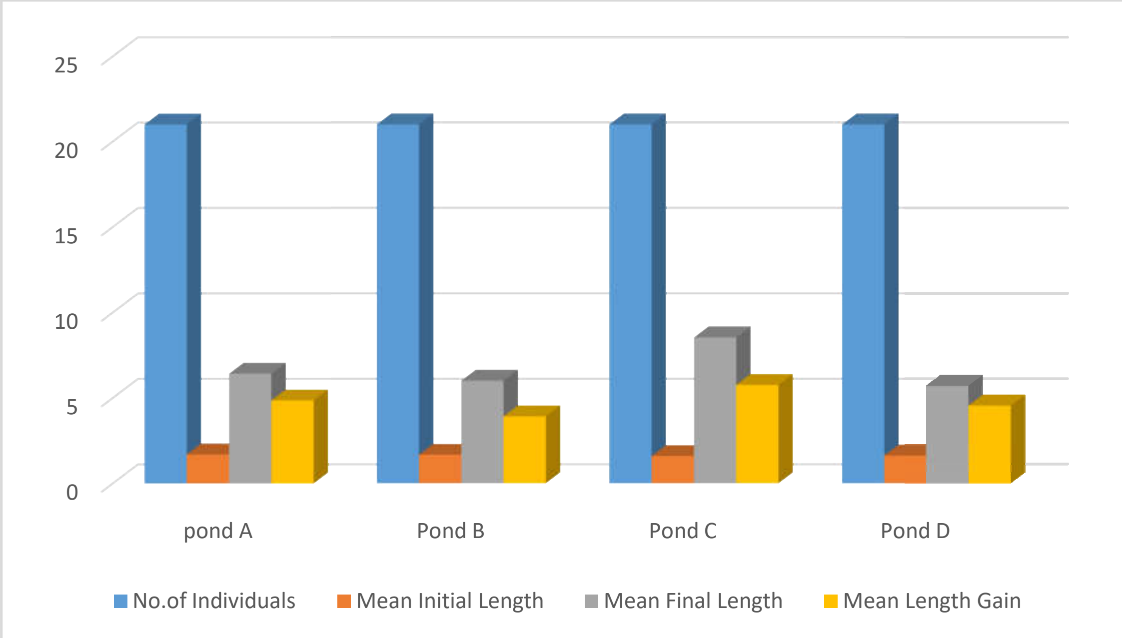

Figure 3: Mean body length of raising period.

4.1.3 Specific Growth Rate (SGR)

Highest specific growth rate (SGR) was found in replicated cage of pond C which was fertilized with both fertilizers broiler excreta and DAP in the 1:1 ratio, was 2.58 %/day/fish. SGR of pond A was 1.78 %/day /fish, which were fertilized with broiler excreta. SGR of pond D was 1.60 %/day/fish, fertilized with DAP quarterly. The lowest SGR was found in the cages of pond B (Control cages) was 1.58 %/day/fish.

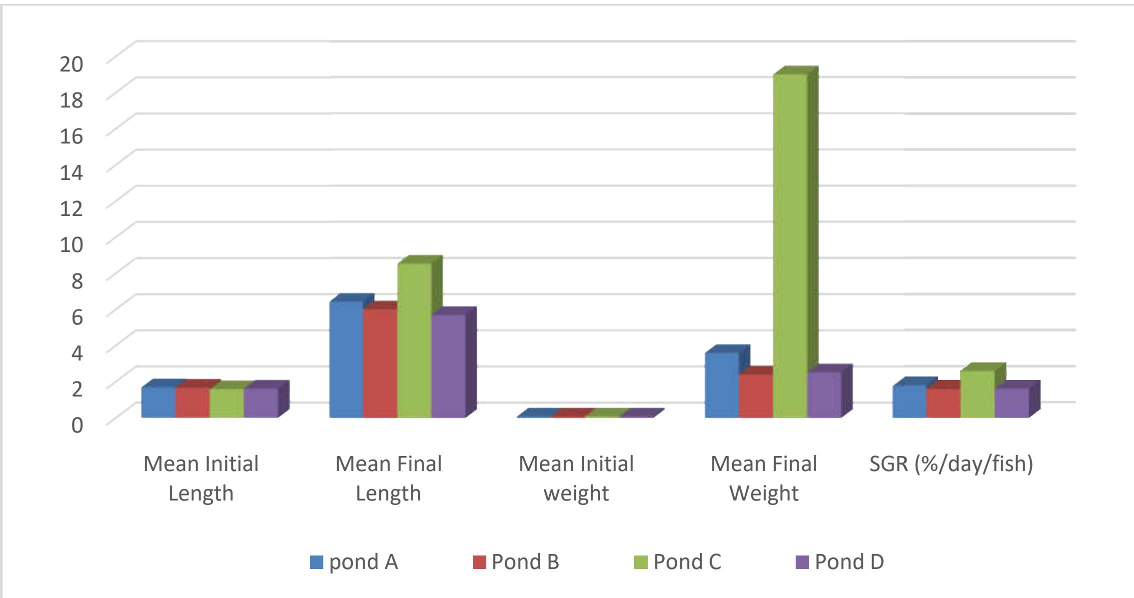

Figure 4: Specific growth rate of common Carp.

4.1.4 Percentage of weight Gain (PWG)

The PWG was found highest in replicated cage of pond C (21011 %/fish) which were fertilized with both fertilizers broiler excreta and DAP in the 1:1 ratio. The PWG was found to be 3900 %/fish in the replicated cage of pond A, were fertilized with broiler excreta weekly. The PWG was found to be 2711 %/fish in the replicated cage of pond D, were fertilized with fertilized with DAP quarterly and lowest PWG was found in replicated cage of pond B (2566 %/fish) which was Control Pond.

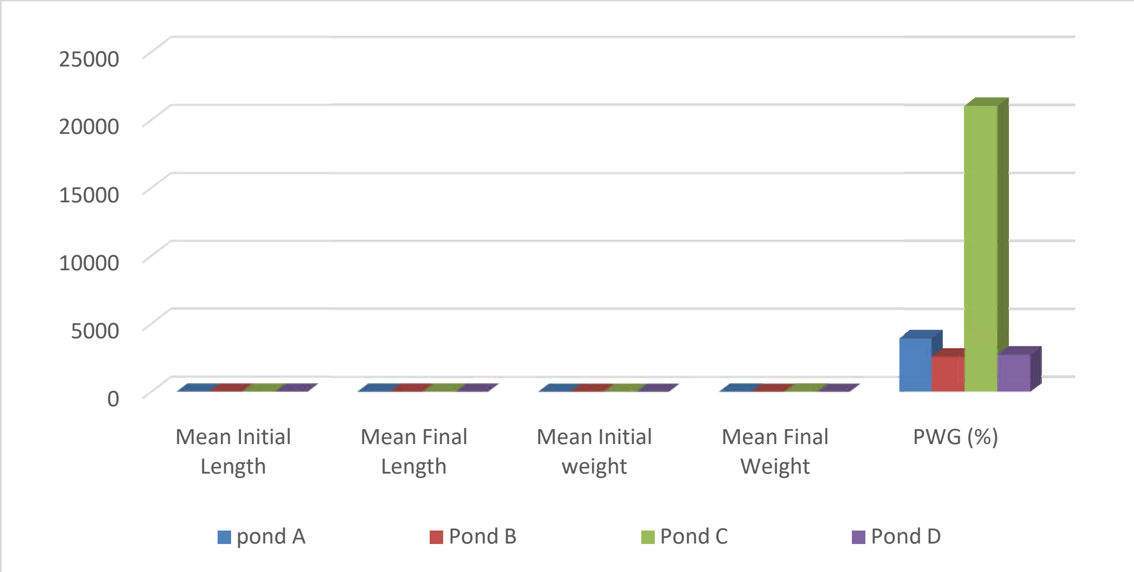

Figure 5: Percentage of weight Gain of common Carp

4.1.5 Daily Weight Gain (DWG)

The DWG was found highest in replicated cage of pond C (0.210 g/fish/day) which was fertilized with both fertilizers broiler excreta and DAP in the 1:1 ratio. The DWG was found to be 0.039 g/fish/day in the replicated cage of pond A, were fertilized with broiler excreta weekly. The DWG was found to be 0.027 g/fish/day in the replicated cage of pond D, were fertilized with fertilized with DAP quarterly and lowest DWG was found in replicated cage of pond B (0.025 g/fish/day) which was Control Pond.

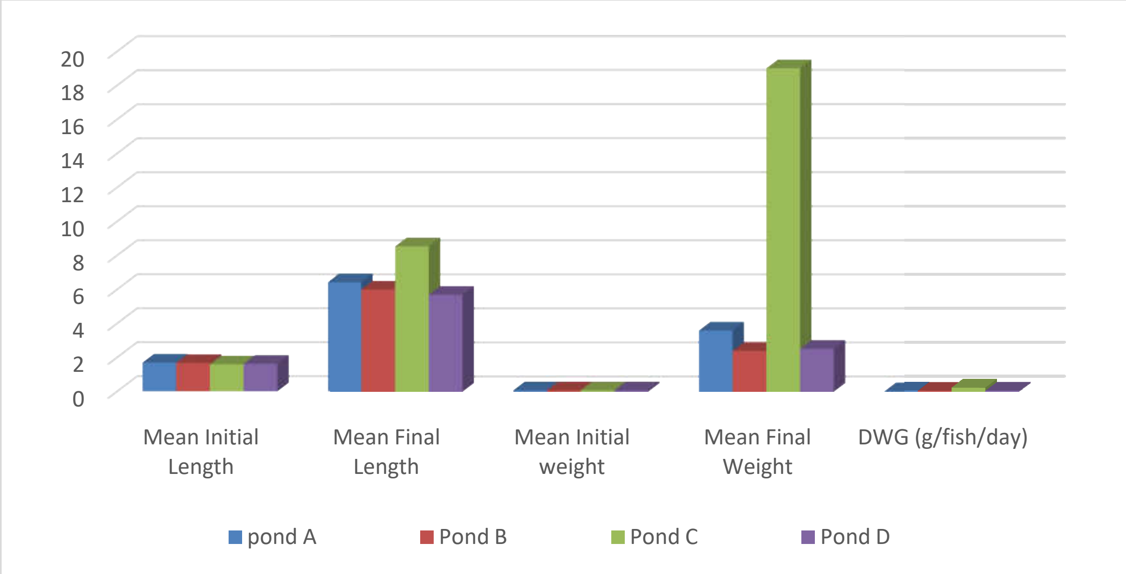

Figure 6: Daily Weight Gain of Common Carp.

4.1.6 Condition Factor (K)

The Condition Factor (K) which was not applicable to fry, provides a useful guide for older Parr and matured fish. Therefore, Condition Factor of final measurement was mention. The Condition Factor of pond A, pond B, pond C and pond D were 1.35, 1.10, 3.05 and 1.36 respectively.

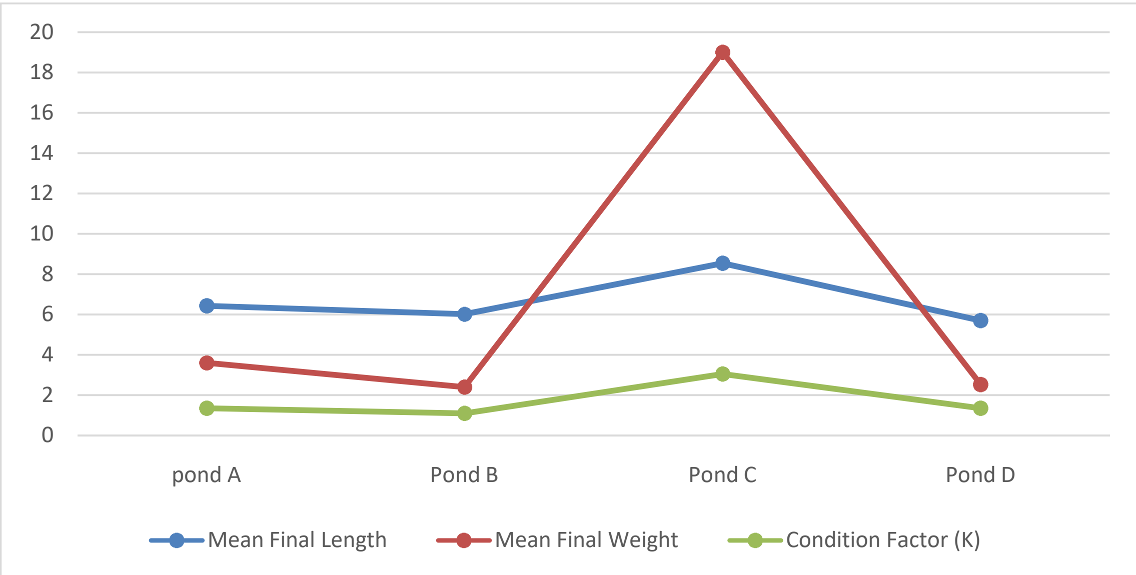

Figure 7: Condition Factor of common Carp.

4.1.7 Correlation Coefficient (r)

The Correlation Coefficient (r) between length and weight of pond A was 0.96 that implies strong positive relationship and (r>6P.Er) i.e. significant. The Correlation Coefficient (r) of pond B was 0.99 that implies strong positive relationship and significant The Correlation Coefficient (r) of pond C was 0.82 that implies strong positive relationship and significant. The Correlation Coefficient (r) of pond D was 0.98 that implies strong positive relationship and significant.

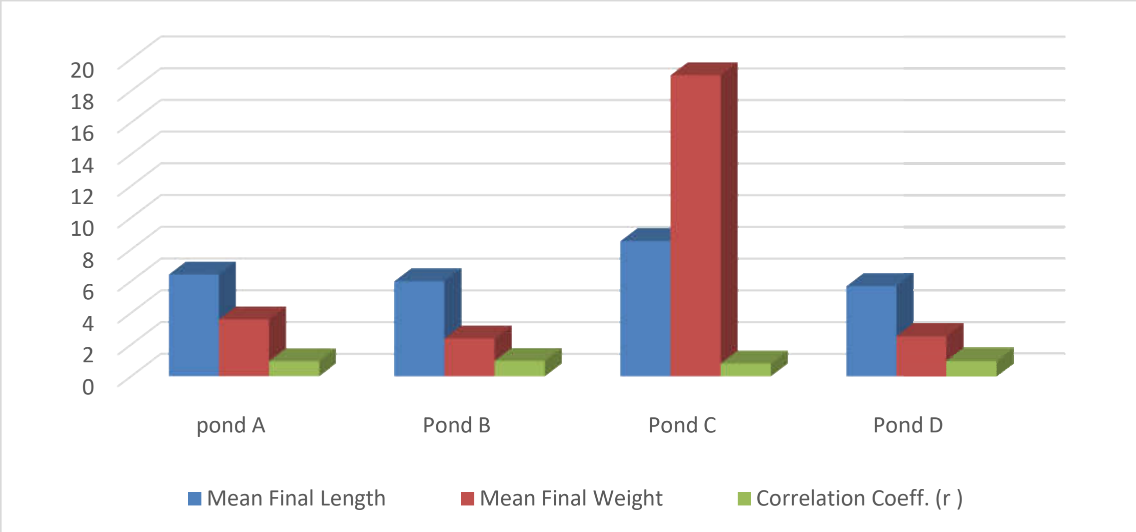

Figure 8: Correlation coefficient of Common carp of different ponds

4.1.8 Productions

The production of raising days of pond A, Pond B, Pond C and pond D were 54 g, 36 g, 285 g and 37.95 g respectively. Total production in kg/h/year of pond A, Pond B, Pond C and pond D were 741.62, 494.41, 3914.10 and 521.193 respectively.

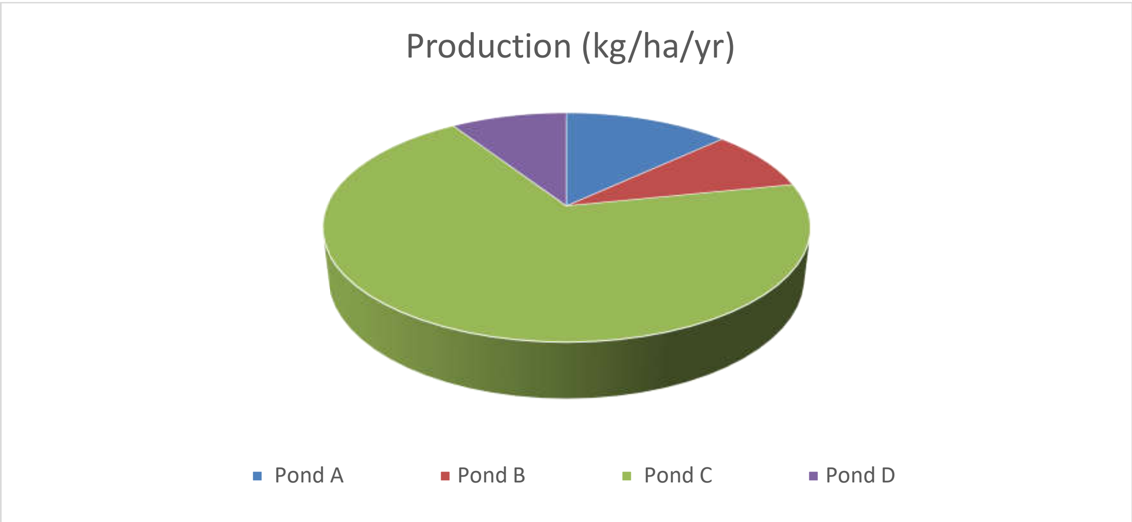

Figure 9: Production of Common Carp at various treatments.

4.1.9 Survival Rate (SR)

The survival rate of fishes of Pond A, Pond B, Pond C and Pond D were 71.42%

Table 1. Growth response of Common Carp during raising period.

Growth Response	Pond A	Pond B	Pond C	Pond D
Mean Initial Weight (g/fish)	0.09	0.09	0.09	0.09
Mean Final Weight (g/fish)	3.6	2.4	19	2.53
Mean Initial Length (cm/fish)	1.7	1.68	1.6	1.63
Mean Final Length (cm/fish)	6.43	6.01	8.54	5.7
Specific Growth Rate(%/day/fish)	1.78	1.58	2.58	1.6
Percent Weight Gain (%/fish)	3900	2566	21011	2711
Daily Weight Gain (g/fish/day)	0.039	0.025	0.21	0.027
Condition Factor (K)	1.35	1.1	3.05	1.36
Correlation Coefficient (r)	0.96	0.99	0.82	0.98
Total Weight (g)	54	36	285	38
Production (Kg/ha/year)	741.61	494.41	3914.1	521.19

4.2 Water Quality Parameters

The mean water quality parameters, as temperature of pond A, Pond B, Pond C and Pond D were 23.3°C, 23.5°C, 23°C and 23.2°C respectively. Transparency of Pond A, Pond B, Pond C and Pond D were 33.35 cm, 57.5 cm, 20.5 cm and 25.5 cm respectively. pH of Pond A, Pond B, Pond C and Pond D were 7.02, 8.35, 6.25 and 7.30 respectively. Dissolved Oxygen of Pond A, Pond B, Pond C and Pond D were 4.94 mg/l, 5.20 mg/l, 4.6 mg/l and 5.02 mg/l respectively (appendix 9).

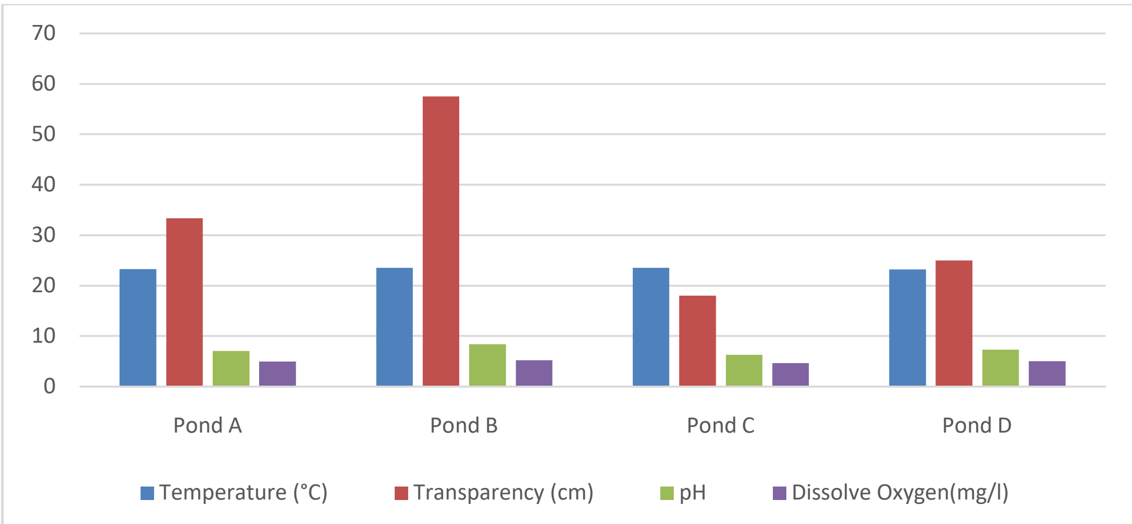

Figure 9: Mean water quality parameters of experimental ponds of raising days.

5. DISCUSSION

The study of length-weight relationship is of great importance in fishery science, as it assists in understanding the general well-being and growth patterns in a fish population. Basheer *et al*. (1993) opined that length- weight relationship of fish varies depending upon the condition of life in aquatic environment. In the present study, it was seen that the fishes that were given both fertilizers i.e. broiler excreta and DAP showed the highest growth in body length and weight. Inorganic fertilizer adds nitrogen in its different forms which helps the phytoplankton to bloom (Bhatnagar and Garg, 2000).

Highest specific growth rate (SGR) was 2.58 % /day/fish which was fertilized with both fertilizers broiler excreta and DAP in the 1:1 ratio (pond C). SGR of pond D was 1.60 % /day/fish, fertilized with DAP quarterly and 1.78% pond A, cages which was fertilized only with broiler litter weekly (14 week). The lowest SGR was found in the cages of pond B (control cages) was 1.58 % /day/fish. Highest specific growth rate (0.26 %/day) was recorded in the fishes which were fed with 10% poultry dropping incorporated diet (Chauhan, 2014). Even the poultry dropping percentage is increased SGR do not increase but if incorporated with DAP significantly increase the SGR.

Similarly, the PWG found highest in replicated cage of pond C (21011%/fish) and lowest PWG was found in replicated cage of pond B (2566 %/fish) in pond B. The Daily weight gain was found highest in replicated cage of pond C (0.210 g/fish/day) which was supported by Dheke (2013).

In present study, pond A, cages which was fertilized only with broiler litter showed good growth response than those of control cages. The growth response was higher than those of pond B i.e. 1.5 times greater fish production. The coefficient correlation is 0.96, which is positively significance. Pond A showed that even organic fertilizer enhances the growth factors of fish as supported by Banerjee *et al.* (1979), Afifi *et al*. (2000), Ghanim *et al*. (2015) and Ng and Leger (2016).

In present investigation, Pond D, cages that were fertilized with only DAP biweekly showed 1.05 times greater fish production than pond B (control) but was less than compared to pond C. The coefficient correlation (0.98), is positively significance ($P > 0.01$) and were significantly higher in fertilized ponds than in controls. Therefore, reducing the dose of P_2O_5 could reduce cost without reducing fish production (Kroupova, 2010; Tabinda, 2010).

In present study, Pond C cages were fertilized with Broiler litter weekly at the rate of 2,597 kg/ha/yr and Di-ammonium phosphate (DAP) biweekly at the rate of 1,442 kg/ha/yr showed 7.9 times greater fish production than Pond B (control). The coefficient correlation (r) was 0.82, which is positively significant (Sayeed *et al*., 2007; (Mosha *et al*., 2016; Kaur *et al*., 2016; Mixph, 2013).

The relative condition factor K is an indicator of general well-being of the fish. K greater than one (1) in pond C, indicative of the general well-being of fish, whereas its value least in pond B (LeCren, 1951; George *et al*., 1985., Kour *et al*., 2016). Salam *et al*. (2005) pointed out that 'K' remained constant with increase in length and weight of fish.

As temperature, alkalinity, turbidity, dissolved oxygen are four water characteristics that are of particular importance for fish pond management (Coche *et al*., 1996) so in the present investigation these were maintained within acceptable range with water temperature 23^{o}C, pH between 7.02 and 8.95 (Santhosh and Singh 2007; Wurts and Durborow, 1992).Turbidity recorded was between 20 to 33, generally adequate for good fish production and there is an increase in the frequency of dissolved oxygen problems (Bhatnagar *et al*., 2004) which was seen in pond C and in Pond B it was 57 showing poor growth response (Boyd and Lichtkoppler 1979). According to Bhatnagar and Singh (2010) and Bhatnagar *et al*., (2004) DO level >5 ppm is essential to support good fish production but in present context pond B having DO 5.20 ppm showed least growth whereas, other ponds with DO 4.6 ppm exhibited good growth response.

6. CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

From the present experiment it can be concluded that growth performance of Common Carp (*Cyprinus carpio*), is found better in combined use of Organic fertilizer as Broiler litter and Inorganic fertilizer as Diammonium phosphate (DAP) than other treatments, Broiler litter, Diammonium phosphate and control respectively.

6.2 Recommendations

- Poultry litter containing hull/husk as bedding material is better than sawdust bedding materials.
- Always use the seeds from the government breeding center.
- Broiler litter has a better effect on growth of Carp, combination with Inorganic fertilizers.
- Use of organic manure in the Carp culture is the best way of west management in fish production.
- Polyculture with herbivorous fishes control the plankton abundance.
- Phytoplankton abundance related to various treatments, studied by new researcher.
- Protein quality of various treatments would be the topic to be studied.
- The cause of mortality of various treatments would be the topic to be studied.

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APPENDIX 1: Broiler litter- Nutrient Composition.

Constituent	Müller			Bhattacharya and Taylor 1975	Blair 1975
	Czechoslovakia 1968c	S.E. Asia 1975a	Mauritius 1978		
Moisture %	13.6	19.6	22.3	15.3	15.5
Composition of dry matter					
N × 6.25%	25.5	17.4	28.3	31.3	25.3
True protein %	14.9	6.9	17.1	16.7	16.6
Digestible protein %	18.6	-	21.2	23.3	-
Alanine %	-	-	-	0.88	0.8
Arginine %	-	-	-	0.51	0.43
Aspartic acid %	-	-	-	1.22	1.15
Glutamic acid %	-	-	-	2.19	1.81
Proline %	-	-	-	0.93	-
Glycine %	-	-	-	2.14	2.55
Histidine %	-	-	-	0.24	0.2
Isoleucine %	-	-	-	0.64	0.58
Leucine %	-	-	-	1.00	0.92
Lysine %	-	-	-	0.57	0.49
Methionine %	-	-	-	0.13	0.13
Cystine %	-	-	-	0.09	0.14
Phenylalanine %	-	-	-	0.54	0.49
Tyrosine %	-	-	-	0.33	0.32
Serine %	-	-	-	0.57	0.53
Threonine %	-	-	-	0.57	0.52
Valine %	-	-	-	0.82	0.74
Crude fibre %	25.2	24.5	23.5	16.8	18.6
Ether extract %	2.70	2.80	2.10	3.3	2.3
NFE %	29.6	33.4	33.6	29.53	27.1
Ash %	17.0	21.9	12.5	15.0	14.1
Ca %	1.30	2.50	2.10	2.37	2.5
P %	0.90	1.60	1.70	1.80	1.6
Na %	0.60	0.30	0.40	0.54	0.42
K %	2.40	2.40	1.90	1.78	1.77
Cu ppm	100	72	312	98	23
Fe ppm	-	-	388	451	-
Zn ppm	138	-	173	235	343
Mg %	-	0.33	0.41	0.44	0.35
Mn ppm	99	-	275	225	-
B ppm	34	-	-	38	-
Al ppm	-	-	-	284	-
Lignin %	-	-	5.40	-	8.04
Gross energy Mcal/kg	-	-	-	3.25	-
Digestible energy Mcal/kg	-	-	-	2.44	-
Metabolizable energy Mcal/kg	-	-	-	2.18	-
TDN	54.0	-	68.9	72.5	-

APPENDIX 2: The following changes in the composition of broiler litter in relation to the age of broilers were observed (Hennig and Poppe, 1977).

Age of broilers weeks	**Dry matter** %	**Crude protein %**	**Ether extract %**	**Crude fibre %**
1–2	28.0	33.6	4.0	12.6
4–5	31.0	40.0	1.4	12.9
7–8	35.0	43.5	2.7	14.0
Mean	31.3	39.0	2.7	13.2

APPENDIX 3: When to fertilize the pond organically (Coche *et al*., 1996)

Water Parameters	**Yes**	**No**
Water temperature at noon	Above 20°C	Below 20°C
Secchi disc transparency	More than 40 cm	Less than 40 cm
Water pH at Sun set	Below 9	Above 9
DO before Sun rise	Above 3-4 mg/l	Below 3-4 mg/l

APPENDIX 4: When to fertilize the pond inorganically (Coche *et al*., 1996).

Water Parameters	**Yes**	**No**
Water temperature at noon	Above 16°C	Below 16°C
Secchi disc transparency	More than 40 cm	Less than 40 cm
Water pH at Sun set	Less than 9	More than 9
DO before Sun rise	More than 3 mg/l	Less than 3 mg/l

APPENDIX 5: Data of pond A (Organically Fertilized).

Pond A	No. of Sample	Stocking Day		15 Days		30 Days		45 days		60 Days		75 Days		90 Days	
		L(cm)	W(g)	L(cm)	W(g)	L(cm)	W(g)	L(cm)	W(g)	L(cm)	W(g)	L(cm)	W(g)	L(cm)	W(g)
	1	1.9		4.5		5.5		6.5		7.2		6.8		6.7	
	2	1.6		4.3		5.5		6.5		6.6		7.0		7.3	
	3	1.9		4.5		4.7		5.0		6.6		7.3		7.0	
R1	4	1.8		4.5		5.2		5.5		6.7		6.5		6.7	
	5	1.8		4.0		5.0		6.0		6.8		6.8		6.5	
	6	1.8		4.9		5.5		6.0		6.2		-		-	
	7	1.8		4.3		5.5		6.1				-		-	
	1	1.9		4.2		5.0		5.0		6.0		6.4		7.1	
	2	1.6		3.8		5.0		5.8		6.6		6.0		6.8	
	3	1.9		3.9		5.0		5.5		6.6		6.1		6.0	
R2	4	1.9		3.8		5.1		5.5		6.2		6.5		6.5	
	5	1.8		3.2		5.1		5.0		5.6		5.1		6.2	
	6	1.6		3.5		4.8		5.4		5.5		-		-	
	7	1.8		3.4		4.9		4.5		5.2		-		-	
	1	1.8		3.5		4.4		4.8		5.5		5.9		6.0	
	2	1.4		3.5		4.4		4.5		5.0		5.3		6.0	
	3	1.6		3.6		4.2		4.5		5.0		5.0		6.3	
	4	1.3		3.5		4.0		4.3		4.6		6.8		5.6	
R3	5	1.5		3.4		4.0		4.6		4.3		5.3		5.6	
	6	1.4		3.2		4.0		4.2		4.4		-		-	
	7	1.6		4.0		4.0		-		5.0		-		-	
Total	21	35.7	2	81.5	19	100.8	34	105.6	49	115.6	62	93.1	50	96.3	55
Mean	7	1.7	0.09	3.88	0.9	4.8	1.62	5.26	2.45	5.50	2.95	6.20	3.33	6.42	3.66

APPENDIX 6: Data of pond B (Control pond)

Pond B	No. of Sample	Stocking Day		15 Days		30 Days		45 days		60 Days		75 Days		90 Days	
		L(cm)	W (g)	L(cm)	W(g)	L(cm)	W(g)	L(cm)	W(g)	L(cm)	W(g)	L(cm)	W(g)	L(cm)	W(g)
R1	1	1.6		2.4		3.3		6.0		5.8		6.2		7.1	
	2	2.0		3.9		4.4		5.5		5.6		5.5		6.8	
	3	1.6		2.4		3.2		5.0		5.0		5.5		6.5	
	4	1.6		2.4		3.3		4.0		5.0		5.8		6.5	
	5	1.6		2.4		3.3		4.5		5.5		5.0		6.5	
	6	1.5		2.5		3.3		4.5		4.2		5.0		-	
	7	1.6		2.2		3.3		3.8		5.5		5.1		-	
R2	1	1.6		2.0		4.0		4.0		5.0		5.5		6.2	
	2	2.0		2.4		3.3		3.5		5.0		5.0		5.7	
	3	1.6		3.9		3.3		4.0		5.1		5.5		6.1	
	4	1.9		2.6		3.0		3.5		4.4		6.1		5.8	
	5	1.8		2.5		3.3		3.3		4.6		5.3		5.6	
	6	1.8		2.5		3.4		4.5		4.0		5.5		-	
	7	1.8		2.4		3.9		3.5		4.4		5.5		-	
R3	1	1.6		2.2		3.3		4.0		4.0		5.0		5.3	
	2	1.6		2.4		3.1		3.5		4.0		5.0		5.5	
	3	1.6		2.5		2.9		4.2		4.0		4.5		5.5	
	4	1.6		2.6		3.3		3.8		4.0		4.7		5.5	
	5	1.6		2.2		2.9		3.5		4.0		4.4		5.5	
	6	1.8		2.4		3.3		3.5		5.8		4.5		-	
	7	1.5		2.6		2.7		3.5		5.0		4.5		-	
Total	21	36.9	2.0	53.4	10	69.8	16	85.6	24	99.9	38	109	46	90.1	44
Mean	7	1.76	0.09	2.54	0.47	3.32	0.76	4.08	1.14	4.75	1.8	5.19	2.19	6.01	2.93

APPENDIX 7: Data of pond C (Mix fertilized).

Pond C	No. of Sample	Stocking Day		15 Days		30 Days		45 days		60 Days		75 Days		90 Days	
		L(cm)	W(g)	L(cm)	W(g)	L(cm)	W(g)	L(cm)	W(g)	L(cm)	W(g)	L(cm)	W(g)	L(cm)	W(g)
	1	1.8		4.5		5.2		8.5		8.8		9.5		12	
	2	1.8		4.5		7.7		8.0		8.8		9.5		12	
	3	1.4		5.5		7.0		8.0		7.0		8.5		9.3	
R1	4	1.6		5.5		6.6		6.5		7.2		7.5		8.2	
	5	2.3		4.4		6.6		7.0		7.1		7.2		7.9	
	6	1.9		4.3		6.0		6.8		7.2		-		-	
	7	2.0		3.3		5.8		6.5		7.7		-		-	
	1	1.5		4.5		5.3		6.0		6.8		7.5		8.2	
	2	1.4		4.2		5.0		6.0		6.0		7.5		8.2	
	3	1.5		4.5		5.5		6.0		7.0		7.5		7.2	
R2	4	1.5		4.2		5.0		6.1		6.6		7.5		8.0	
	5	2.0		4.0		4.9		6.5		7.0		7.7		8.2	
	6	1.5		3.5		4.9		5.2		7.0		-		-	
	7	1.4		4.0		5.0		5.0		5.7		-		-	
	1	1.3		4.0		4.4		5.5		6.0		7.5		8.2	
	2	1.5		4.0		4.4		5.5		6.6		7.5		8.2	
	3	1.5		4.2		4.1		5.0		5.3		7.2		7.3	
R3	4	1.5		3.8		4.4		5.0		5.5		7.2		7.6	
	5	1.4		3.3		3.8		5.2		5.5		7.5		7.6	
	6	1.3		3.0		4.4		5.1		6.6		-		-	
	7	1.6		4.2		4.0		5.0		9.9		-		-	
Total	21	33.7	2	87.4	27	110	46	128.4	82	145.3	106	116.8	152	128.1	285
Mean	7	1.60	0.09	4.16	1.29	5.24	2.19	6.11	3.90	6.91	5.04	7.80	10.13	8.54	19

APPENDIX 8: Data of pond D (Inorganically fertilized).

Pond D	No. of Sample	Stocking Day		15 Days		30 Days		45 days		60 Days		75 Days		90 Days	
		L(cm)	W(g)	L(cm)	W(g)	L(cm)	W(g)	L(cm)	W(g)	L(cm)	W(g)	L(cm)	W(g)	L(cm)	W(g)
	1	1.5		3.5		4.4		6.0		5.5		7.0		7.2	
	2	2.0		4.0		5.0		6.0		6.0		6.0		6.2	
	3	1.8		4.0		5.0		7.0		6.0		5.2		5.5	
R1	4	1.9		4.0		5.5		5.5		5.8		5.3		5.5	
	5	1.4		4.5		5.0		6.0		6.0		5.9		5.6	
	6	1.6		4.0		4.8		5.2		7.0		6.5		-	
	7	1.5		3.5		4.8		4.8		5.0		5.0		-	
	1	1.6		3.5		4.4		5.2		6.0		6.0		6.0	
	2	1.5		3.5		4.6		5.1		6.0		5.5		5.8	
	3	1.8		4.0		4.4		4.9		5.5		5.5		5.2	
R2	4	2.1		3.5		4.4		5.9		6.1		5.5		6.0	
	5	1.6		4.5		4.4		5.0		5.5		6.0		5.4	
	6	1.8		4.0		4.2		5.0		5.5		5.5		-	
	7	1.5		3.5		4.4		5.0		5.5		5.2		-	
	1	1.5		3.5		4.4		5.5		5.3		5.3		5.2	
	2	1.4		3.0		4.2		4.8		5.0		4.6		5.5	
	3	1.5		3.5		4.1		4.5		5.5		6.0		5.6	
R3	4	1.6		3.8		3.8		4.8		5.1		5.5		5.4	
	5	1.8		3.5		4.0		4.7		4.5		5.5		5.5	
	6	1.4		4.0		3.8		4.8		4.0		5.5		-	
	7	1.5		3.5		3.8		5.0		4.0		5.5		-	
Total	21	34.3	2	78.8	25	93.4	30	110.7	48	114.6	50	118	52	85.6	36
Mean	7	1.63	0.09	3.75	1.19	4.44	1.42	5.27	2.29	5.46	2.38	5.61	2.48	5.70	2.57

APPENDIX 9: Mean physicochemical parameters of various ponds during experiments.

Water Parameters	Pond A	Pond B	Pond C	Pond D
Temperature (°C)	23.3	23.5	23.5	23.2
Transparency (cm)	33.35	57.5	18	25
pH	7.02	8.35	6.25	7.3
Dissolved Oxygen (mg/l)	4.94	5.2	4.6	5.02

PLATE – I
Cages of different treatments in four different Ponds

Photo: 1 Cages of Pond A

Photo: 2 Cages of Pond B

Photo: 3 Cages of Pond C

Photo: 4 Cages of Pond D

PLATE – II
Fries of Common Carp and fertilizers.

Photo: 5 Preparing to fill Oxygen at FDTC Janakpur.

Photo: 6 Fries were kept in shade for resting.

Photo: 7 Storage of broiler litter.

Photo: 8 Diammonium phosphate (DAP).

Photo: 9 Lime powder ($CaCO_3$).

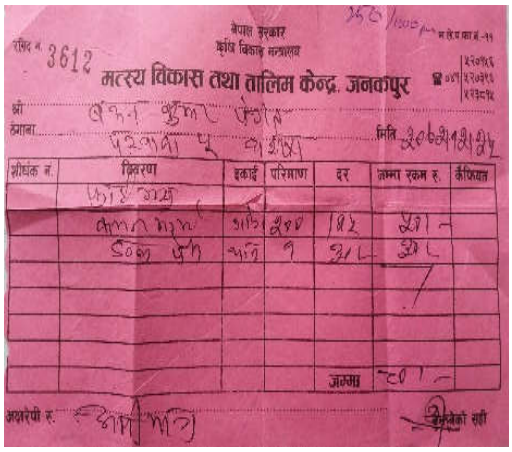

Photo: 10 Bill of FDTC Janakpur

PLATE – III
Length and Weight measurements

Photo: 11 Length of fingerling of pond C (60 days).

Photo: 12 Length of fingerling of pond C (75 days)

Photo: 13 Length of fingerling of pond C (75 days).

Photo: 14 Wt. of fingerling of pond A (75 days).

Photo: 15 Wt. of fingerling of pond C (60 days).

Photo: 16 Wt. of fingerling of pond A (90 days).

PLATE – IV
Water quality parameters analysis

Photo: 17 Adjusting sacchi disk at pond A.

Photo: 18 Taking sacchi disk length at pond B

Photo: 19 Water sampling for pH at pond A.

Photo: 20 Transferring for DO analysis at pond B.

Photo: 21 Taking temperature at pond B.

Photo: 22 Noting the temperature of pond C.

PLATE – V
Phytoplankton abundance and colour of water of four treatments

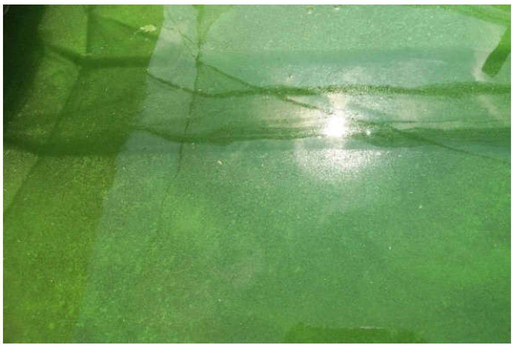

Photo: 23 Phytoplankton of pond A.

Photo: 24 Phytoplankton of pond B.

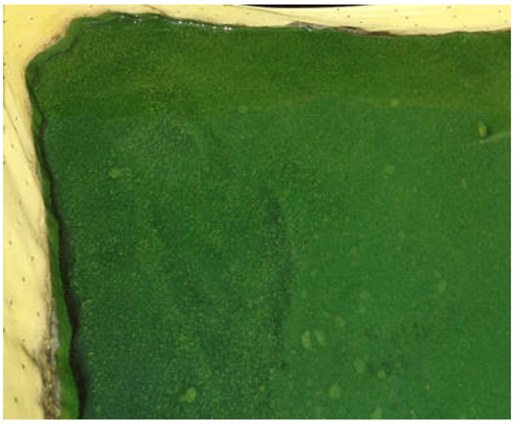

Photo: 25 Phytoplankton of pond C.

Photo: 26 Phytoplankton of pond D.