1. INTRODUCTION

1.1 Background

The Himalayan resources of kingdom of Nepal is blessed by natural resources with varying array of water bodies having an immense treasure of fish fauna. Nepal is a small country with fabulous geographical region viz. low plain land (Terai), mid land and high land with snow covering throughout the year. Nepal's climate, altitude, topography and geography are extremely diverse and unique on the earth. The Himalayan region contributes about 22,077 km^2 of the total area of Nepal (Shrestha, 2008). Nepal is an agrarian society. Agriculture shares 40% of GDP and about 88% of the population depends on agriculture for livelihood. (Agriculture Development Office Rupandehi). Agriculture plays pivotal role for any attempts to increase income and improve living standard of the people in this country. Nepal is endowed with several types of water resources arising from the glaciers and the consequent types of rivers arising from the Himalaya. Collectively, these water bodies cover nearly 3 percent of Nepal's land area (Table 1).

Table 1:.Estimated water surface area of Nepal.

S.N.	Resources detail	Estimated coverage(ha)	Coverage
1	Natural water		
	1.1 Rivers	395,000	48.20
	1.2 Lakes	5,000	00.60
	1.3 Reservoirs	1,500	00.19
2	Irrigated paddy fields	398,000	48.60
3	Village ponds	6,900	00.85
4	Marginal/Swamps/Gholes etc.	12,500	01.50
	Total	8,18,900	100.00

(Sources: DOFD, 2010)

The existing water resources of the country and their future potential reveal that there is a tremendous scope for expansion and intensification of fish production in the country. The water resource is very rich in indigenous fishes of cold and warm water fishes. Different water bodies of Nepal provide a suitable habitat for 232 indigenous fish species (Shrestha 2008). Many local fishermen communities are depended upon capture fishery for the livelihood. Besides capture fishery, there is a great scope for the expansion of aquaculture in this country.

Fish is consumed by the non-vegetarian consumers of all ethnic groups as one of the protein source and tasty food items in Nepal. It is noteworthy that the star hotels are found to utilize a substantial volume of fish to cater the demand of tourists. The growing education and consciousness among Nepalese people have brought about significant changes in their food consumption pattern, increasing consumption of nutritious food like fishes. The available data show the per capita fish consumption has reached 2.19 kg/year (DOFD 2013). The fresh/iced fish is supplied to the Nepalese households and Nepalese consumers through hotels/ restaurants. Frozen fish is consumed by foreign tourists at restaurants/hotels and 10% of Nepalese people (Lofvall 1998). The fish supply situation in Nepal indicates that the fish consumption has been increased from the level of 0.3 kg to 1.1 kg per capita/ annum between 1985/ 86 and 1997/98 and has reached 2.19 kg per capita/annum in the FY 20012/2013 (DOFD 2002). So far, semi-intensive polyculture of carp is practiced in our country, it has contributed in strengthening subsistence economy of poor fish farmers only. The contribution of fishery sector to national AGDP is only 2.0%, so far.

Mountains and hills make up 83 percent of the area of Nepal while Terai occupies 17 percent. Nepal has been divided into 14 Zones and 75 districts, Among 75 district Rupandehi is located about 260km western of Kathmandu. Rupandehi is in the terai marshy terrain at the base of Himalayan mountain comes under the Lumbini Zone.
The climate of the Rupandehi district is marked by tropical and subtropical climate. There is heavy rainfall during rainy seasons and heavy cold in winter season.

1.2 Present status of aquaculture in Nepal

The History of fish culture goes back to 1947 with an introduced of India Fisheries and aquaculture can meet the challenges of age-old poverty by opening the prospects of food security, employment, better income etc. The history of fisheries development dated back to 1952 with the introduction of traditional fisheries activities. Government of Nepal has been giving high priority in fisheries since decades. In an endeavor to alleviate hunger and malnutrition, Government of Nepal has been has been giving priority to establish Fisheries

Development Centers in Nepal. First Fishery Development Center was established under Agriculture during the period of 1957 and the number of centers was increased to 12 by 1972 A.D. in the country.

Warm water fishes like Indian and Chinese carps are the major items of aquaculture in the plain areas of Nepal. Induced breeding of Chinese carps and Indian major carps started in Nepal from 1970/1971. A systematic aquaculture, particularly pond fish culture was initiated in 1981/82 with the implementation of "Aquaculture Development Project" supported by Asian Development Bank. Aquaculture production was estimated to be about 750 metric ton in 1981/82 and reached 4939 metric ton in 1986/87. During this period, the production technology was successfully transferred to the private sector with the establishment of many private fish hatcheries to expand the fisheries activities. With the assistance of international agencies like UNDP, FAO, ADB, JICA, IFAD, fish production in the country had reached 11,925 metric ton in 1996/97 from 4939 metric ton in 1986/87. The increase in fish production has continued thereafter reaching 15,023 metric ton in 1999/2000 , 17,100 metric tons in 2001/02 (DOFD 2002) and 36,000 metric tons in (2012/013), (Mishara R. 2013) The estimated total number of families involved in pond fisheries was about 65,063 1995/96 and 73,000-74,000 families in 1996/97 with interdependent beneficiaries reaching about 366,000-439,000 people. About 2% of total population is benefited from aquaculture and fisheries.

1.2.1 Indigenous fishes species in Nepal

Nepal is most suitable for the culture of fishes because climate and abundant water resources on the basis of published literatures, A check list of 232 indigenous fishes species has been compiled from Nepal (Shrestha 2008). This fishes are unique due to topography, geography structure and different climatic condition of Nepal such as *Tor putitora, Schizothorax nepalensis, Barilius barila, B. barna ect.* **(** recorded from Tinau river).

1.2.2 Exotic fish species in Nepal

Common carp (*Cyprinus carpio*) was introduced from India in 1959 and Israel in 1960. Grass carp (*Ctenopharyngodon idella*) was introduced to Nepal from India in 1967, followed by silver carp (*Hypothalmichthy smolitrix*) from Japan 1968 and bighead carp (*Aristichthys* *nobilis*) from Hungary in 1971/72. Intensive commercial culture of Rainbow trout (*Onchorynchu smykiss)* is being practiced in cemented raceways from more than one decade in Nepal. Introduction of exotic fishes like gold fish (*Carassius auratus),* silver barbs (*Puntius gonionatus*), tilapia (*Oreochromis niloticus*) and giant fresh water prawn (*Macrobrachiumro senbergii*) had started in culture practice recently as ornamental aquarium fish and in polyculture (Srivastava CBL 1999).

1.3 Common carp (*Cyprinus carpio*)

The omnivorous fish Common carp which was introduced from India (1959) and Israel (1960) grow well to about 76cm length and weight of about 6.5 kg. and as one of the principle species in polyculture. The fish is bottom feeder and grows rapidly in tropical climate. The growth rate was about 1-1.75 kg/yr. in Nepal (Srivastava CBL 1999). This species comprises major portion of aquaculture production in our country. The fish can be profitably cultured in ponds, ditches, rice fields and enclosure in combination with other carp species. A large number of government and private agencies have disseminated technology of common carp culture to the rural farmers as a low cost enterprise. For aquaculture, the farmers mainly depend on hatcheries for common carp seeds.

Common carp spawning characteristics were compared between season and out-of-season periods. There were no differences in the percentage of ovulation, spermatozoa motility and embryo survival to the eyed-egg-stage between the spawning periods. Fish spawned during the season produced oocytes of higher total weight than those spawned out-of-season. On the day exogenous feeding began, larvae obtained in out-of-season spawning were shorter than those obtained during the spawning season. However, the out-of-season larvae started feeding two days earlier than in-season larvae. As a result, seven days after fertilization, larvae obtained during out-of-season had the same length as larvae obtained during season. It appears to be possible to obtain common carp larvae half a year before the natural spawning period without decreasing the quality of gametes and larvae. (Parihar, R.P. 2009)

Carp are omnivorous, with a high tendency towards the consumption of benthic organisms, such as water insects, larvae of insects, worms, molluscs, and zooplankton. Zooplankton consumption is dominant in fish ponds where the stocking density is high. Additionally, the carp consumes the stalks, leaves and seeds of aquatic and terrestrial plants, decayed aquatic plants, etc. Pond farming of common carp is based on natural food with supplemental feeding of cereals. Daily growth can be 2 to 4% of body weight (bw). Carps can reach 0.6 to 1.0 kg body weight within one season in subtropical/tropical polyculture. Growth in temperate climate is slower, the fish reach 1.5 kg body weight after 3 rearing seasons. Common carp grow well to about 76cm length and weight of about 6.5 kg. Carp are omnivorous, with a high tendency towards the consumption of benthic organisms, such as water insects, larvae of insects, worms, molluscs, and zooplankton. Digging in the bottom in search for food items results in turbid water. Typical carp ponds in Europe are shallow, eutrophic with a muddy bottom and dense aquatic vegetation at the dikes. Pond farming of common carp is based on natural food with supplemental feeding of cereals.

The majority of production of swimming-up larvae is based on artificial propagation in hatcheries. Brood fish are kept sex-separated in tanks with oxygen-saturated water at 20-22ºC. To induce and synchronize ovulation and spermiation by hormonal stimulants, brood fishes receive injection of pituitary gland, pituitary extract or a mixture of GnRH/dopamine antagonist Gametes are collected by the dry method for immediate fertilization but can be stored for several hours also After gamete activation, the adhesiveness of eggs is eliminated either by the "Woynarovich method" using salt/urea and tannic acid bath, by treatment in milk, or enzymatic treatment incubation is carried out in hatchery jars. Hatched fry are kept in large trays or conical tanks until stocking at the stage of swimming-up larvae into properly prepared nursery ponds. Approximately 300 000 to 800 000 newly hatched fry can be expected from a single female.

Classification (Used by Linnaeus 1758)

Phylum -Chordata
Group -Vertebrata
Subphylum -Gnathostomata
Series -Pisces
Class -Teleostomi
Subclass -Actinopterygii
Order -Cypriniformes
Division -Cyprini
Genus -*Cyprinus*
Species -*carpio*

The common carp has two strains – one with large scales all over the body, locally known as German carp which was introduced to Nepal from India and other with few large scales scattered over the body locally known as mirror and Israeli carp form Israel.

1.3.1 Morphology of Common carp

- Body compressed and head triangular
- Snout obtusely rounded, mouth oblique protrusible and small, lips fleshy
- Barbells two pairs, rostral as long as maxillary
- Dorsal fin inserted at mid-point of the body length, dorsal spine stout and serrated
- Anal fin trapezoidal in shape
- Pectoral fin large
- Caudal fin deeply emarginated
- Scales large, lateral line emarginated
- Fin formula, $D_{III\text{-}IV}$ 18-20, A_{III} 5, $P_{1\ 15}$, $_{VI\ 8}$.

Three varieties of common carps exist like

Cyprinus carpiocommunis-	It is commonly called scale carp owing to the presence of regularly arranged rows of scales all over the body.
Cyprinus carpionudus-	It is commonly called leather carp, owing to a general loss of scales.
Cyprinus carpiospecularis-	It is commonly called mirror carp characterized by the presence of scales arranged in an irregular pattern and just scattered.

1.4 Silver carp

Silver carp is a freshwater species living in temperate conditions (6-28 °C) found in static or slow-flowing water. In its natural range, it is potamodromous, migrating upstream to breed; eggs and larvae float downstream to floodplain zones. Silver carp are typical planktivores, the gillrakers being the main means of filtration. Silver carp consume diatoms, dinoflagellates, chrysophytes, xanthophytes, some green algae and cyanobacteria ('blue green algae'). In addition, detritus, conglomerations of bacteria, rotifers and small crustaceans are other major components of their natural diet. Silver carp spawn in late spring and summer, when the temperature of the water is relatively high. From April to August, either because of the rainstorms or the swollen upper reaches of streams and rivers, its brood stocks are concentrated in spawning locations where conditions are favourable, and the current swift, complicated and irregular. Spawning temperature is generally between 18 ºC and 30 ºC, with an optimum of 22-28 ºC. The eggs of silver carp, like all Chinese carps, are non-adhesive. After spawning, the eggs begin to absorb water through the egg membrane and swell until its specific gravity is slightly greater than that of water, so they can stay at the bottom (in the case of static waters) or float halfway in mid-water (in flowing waters) until the fry hatch.

Classification (used by Linnaeus,1758**)**

Phylum -Chordata
Group -Vertebrata
Subphylum -Gnathostomata
Series -Pisces
Class -Teleostomi
Subclass -Actinopterygii
Order -Cypriniformes
Division -Cyprini
Genus -*Hyphophthalmichthys*
Species - *molitrix*

1.4.1 Morphology of Silver carp

Body: compressed Scales: small, Mouth: in front, with lower jaw slightly slanting upward. Eyes: comparatively small, situated below the horizontal axis of body. Gill membrane: unconnected to isthmus. Gill rakers: dense, interlaced and connected, covered with a sponge-like membraneous sieve. Abdominal keel: extending from the base of pectoral fins to the anus. Pectoral fin: its terminal tip does not exceed the base of ventral fin. Pharyngeal teeth: one row in 4/4, with fine lines and tiny grooves on surface. Intestinal length: 6---10 times that of body length. Colour of body: silvery white while alive; colour of dorsal, very dark brown. The largest body so far discovered is about 20 kg.

1.5 Hatchery at Mandal Fish Hatchery Farm (MFHF)

Most hatcheries rear their own brood stocks and they do not recruit from natural sources (river, lakes) or bring from other fish farms. Each hatchery therefore can be considered as an isolated, self-sustaining and genetically closed system. Due to genetically closed system, population of various farms can face inbreeding and genetic drift problems. But, brood fishes of common carp reared in MFBC, Patradanda are undergoing cross breeding and selection from here farmers are taking up to Dhangadi. It also supply seed to Dayanagar VDC commonaly called MachhaGau (Fisheries village).

MFBC was established with following main objectives –

- To collect variety of warm water fishes for culture practices.
- To produce carp's hatchlings, fry and fingerlings to supply local fish farmers.
- To produce table fish to the consumers to reduce import from India.
- To minimize the exotic seed of fishes
- To develop research center for breeding

Mandal fish hatchery farm produces eggs 125,000/kg Common carp, 150000/kg Silver carp, 180000/kg Bighead carp,140000/kg Grass carp, 250000/kg Rahu and 300000/kg Naini

1.6 Rational

In Nepal, many studies in birds, mammals, reptiles and environmental related issues were conducted but such studies on Pisces are very scanty. The study of fishes like Common carp and Silver carp are highly useful as a food sources but their details study about breeding and raring is not done well. This study is one among the very few studies that describe the breeding and raring of these two fishes which help to fill to some extent the knowledge gap and research of these species.

1.6 OBJECTIVES

1.6.1 General Objective

Objective on Induced Breeding and Rearing of Common Carp *(Cyprinious carpio)* and Silver Carp *(Hypophthalmichthys molitrix)* at Mandal Fish Hatchery Farm.

1.6.2 Specific objectives of the present study are

1. To observe the physio-chemical parameters of pond water - Temperature , DO ,Colour , CO2, pH ,
2. To observe biology of common carp and Silver carp - fecundity, gonado-somatic index (G.S.I), fertility rate, hatching rate
3. To observe various stages of embryonic development of Common carp and Silver carp.
4. To observe the growth of Common carp and Silver carp (fry).
5. To observe Comparative breeding rate of Common carp and Silver carp.

1.7 JUSTIFICATION

- Few works have been done so far to explore the fish breeding till date in Rupandehi. Thus, extensive exploration of fish breeding covering this area is essential.
- It was not possible to take induced breeding of all carps at a time so two species have been taken for sound data along with effective survey.
- The fish breeding system will be studied for strengthening its spawning.

2. LITERATURE REVIEW

2.1 Common carp

2.1.1 History and Biology

Among all the species, the common carp (*Cyprinus carpio*) had the longest history of culture. Spawning of common carp in China was reported as early as 475 B.C by Fan Li. Common carp was first introduced into North America in the mid-nineteenth century and subsequently became wide spread in streams and lakes there. There are many similar native cyprinids involved in aquaculture in different countries of South East Asia; but still common carp was introduced in South East Asian countries between 1914 and 1957 introduced in culture practice now throughout the region (John and Willian, 1972). It had been introduced in India in the lakes of the Nilgiri mountain ranges from China and South East Asia. It was first introduced into Ceylon and later into South India, where it had successfully acclimatized and started to breed throughout the year. Three varieties of common carps are found in the Nilgiri: *Cyprinus carpio Specularis* (Mirror carp), *Cyprinuscarpionudus* (Leather carp) and *Cyprinuscarpiocommunis* (Scale carp) (Srivastava CBL 1999).

The common carp is probably one of the world's most domesticated fish. Its natural habitats are rivers and lakes of Eastern Europe and the main land of Asia. The common carp has four sub-species viz. *Cyprinus carpio* European Transcaucadian area, *Cyprinus carpio auralensis* of the mid-Asian region, *Cyprinus carpio haematopterus* of Amur-Chinese or far eastern region and *Cyprinus carpio* viridiviolaceus of the North Vietnam (Jhingran and Pullin, 1998). Common carp is a native fish limited to a number of European countries, namely those of the Danube River drainage system. However, present occurrence of wild Danubian carp populations is questionable, probably limited to only a few areas in the drainage system, and are threatened by anthropogenic effects as well as farm escapees and restocking farmed populations into open waters. A few wild populations have recently been reported from Turkey, and although these are not native, they constitute an important resource. Wild stocks are also to be found in Central Asian countries, e.g. Uzbekistan, which clusters with the European populations (Jhingran 1998).

Common carp are tolerant to oxygen levels as low levels as 7 percent saturation, high levels of turbidity, moderate salinity (14%), a wide range of temperatures (2-40.6°C) and high levels of toxicants (Koehn 2004). They prefer mid latitude, low-altitude, slow-flowing rivers and standing waters (lakes, dams, billabongs etc.) and are less common in cool, swift-flowing streams (Koehn *et al.* 2000).

Carp are bottom feeders, sucking sediments into their mouths and expelling indigestible particle through their gill openings (Koehn *et al.* 2000). Their diet varies depending on what foods are available, but they are known to eat micro crustaceans, aquatic insect larvae, molluscs, swimming and terrestrial insects and seeds and other plant matter (Hume *et al.*1983a; Koehn *et al.* 2000).

Common carp have been observed to spawn in waters that show seasonal temperatures of 17-29°C (Hume *et al.* 1983b). Carp migrate to and from appropriate spawning grounds during breeding season, sometimes travelling hundreds of kilometres (Balon 1995; Stuart and Jones 2006). Eggs are sticky and are laid on submerged vegetation (Balon 1995; Koehn *et al.* 2000). This stickiness has been hypothesized as facilitating carp dispersal, as eggs can stick to the pond bed and makes the water fowl which will be subsequently transported between waterways (Gilligan and Rayner2007). Flood conditions are especially favorable to carp spawning, as they provide abundant food resources for adults and abundant vegetation for the attachment of eggs and result in plankton blooms to provide food resources for growing larvae and juveniles.

2.2 Silver Carp

2.2.1 History and Biology

Sliver carp are filter feeders that eat phytoplankton, zooplankton, bacteria, detritus and they graze aquatic vegetation. They live in freshwaters that are standing or slow flowing. After 3 years they are mature enough to breed and will breed until the sir maximum age of 10 years old. Spawning occurs anytime between April and September when the temperature is between 18-20 degrees Celsius. They migrate up stream to breed in groups of 15 to 20. They need water with some current so the eggs and larvae can float downstream. The silver carp swim just below the water surface and are often disturbed by boat motors and will jump from the water when startled. These “flying fish” can pose a danger to anglers, boaters, and other recreational users. Silver carp have been cultured around the world, and in many countries are relied on heavily as a food source.

Since silver carp appear to be well established in Indiana's large rivers, the main management objective at this time is preventing them from invading other bodies of water. Unused bait should be disposed on land or in the trash but never in water. Some points should be kept into consideration for its management -

- Always drain water from your boat, live well and bilge before leaving the access area.
- Never transfer fish from one body of water to another.
- Immediately kill all silver carp and other Asian carp that are caught.
- Immediately report new locations of silver carp or other Asian carp to the Indiana Department
- Never transfer fish from one body of water to another.
- Immediately kill all silver carp and other Asian carp that are caught.
- Immediately report new locations of silver carp or other Asian carp to the Indiana Department of Natural Resources, Division of Fish and Wildlife (Srivastava CBL 1999).

2.3 Growth and Embryological Research

Ponds, reservoirs, and lakes with substrates ranging from mud, sand or gravel also serve as habitat for this fish. Common carp are usually found in freshwater systems, but have the ability to tolerate salinities of 1ppt. (Crivelli 1981).

The species is omnivorous and feeds from both bottom sediments and surface waters. Their diet includes a wide variety of aquatic plants, algae, plankton, insects and their larvae, benthic invertebrates, and small fish. Bottom feeding is achieved by disturbing sediments with the snout, then sucking in dislodged food and sediments; turbidity is often increased when the fish blows the unwanted sediment out (Steiner 2000). Pharyngeal teeth are located in the throat and are used to crush food items. Senses of taste and smell are highly developed and may be used to locate food (Steiner, 2000). Spawning occurs in shallower areas of the littoral zone and usually includes multiple males and a single female (Morrison and Webb, 2004). Temperatures required to induce spawning are usually between 15 to 28 degrees Celsius (Morrison and Webb, 2004). In the U.S., spawning takes place from March through July, but has been observed as late as November (Wang, 1986).

Common carp (*Cyprinus carpio*) and Silver carp (Hypopthamichthys molitrix) are the most commercially important and widely cultivated freshwater 35 -37 fish in the world (Biro 1995 Zhou et al. 2003), contributing to 11% of the total world freshwater aquaculture 36 production (FAO 2007). More than 90% of this production comes from Asia (FAO 2007), where common 37 carp is cultured in various pond aquaculture systems.

The common carp and Silver was found better feeding conditions in ponds along with silver carp than in the monoculture alone. Wohlfarth et. al. (1975) described the growth rate in relation to the quality of the environment. He provided a thorough description of genetic differences between Chinese and European races of common carp. In intensive tests, they found the Nasice carp (European races of common carp) was more capable of taking advantage of favorable pond conditions by growing faster, reaching higher yields and weight when appropriate external inputs were available.

Common carp and Silver carp spawning characteristics were compared between season and out-of-season periods. There were little differences in the percentage of ovulation, spermatozoa motility and embryo survival to the eyed-egg-stage between the spawning periods. Fish spawned during the season produced oocytes of higher total weight than those spawned out-of-season. On the day exogenous feeding began, larvae obtained in out-of-season spawning were shorter than those obtained during the spawning season. However, the out-of-season larvae started feeding two days earlier than in-season larvae. As a result, seven days after fertilization, larvae obtained during out-of-season had the same length as larvae obtained during season. It appears to be possible to obtain common carp larvae half a year before the natural spawning period without decreasing the quality of gametes and larvae. (Parihar 2009) Each hatchery therefore can be considered as an isolated, self-sustaining and genetically closed system (Eknath and Doyel 1990). This might have a rise due to mismanagement practices such limitation of founder stock choice, small population of brood stocks maintained or stocking density, feeding regime (Doyle 1983). It is well known that the inbreeding causes homozygosity with deteriorated recessive genes which results defective phenotypes but proper management to keep pure line broods of fishes was not observed in fish hatcheries of Nepal so far. Thirty five years of unmanaged breeding practices have resulted high rate of inbreeding in common carp with the development of deformed varieties of smaller and smaller size. Genetic deterioration of existing stock of common carp is common with wider variation in morphometric characteristics from the original in most of the fisheries farms. One of the reasons of common carp for reduced growth rate of about 10-20% is unsubstantially claimed for the occurrence of inbreeding between single generations of sib mating (sister-brother mating). It has made very difficult to distinguish the different varieties of common carp. To overcome the problems and maintain good yield, a new races of common carp i.e. Yugoslavian strains (European races) known as Nasice carp had been introduced in Nepal from Israeli in 1990 (Shrestha 2008)

Wagle and Pradhan (2003) estimated effective population size and the rate of inbreeding (F) of common carp on the basis of numbers of new individual recruited as brood stock each year and the variance of their productive success. Effective population size ranges from as low as 5 to a maximum of 19, and the rate of inbreeding from 2.5% to 10.3% per year for common carp based on the data collected of 1999 to 2001 from hatcheries representing brood stock management one in Terai and two in mid hill region of the country. In the context of current brood fish management and hatchery practices adopted in many government and private hatcheries; it is a apparent that there has been decline in effective population size.

Good genetic management and selection have the potential to help overcome this problem (Hussain et al. 2002). Genetic stock improvement through genetic selection is one of the most useful ways of enhancing desirable traits in a founder stock with high genetic variability to reduce inbreeding in a population (Eknath et al. 1998). Selection is an effective method for fish genetic improvement, provided that a target i.e. mainly controlled by additive genetic variance (Falconer 1998). Selection method have been efficiently used to improve economical important traits of aquatic animals (Bondari 1983, Tave, 1986 and Gjedrem, 1993, 1997). To prove that inbreeding is one of the major causes of observed decline in growth and reproduction performance and one has to crossed breed stocks from different hatcheries and demonstrates heterosis effect, if any. The hatcheries population, therefore, can be considered as isolated sub-population of original ancestral population of source hatcheries. Genetically, they are isolated inbreed lines of the same population.

3. MATERIALS AND METHODS

3.1 Study Site

The present work was carried in Mandal Fish Hatchery Farm (MFHF), Pathardanda, Tilottama Municipality – 17, in the Lumbini Zone of western Nepal. Mandal Fish Hatchery Farm is Private Farm at Rupendehi was established in 2057 B.S. by Mr. Rameshowar Mandal. Itlies approximately 13 km south of Butwal and 31km north of Lumbini. The total area occupied by the farm is about 5 hectares and out of which3.5 hectares has water area.

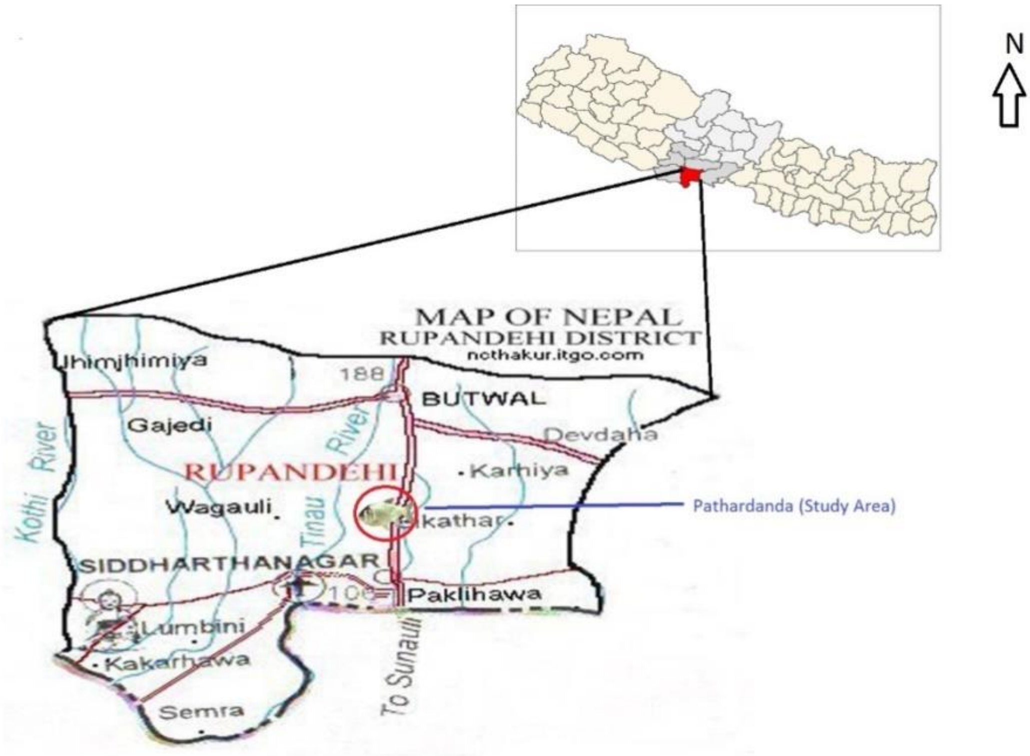

Figure 1: Map of study site, Pathadanda 13km north of Sidharthanagara

The main water source of the farm is swallow and deep boring. The occasional supply of water is provided by canal from Tinau river. There is 1 hatchery along with-

- 18 nursery ponds ,
- 6 Brood fish spawning tank,
- 2 early brood tanks,
- 2 rearing tanks for hatch.

- 6 Rearing tanks for fingerlings was established in this farm.

A long four meter graduated measuring stick was taken from the Mandal Fish Hatchery Farm to measure the depth of the pond. The depth was taken three times regularly and the mean depth was noted.

3.2 Study period

The field study was carried out for 5 months from February 2014 to July 2014.

- Breeding - conducted from March 1st - June 15th 2014(Common carp)
- Breeding - conducted from May 1st - July15th 2014(Silver carp)
- Embryological and growth check-up study of spawn - 17thmarch - 26th July 2014
- While larval rearing and growth check-up of fry - 17thmarch - 26th July 2014

Table 2: Time table availability of fish seeds at Mandal Fish Hatchery Farm, Rupandehi

S.N.	**Types of Fish**	**Types of Fish seed**		
		Hatching	Fry	Fingerlings
1	Common carp	March- May	April-May	May-July
2	Silver carp	April-August	April-Sept.	July-Nov
3	Big head carp	April-August	May-Aug	June-Nov
4	Rohu	May-Jun	July-Sept	Sept-Feb
5	Naini	Jun-Aug	July-Aug	Nov-Feb
6	Grass carp	April	May-June	July-Aug

3.3 Physio-chemical Parameters

3.3.1 Physical Parameters

The physio-chemical parameter of water studied during experimental period was as follows:

Nature of day: It was recorded in the field during working only by visual observation.

Color of water: The pond water was taken in a petri dish over white paper and then the color of water was observed.

.

Temperature: The water temperature was measured by using a stand mercury thermometer graduated 0^o - 35^o C with a precision of 0.1^o C. The surface temperature was measured by directly dipping the thermometer bulb into the water body for two minutes and the reading was recorded.

3.3.2 Chemical Parameters

The chemical parameters studied during present study were as follows:

- **pH:** The pH of water in hatchery was measured in study sites by pH meter (HANNA instruments HI 9025 meter kit.). First pointer of pH meter dipped into the water for two minutes and reading was recorded.
- **Dissolved Oxygen (DO):** The dissolved oxygen was measured by using Winker's method.
- **Free carbon dioxide (CO_2):** Free Carbon dioxide was determined by titration.

3.4 Determination of fecundity and Gonado Somatic Index (G.S.I.)

Fecundity was estimated separately by sampling one gram of egg and multiplying with the total weight of brood female fish. One gram of the stripped out dry eggs were weighed on an electric weighing machine. Three such samples were taken and were emerged in salt solution separately counting eggs one by one with the help of brush.

Fecundity = No. of eggs per gm. x Wt. of total eggs (gm.) spawned by female fish (Kaur and Dhawan 1997).

GSI expresses the weight of the gonads as the total weight of the body. Stage of the maturity is reflected by weight of the gonads, which are related to the female fish. G.S.I. increases with the maturation of fish being maximum during peak period of maturity and decline abruptly after spawning. G.S.I.(%) of all female fish of the respective carps was determined by the following formula.

Weight of gonads

$$G.S.I = \frac{\text{Gonadial weight of brood}}{\text{Weight of brood}} \times 100\%$$

(Kaur and Dhawan 1997)

3.5Stocking, Breeding, rearing of hatchlings, fry of Common carp and Silver carp

The breeding was initiated involving local brood stocks present in Mandal Fish Hatchery Farm. They selected the broods from the stacking tank those which have active and suitable length, weight. Then the brood was transferred to the breeding tank on the basis of weight of brood in Mandal Fish Hatchery Farm. The broods was kept 100kg/kathha.

3.5.1 Maintenance of brood stocks in brood stock ponds

Two ponds - one for male brood fish and another for female brood fish - were selected for study. “Broods” refers to the mature male and female ready for spawning. Male and female were stocked in different ponds to avoid self-fertilization.Each of the pond had been prepared according to standard pond management practices for stocking and rearing of brood stocks. The specimens selected were healthy without any deformity of the body. In the initial stage of brood maintenance, they were kept in stocking ponds. Due to insufficient macro-vegetation or filamentous algae in the ponds, broods were fed with decayed vegetable matter containing bottom dwelling organisms. The fishes were also fed with supplementary feeds containing shrimp, soybean, wheat flour, rice bran, oil cake with 20% protein (Table 3)

Table 3. The feed materials used for brood fish of common carp and Silver carp

Ingredient	Percentage (%)
Shrimp meal	25%
Soybean meal	05%
Wheat flour	20%
Rice bran	25%
Oil cake	25%
	100%

3.5.2 Breeding of common carp and Silver carp

Matured male and female broods were selected based on external secondary sexual characters (Jhingran and Pullin, 1988). One brood fish was compared with the other to determine the readiness of broods, both male and female carps, for spawning. The one which when its tail raised showed its contour of ovary to move forward was selected out in the case of female carps for the study. The male brood, which when extruded out milt freely when the abdomen was pressed, was selected out for the study. After selection, the broods were transferred from brood ponds into the circular spawning tanks inside the hatchery room in hammocks. Here also the male and female were kept in separate holding tanks for conditioning with the regular flow of water in the tanks. Length, girth and weight of each brood fishes were measured. After 8 hours of conditioning in hatchery, Ovaprim hormone was injected at the dose of 0.5 mg/kg. Each brood was injected intramuscularly (IM) on either side of the dorsal fin above the lateral line at an angle of 45^{o} laterally and to a depth of about 1-1.5 cm. Before removing the syringe after injecting the fish, the site of puncture was pressed and massaged to prevent the suspension from running out. After 10-12 hours of injection, the broods are ready for stripping and eggs were first stripped out by pressing the female's body and abdomen and eggs were collected in a clean and dry plastic trough. Soon after which milt was squeezed directly over the stripped eggs. Eggs and sperms were mixed for fertilization with a feather for about one minute. Eggs were then washed with clean water several times to remove excess milt.

3.5.3 Incubation of eggs and rearing of hatchlings

Common carp eggs were loaded in chemically treated incubation tanks. Malachite green (2-5 gm in 10 litre water) was treated in water before transferring eggs to prevent from attack of bacteria and fungus. Soon after the loading of eggs, water was treated with potassium permanganate (5-8 gm in 10 litre water). 50 fertilized egg were kept in three floating sieves in the incubation tank for an experiment to study fertility rate and hatching rate. The hatchlings were given appropriate food a little before total absorption of the yolk sacs. They were fed with milk powder by simply scattering it over the water slowly from the edge. This helps the food not to be flushed out immediately through the outlet. In the same way, egg yolk mixed with water were also given thrice a day.

Determination of fertility rate (%): Fertility rate was calculated for every female separately by sampling eggs at the early morula stage. It could be estimated properly after four hours of embryonic development. The eggs in the sieve were taken out in a plastic trough and checked for the fertility. Fertilized eggs were observed as clear crystals balls whereas the unfertilized ones were dull and opaque. Its fertility was calculated in average of the total sample eggs.

$$\text{Fertility rate} = \frac{\text{Total number of fertilized eggs}}{\text{Total number of eggs}} \times 100$$

(Kaur and Dhawan 1997).

Determination of hatching rate (%): Hatching number was determined by taking out the net bowl in a plastic trough and number of hatched ones and unfertilized eggs were counted to obtain the hatching rate.

$$\text{Hatching rate} = \frac{\text{Total number of hatchling}}{\text{Total number of Fertilized eggs}} \times 100$$

(Kaur and Dhawan 1997)

3.5.4 Study of embryonic development of fertilized eggs

The sample of fertilized eggs was collected for the study of the different embryonic stages of the common carp. Eggs at various stages were preserved in 1% formalin solution and the study was done under a photographic microscope. The photos of different embryonic stages of common carp was taken by the microscope camera in the laboratory of Central Department of Zoology, Kirtipur (Photo Plates 4: (Photo20-33)).

3.5.5 Rearing of hatchlings till fry stage

After nursing of hatchlings for 5 days inside the hatchery in the incubation tank, one week old hatchlings were transferred into the prepared nursery ponds in the farm. Collection of hatchlings were done through the outlet of the incubation tank by putting a piece of cotton cloth on the mouth of the exit of incubation tank outlet. The hatchlings were then measured in a measuring cup (at the rate of 50,000 hatchlings per cup). The hatchlings were transferred to the nursery pond for rearing in plastic bags containing sufficient amount of water. Fry were fed two times a day with 30% crude protein feeds. This experiment was continued for 30 days.

Hatchlings after transferring to the nursery pond, the growth checkup was done at weekly intervals. Hatchlings were scooped out from the pond with the help of scoop net and the length and weight of hatchlings were measured, up to one month i.e. up to fry.

4. RESULTS

4.1 Physio-chemical parameter

4.1.1 Physical Parameter

The physical parameters had been studied from the sub-surface of water bodies.

4.1.1.1 Nature of Day

During the study period the nature of day was observed.. Within the 5 months of study period, 7 days were recorded cloudy, 5 days partly cloudy, 3 days rainy and rest days were sunny (clear sky).

4.1.1.2 Color of water

The water color at MBFC was noted greenish during the whole study period.

4.1.1.3 Temperature

The range of temperature of brood pond was 20-28^o C in the morning (7-9 a.m.) and 22-32.6^{o}C during day (2-4 p.m.) from March 1st to May 15th, that of incubation tank was 22.7-23.5^{o}C in the morning (7-9 a.m.) and 24-24.5^{o}C during day (2-4p.m.) from 16th May to 23rd May and that of nursery pond was 30-33.4^{o}C during (7-9 a.m.) and 31-34.7^{o}C during (2-4 p.m.) from May 24th to June 28th. The highest temperature (34.7 ^{o}C) was recorded in June (Table 2).

4.1.2 Chemical parameter

4.1.2.1pH

The pH remained alkaline during whole study period; it ranged from 8.6 to 10.8 showing highest (10.8) at May and lowest (8.6) at March in brood pond and that of incubation tank was 8-8.5 in the morning (7-9 a.m.) and 8.7 to 8.9 during day (2-4 p.m.) from 16th May to 23rd May and that of nursery ponds ranged from 9.6 to 13.6 from 23rdMay to 28thJune (Table 3).

4.1.2.2 Dissolved Oxygen (DO)

The range of dissolved oxygen concentration of brood pond was 5.9- 7.5 mg/l during 6-7 a.m. and 6.0 -7.5 mg/l during 2-3 p.m.; that of incubation tank was 7.0-8.5 in the morning (7-9 a.m.) and 8.0-9.2 during day (2-4 p.m.) from 16th February to 23rd March and that in nursery ponds it ranged from 5.8-6.6 mg/l during 7-9 a.m. and 7.3-8 mg/l during 2-4p.m from 24th march to 28th June. The concentration of DO increased considerably from 6 a.m. to 3 p.m (Table 4).

4.1.2.3 Free CO_2

The range of free CO_2 (mg/l) of brood pond was 14.5-17.2 mg/l in incubation tank it was 13.8 and that of nursery pond was 14.8-15.3 mg/l (Table 4).

Table 4: Physico-chemical parameter of brood ponds, incubation tank and nursery ponds

Average data →	**Temperature (^{0}C)**		**pH**		**DO (mg/l)**		**Free CO_2 (mg/l)**
	7-9 a.m	**2-4p.m**	**7-9 a.m**	**2-3p.m**	**7-9 a.m**	**2-4 p.m**	
Brood ponds (March- May)	**20.0-28.0**	**22.0-32.6**	**8.6 – 12.8**		**5.5-6.8**	**6.0-7.5**	**14.5-17.2**
Incubation tanks (May)	**22.7-23.5**	**24.0-24.5**	**8-8.5**	**8.7-8.9**	**7.0-8.5**	**8.0-9.2**	**13.8**
Nursery ponds (June)	**30.0-34.4**	**33-35.7**	**9.6 – 13.6**		**5.8-6.6**	**7.3-8.0**	**14.8-15.3**

4.2.1 Fecundity and Gonado Somatic Index (G.S.I)

The total number of eggs spawned was found to range from 2, 50, 000 – 4, 60,000 and GSI 10% of female brood fish using ovaprim hormone and brood was taken by breeding tank kept in 100kg/katha (Table 5).

Table 5: Fecundity and GSI of Common carp by using Ovaprim Hormone in the different day of Mandal Fish hatchery Farm.

Number of Female	Weight of Female (kg)	Fecundity	Weight of total eggs spawned (gm)	G.S.I. (100%)
1	**2**	**250,000**	**252.5**	**12.6**
2	**2.5**	**3, 00, 000**	**303**	**12.12**
3	**2.75**	**3, 25, 000**	**328**	**12.1**
4	**3**	**3, 45, 000**	**348**	**11.6**
5	**3.5**	**4, 02, 500**	**406.5**	**11.6**
6	**4**	**4, 60, 000**	**464.6**	**11.6**

The total number of eggs spawned was found to range from 3, 00, 000 – 5, 60,000 and GSI 10% of female brood fish using Oviprim hormone (Table 6).

Table 6. Fecundity and GSI of Silver carp by using Oviprim Hormone in the different day of Mandal Fish Hatchery Farm.

Number of Female	Weight of Female (kg)	Fecundity	Weight of total eggs spawned (gm)	G.S.I. (100%)
1	**2**	**300, 000**	**303**	**15.15**
2	**2.35**	**345, 000**	**348**	**15.13**
3	**2.5**	**362, 500**	**366**	**14.6**
4	**3**	**420, 000**	**424**	**14.1**
5	**3.5**	**4 90, 000**	**494**	**14.1**
6	**4**	**560, 500**	**565.6**	**14.14**

4.2.3 Fertility Rate and Hatching Rate of Common carp and Silver Carp

The fertility rate or rate of fertilization of eggs by milt was recorded 82.5%. Out of total fertilized eggs, only 53.6% of them were successfully hatched (Table 7).

Table 7: Fertility Rate and Hatching Rate of Common carp

Number of eggs in sieve	No. of viable and fertilized eggs	Fertility Rate (%)	Hatching Rate (%)
40	35	87.5	56
40	32	80	53
40	33	82.5	54
40	31	77.5	44
40	37	92.5	58
40	30	75	46

The fertility rate or rate of fertilization of eggs by milt was recorded 84.5%. Out of total fertilized eggs, only 55.6% of them were successfully hatched (Table 8).

Table 8: Fertility Rate and Hatching Rate of Silver carp in Mandal Fish Hatchery Farm

Number of eggs in sieve	No. of viable and fertilized eggs	Fertility Rate (%)	Hatching Rate (%)
60	50	83.3	54.5
60	55	91.6	57.5
60	56	93.3	59
60	47	78.3	46
60	43	71.6	44
60	48	80	48

4.3 Embryonic development of fertilized eggs

4.3.1 Structure of common and silver carp egg

The shell of egg was nonporous, tight, non-elastic and translucent, which allowed very poor view of the developing embryo. The thick shell was found yellowish, opaque containing one large opening. The yolk membrane was a thin protoplasmic layer surrounding the yolk to hold it together. In a common carp egg, there was a very little space between yolk membrane and filled with a fluid called previtelline fluid. When an egg was freshly stripped from the female, there was no water in this space. When eggs absorbed water, eggs become little swollen, firm, turgid and shell thickened. The swelling of egg was known as called hardening process and created a current through the micropyle to carry the spermatozoan into the egg.

4.3.2 Different embryonic stage of common carp

Cleavage of egg was observed after 4 hr of fertilization. After 28 hr, eyed egg couldbe distinguished due to pigmentation and visible through the choroid. This stage was called Eyed Stage.The development of embryo could be noticed at 36 hr inside the egg. The development of embryo continued and the the hatching takes place after 48 hours of fertilization.

4.4 Growth study up to fry stage

4.4.1 Growth of length and weight of hatchlings

The length and weight of hatchlings were recorded gradually increasing (Photo Plate 6,7,8 (Photo 34-45) and (figure 3,4,5,6)

4.4.2 Growth check-up of fry up to 40 days

Hatchlings after transferring to the nursery pond, the fry were fed with artificially formulated feed with 45-50% protein at the rate of 5-10% body weight (Table 8) and the growth checkup of Common carp and Silver carp was done at weekly intervals. Length and weight of fry was noted gradually increasing from first week to fourth week (Table 8).

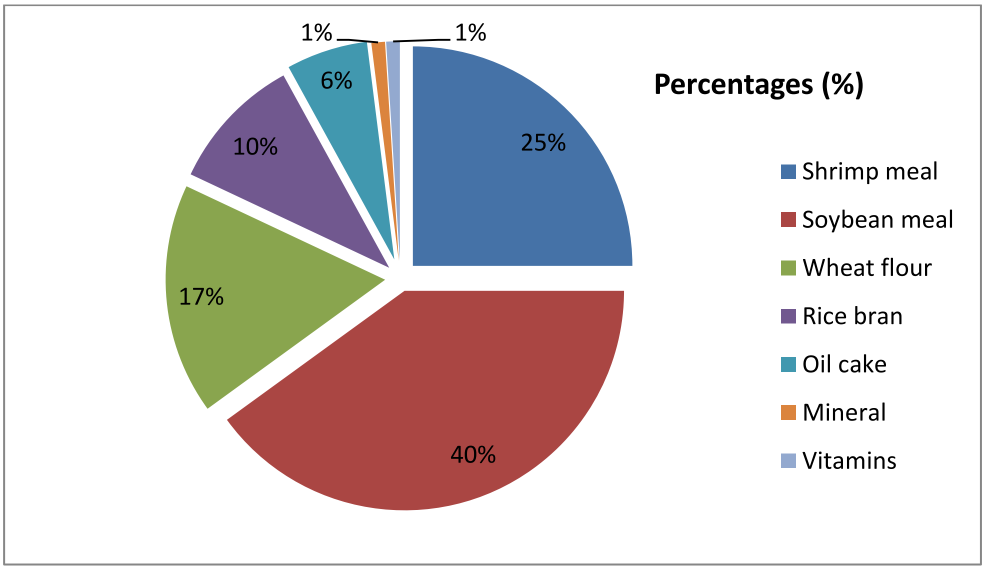

Figure 2 : Composition of feed for fry rearing up to 35 days in percentage

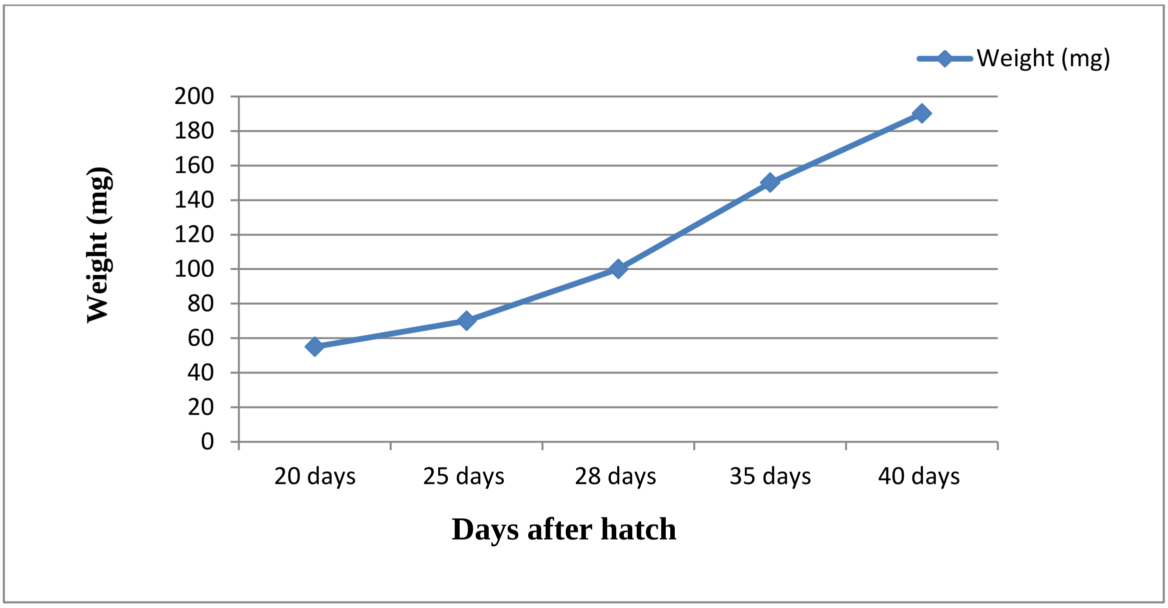

Figure 3 : Weekly growth checkup of Common carp fry in nursery pond with days after hatch and weight.

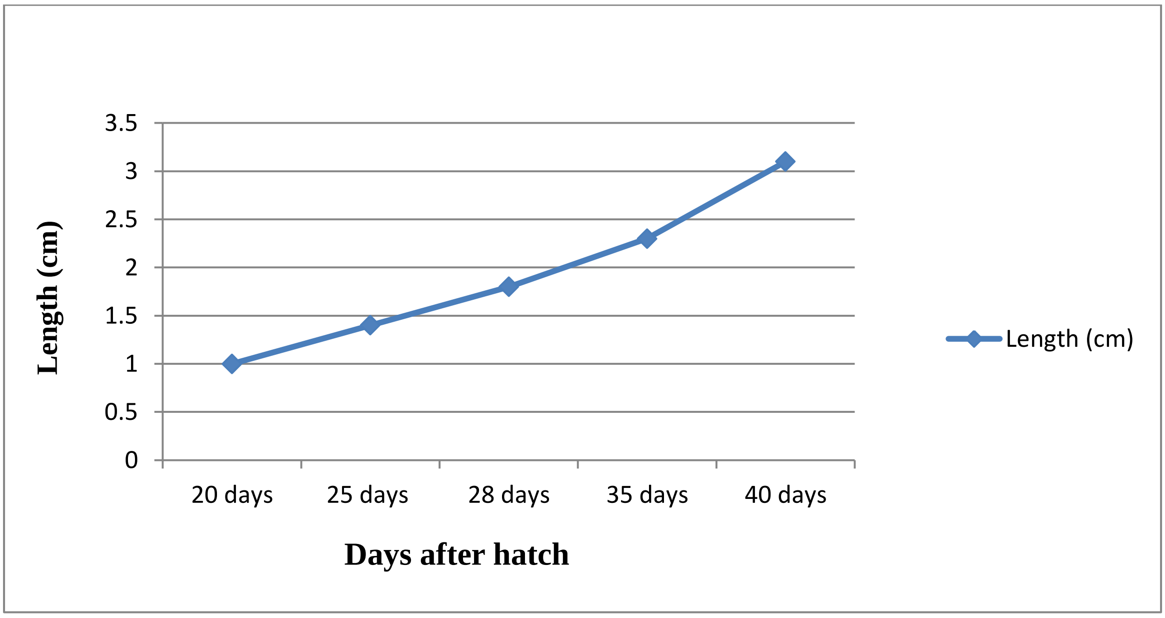

Figure 4: Weekly growth checkup of Common carp fry in nursery pond with days after hatch and length

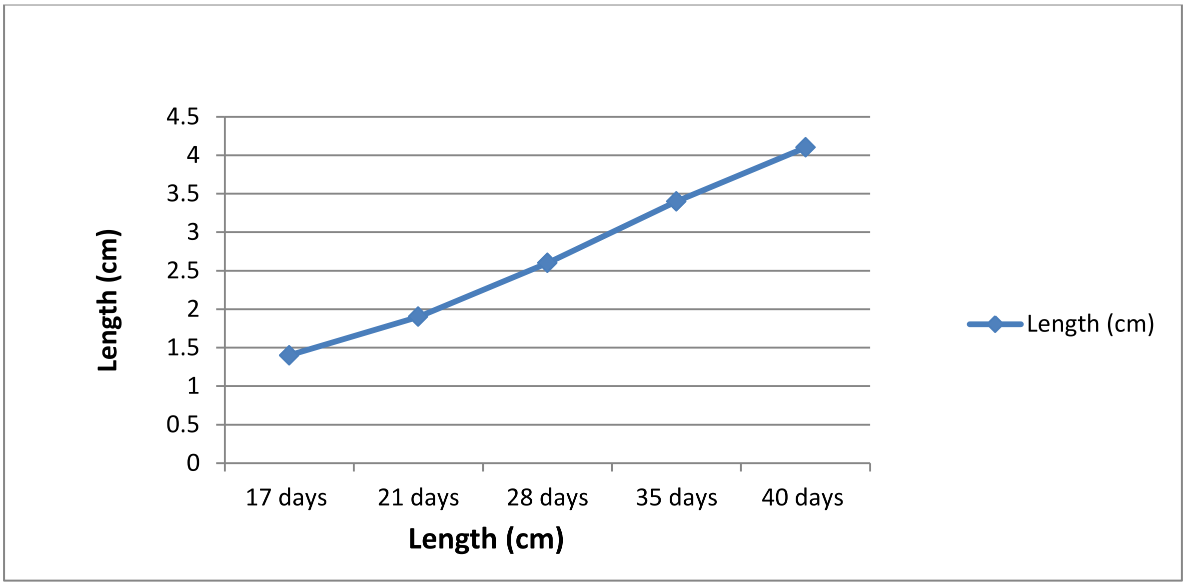

Figure 5 : Weekly growth checkup of Silver carp fry in nursery pond days after hatch and length

Figure 6: Weekly growth checkup of Silver carp fry in nursery pond days after hatch and weight

5. DISCUSSION

A significant role plays by Physico-chemical parameters of water in the biology and physiology of fish. During the present investigation it was observed that water quality parameters of the brood fish pond, hatchery tank and nursery ponds were found to be within the suitable ranges as reported by Jhingran (1991).

Induced breeding were successfully done in carps by using various spawning chemicals namely, fish pituitary extract, human chorionic gonadotropin, ovaprim (sGnRHA) etc. In present study, Ovaprim or ovifax was used to induce final maturation and spawning in common carp. More et, al. (2010) compared the spawning response of ovaprim, ovatide and ovafax compared with pituitary extract in Indian major carps. They reported the percentage of fertilization (88.11 - 97.94%) was found higher with ovaprim treatment than with pituitary extract treatment(53.19 - 85.48%). Similarly, the percentage of hatchling (74.70 - 95.92%) was reported higher with ovaprim treatment than with pituitary extract treatment (60 - 58.82%).The embryological study showed time for hatching of common carp more than other carps (Chinese carps and Indian Major carps) because of its little thicker egg shell than other carps.

In the study, it was found that fertility rate was fairly good (83%) but the hatching rate was not recorded very good (53%) in present study. Low hatching rate might be due to the deformities occurring during embryonic development. Body malformation were observed to happen in the newly hatched larvae even if the embryonic development took in unpolluted and well-oxygenated water, at an optimal temperature (20°C for common carp; Lugowska, Jezierska 2000).

The fecundity, in present study, ranged from 200,000-330,000, but 36,000 to 2,000,000 adhesive eggs was reported in a single spawning season by each female (National Sea Grant, 1999).The high fecundity of most fish allows higher genetic gains to be obtained compared to farm animals through high selection intensities. This means that a very small number of individuals can make a large contribution to the genetic make-up of successive generations. Hence the rate of inbreeding can be high, resulting in depression in fitness and other important traits (Gjerde et al. 1983) and loss of additive genetic variance counteracting further genetic improvement. As a result, the farmers may observe poor survival and growth of the seed and wild broodstock is therefore often used to 'refresh' culture stocks (Eknath and Doyle, 1990). The detrimental effects of inbreeding can be important even with selection procedures which do not make use of family information (Gjerde et al. 1996). Also, the use of a small number of parents can lead to highly variable responses, a measure of the risk of breeding programs (Nicholas, 1989; Meuwissen and Woolliams, 1994; Gjerde et al. 1996). Consequently, restrictions on the rate of inbreeding to limit its negative effect are important when implementing selective breeding programs in fish. Greater care therefore has to be taken both when designing and running selective breeding programs in aquatic species as compared to programs for farm animals.

Wagle and Pradhan (2003) estimated effective population size and the rate of inbreeding (F) of common carp on the basis of common carp on the basis of numbers of numbers of new individual recruited as brood stock each year and the variance of their productive success. Effective population size ranges from as low as 5 to a maximum of 19, and the rate of inbreeding from 2.5% to 10.3% per year for common carp based on the data collected of 1999 to 2001 from 3 hatcheries representing brood stock management in Terai and mid hill region of the country. In the context of current brood fish management and hatchery practices a doped in many government and private hatcheries, it is an apparent that there has been decline in effective population size.

The common carp and Silver carp showed rapid growth in artificially formulated diet and similar outcome reaching 10 to 13 centimeters in length within the first year was reported by Steiner (2000). Spataru et al. (1980) and Schroeder (1983) reported common carp and Silver carp naturally depended on plankton and benthic macro invertebrates but when artificial feed is applied, they will readily accept artificial feed. When artificial food was supplied with plankton and benthic macro invertebrates, common carp ingested the lowest volume of phytoplankton, zooplankton and benthic macro invertebrates. The gut contents of common carp suggested that common carp preferred artificial feed to benthic macro invertebrates.

6. CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

The artificial breeding has given a new horizon to these carp as high valued food commodity. As it has high demand and good price in local and nearby markets it strengthens the livelihood of the associated people in this business.

From the observation we found breeding success rate high in silver carp due to eggs of common carp stickier after strived and also weight - length was higher.

Eggs were lost during the hatching so if more artificial breeding is done then the production is more and supply is maintained in the market.

Silver carp and Common carp have fast growth rate i.e 6 months so it can be good in collecting revenue.

Major features for farming carps on commercial scale is the availability of year round carp seeds , availability of pelleted feed, accessible market ,preservation and quality which was found at the hatchery. As the hatching rate was seen only 50% (approx.) so the administration of oviprim was taken one factor for contribution of constant supply of the carp seeds.

6.2 Recommendations

From the field work followings recommendation would be offered:

1. Further study on survival rate of hatchlings in nursery ponds should be done.
2. More research on embryological study of carps to be focused
3. The good brood fish should be selected for breeding.
4. The inbreeding should be discontinued to improve the fecundity and G.S.I. rate.
5. Nepal Government and other organization like NGO, INGO should support to such type of breeding center
6. Training , workshop, Seminar should be organized boths at National and international level to bring this industry globally competent

7. REFERENCES

Balon E, K. 1995. Origin and domestication of the wild carp, *Cyprinuscarpio*: from Roman Gourmets to the swimming flower. *Aquaculture* **129:** 3-48.

Biro, P .1995.Management of pond ecosystems and trophic webs. Aquaculture 129:373–386

Bondari K.1983.Response to bi-directional selection for body weight channel catfish, Aquaculture 33: 73-81.

Crivelli, A.J. 1981. The biology of the common carp *Cyprinuscarpio*L. in the Camargue, Southern France Journal of Fish Biology 18 (3): 271-290.

DoFD. 2002. Country profile – Nepal 2002/03 (2059/60), (2012/13) Fisheries sub sector- His Majesty's Government, Ministry of Agriculture and Cooperative, Directorate of Fisheries Development, Central Fisheries Building, Balaju, Kathmandu, Nepal.

Doyle, R.W. 1993. An approach to the qualitative analysis of domestication selection in aquaculture, Aquaculture, 33: 167-185.

Eknath, A.E. and R.W. Doyle, 1990: Effective population size and rate of inbreeding in aquaculture of Indian major carps, Aquaculture, 85: 293-305.

Eknath, A.E., M.M. Dey, 1998: Selective breeding of Nile tilapia in Asia, Paper Rye, B. Gjedre, T.A. Abella, Presented in the 6th World Congress on Genetics R.C. Sevillega, M.M. Tayamen, Applied to Livestock Production, 11-16 January, 1998, R.A. Reyes, H.B. Bensten University of New England, Armidale, Australia, 10 pp.

FAO .2007.Fishstat Plus (v. 2.30). FAO, Rome, Italy

FDD, 1998 Country profile – Nepal 1998/99 (2055/56) Fisheries sub sector- His Majesty's Government, Ministry of Agriculture and Cooperative, Directorate of Fisheries Development, Central Fisheries Building, Balaju, Kathmandu, Nepal.

Fisheries and Wildlife Division, Victorian Ministry for Conservation:

Gilligan D, Rayner T. 2007. *The distribution, spread, ecological impacts, and potentialcontrol of carp in the upper Murray River*. NSW Department of Primary Industries: Sydney.

Gjedrem, T. 1983: Genetic variation in quantitative traits and selection breeding in fish and Shellfish. Aquaculture 33:1-72FAO .2007.Fishstat Plus (v. 2.30). FAO, Rome, Italy.

Gjedrem, T. 1997: Selective breeding to improve aquaculture production, World Aquaculture.Hopkins, K.D. 1992: Reporting fish growth: a review of the basic tour of the World Aquaculture Soc. 23(3): 173-179.

Gjerde, B. and Gjaren, H.M. and Villanueva, B. 1996.Optimum designs for fishbreedingprogrammes with constrained inbreeding. Mass selection for a normallydistributed trait. *Livest. Prod. Sci., 47: 59-72.*

Gjerde, B., Gunnes, K. and Gjedrem, T. 1983. Effect of inbreeding on survival andgrowth in rainbow trout.*Aquaculture, 34: 327-332.*

http://iisgcp.org/EXOTICSP/carp/htm>. Accessed 2005 December 2.

Hume DH, Fletcher AR, Morsion AK .1983..*Final Report. Carp Program Report No. 10*.

Hussain, M.g. Islam, 2002. Sock improvement of silver barb (Barbodes M.A. hossain, M.I. Wahid, A.H.M. Kohinoor, M.M. Dey and M.A. Mazid.GonionotusBleeker) through several generation of genetic selection, Aquaculture 204: 469-480.

Jhingram, V.G., and Pullin R.S.V., 1998: A Hatchery manual for the common carp, Chinese and Indian Nov., 1998, Kathmandu (Procedures under publication).

Jhingran, V.G. 1991.*Fish and Fisheries of India 3rdEdition*, Hindustan Publishing Corporation NewDelhi, 727Pp.

Kaur k. and Dhawan, 1997: Introduction to inland Fisheries, National Agricultural Technology Information Center, Ludhiana.

Koehn J, Brumley B, Gehrke P .2000. Managing the Impacts of Carp Bureau of Rural Sciences (Department of Agriculture, Fisheries and Forestry), Canberra, Australia.

Koehn J. 2004. Carp (*Cyprinuscarpio*) as a powerful invader in Australian waterways.*Freshw. Biol.* **49:** 882-894.

Lofvall, L.W. 1998. Fish Marketing in Kathmandu Valley. Support to a new Kalimati Market Project NEP/91/035. FAO of the United Nations, Kathmandu, Nepal.

Lugowska K., Jezierska B., 2000, Effect of copper and lead on common carp embryos and larvae at two temperatures. Folia Univ. Agric. Stetin. 205 Piscaria 26: 29-38.

Meuwissen, T.H.E. and Woolliams, J.A. 1994..Response versus risk in breedingschemes.*Proc. Sfh WorldCongr.Genet.Appl. Livest.Prod*G.,uelph, Canada.

Mishara R.,2013 Status of Fish breeding condition and its essential of Nepal , R.P or K.J.F.B.O, Balaju

More.P.R, 1R.Y. Bhandare, S.E. Shinde, T.S. Pathan and D.L. Sonawane. 2010. Comparative Study of Synthetic Hormones Ovaprim and Carp PituitaryExtract Used in Induced Breeding of Indian Major Carps. Libyan Agriculture Research Center Journal International 1 (5): 288-295, 2010ISSN 2219-4304 © IDOSI Publications, 2010.

National Sea Grant and Geographic Education Alliances. 1999.

Nicholas, F.W.1989. Incorporation of new reproductive technology in geneticimprovementprogrammes. ln: Evolution and Animal Breeding, Hill, W.G. andMacKay, F.C. (eds). CAB International, Wailingford, pp. *203-209.*

Parihar, R.P. 2009. Fish Biology and Indian Fisheries. Central Publishing House, Allahabad.

Schroeder GL (1983) Sources of fish and prawn growth in polyculture ponds as indicated by delta C analysis. Aquaculture 35:29–42 296

Shrestha, T.K. 2008.Ichthyology of Nepal – A Study of Fishes of the Himalayan Waters.Published by Himalayan Ecosphere, Kathmandu, Nepal.

Spataru P, Hepher B, Helevy A (1980) The effect of the method of artificial food application on the feeding habits of carps (*Cyprinuscarpio*L.) with regard to natural food in ponds. Hydrobiol 72:171–178 300

Steiner, L. 2000. Pennsylvania Fishes. Pennsylvania: Pennsylvania Fish and Boat Commission. 177 pp.

Tave, D. 1986: Genetics for Fish Hatchery Managers. AVI Publishing Company, Inc., Westport, Connecticut.

Wagle, S.K. and N. Pradhan 2003: Brood fish management status and suggestions to control inbreeding in carp hatcheries in Nepal. Paper presented in second conventional of Society of Agricultural Scientists (SAS) on 30th July-1st August 2003, NAARC, Khumaltar, Kathmandu, Nepal.

Wang, J.C. 1986. Fishes of California.California Department of Fish and Game, U.S. Bureau of Reclamation, and U.S. Fish andWildlife Service, Technical Report 9 (FS/B10-4ATR 86-9).P. 806.

Wohlfarth, G.W.,R. Moav and G. Hulata 1983: A genotype-environment interaction for growth rate of common carp growing in intensively matures ponds. Aquaculture, 33:187-195.

Wohlfarth, G.W.1993: Heterosis growth of common carp. Agriculture 113:31-46.

Woynarovich, E., 1969: Techniques of hypophysation of common carp. In: FAO/UNDP Region. Seminars on Induced breeding of cultivated Fishes, Calcutta, FRI/IBCF/14:11 p.

Zhou JF, Wu QJ, Ye YZ, Tong JG. (2003) Genetic divergence between *Cyprinuscarpiocarpio*and*Cyprinus*304 *carpiohaematopterus*as assessed by mitochondrial DNA analysis, with emphasis on origin of European 305 domestic carp. Genetica 119:93–97 306.

Photo Plate 1 :

Scenarios of Mandal Fish Hatchery Farm

Photo:1 Entry of Mandal Fish Hatchery Farm

Photo:4 Interview with MFHF Owner

Photo 2: Discussion during field at MFHF

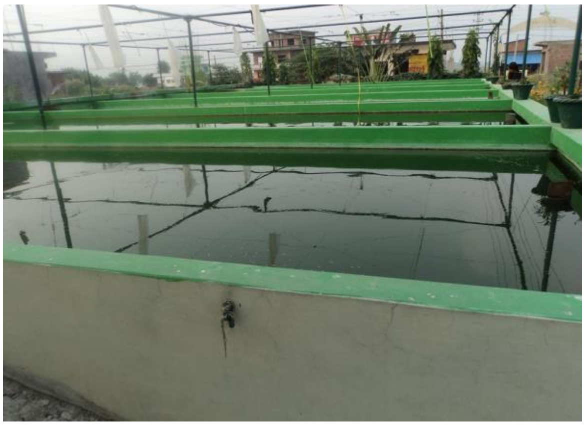

Photo:5 Rearing Tanks of MFHF

Photo 3: Observing fishes via Telescope at MFHF

Photo 6: Researcher at the bank of pond At MFHF

Photo Plate 2:

Field Visit in different seasons and interaction of local expert

Photo:7 Interaction with fishermen at Field

Photo:10 Interaction with fishermen at Field on different time

Photo:8 Intraction about Fish feeding

Photo:11 Field Visit at different season

Photo:9 Ovserbing size of Silver carp at MFHF

Photo:12 Talk about the tablet feed for fishes hatch to brood

Photo Plate 3:

Broods of Common carp and Silver carp along with fry

Photo:13 Silver carp preparing for breeding

Photo:14 Common carp preparing for breeding

Photo: 15 Silver carp on bucket for sell

Photo:16 Fingerlings on Air Oxygenated air bag for transfer

Photo:17 Common carp in the pond

Photo: 18 Fingerling for transfer

Photo Plate 4:

Fertilization process in Mandal Fish Hatchery Farm

Photo 19: Eggs of Silver carp (2 hrs)

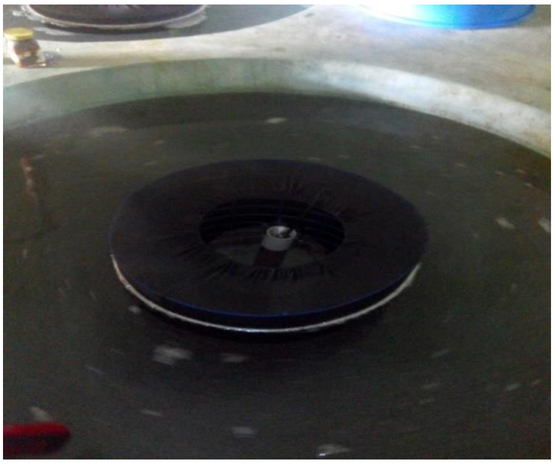

Photo 22: Eggs on Spawning Tank of Common carp

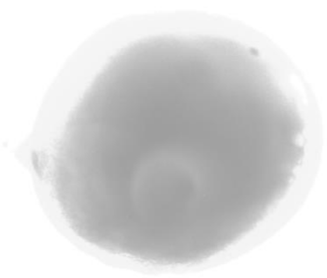

Photo 20 : Unfertilized Egg of common carp

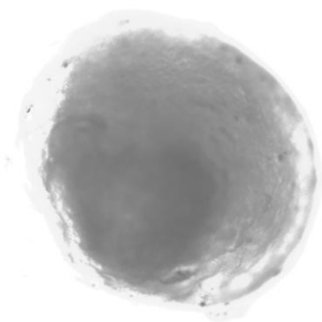

Photo 23: 4 hrs embryo of Common carp

Photo 21: Fertilized egg of (0hr) of Silver carp

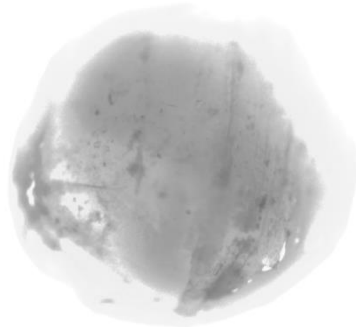

Photo 24: 4 hr embryo of Silver Carp

Photo Plate 5:

Fertilized hatch in Mandal Fish Hatchery Farm

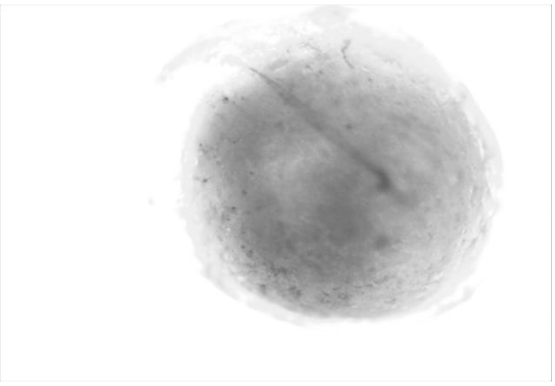

Photo25: 16 hr embryo (Common carp)

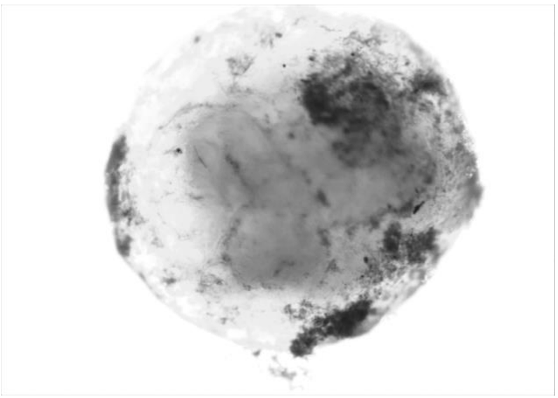

Photo 28. 24 Hr Embryo (Silver carp)

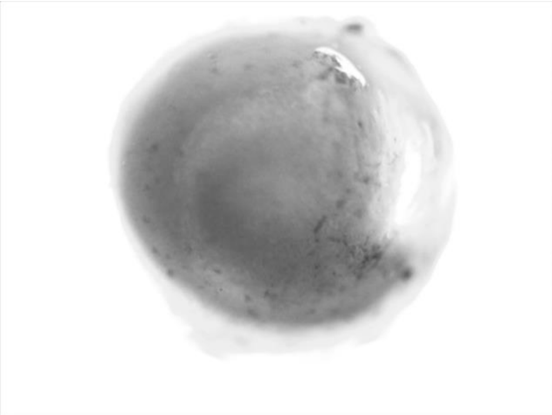

Photo 26: 16 hr embryo (Silver carp)embryo

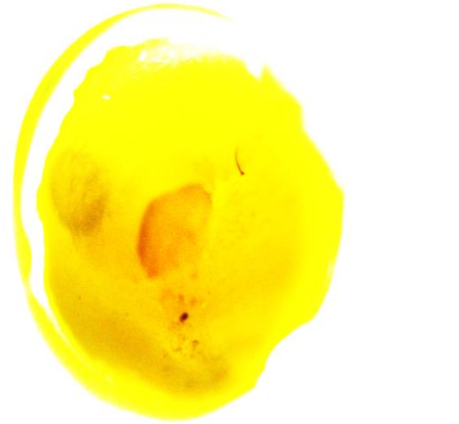

Photo 29: 28 hr embryo (Common carp)

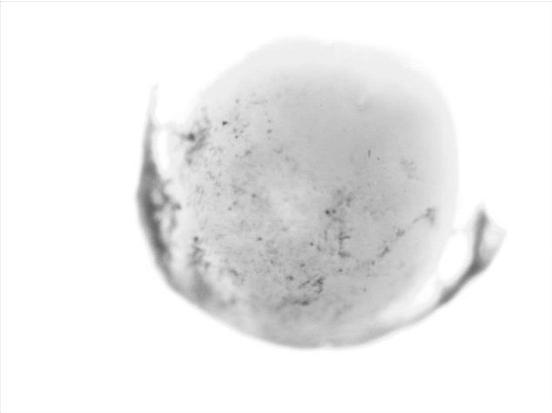

Photo 27: 24 hr embryo (Common carp)

Photo 30: 28 hr embryo (Silver carp)

Photo Plate 6:

Fertilized hatch to embryos in Mandal Fish Hatchery Farm

Photo 31.36 hr embryo (CC)

Photo 32.36 hr embryo (SC)

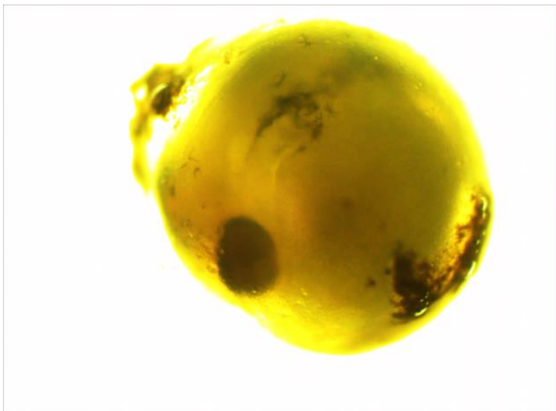

Photo 33.48 hr embryo (CC)

Photo 34. Newly hatched larva of CC

Photo 35.: Newly hatched larva of SC

Photo 36 . 2 days old larva of CC

Photo Plate 7:

Growth check-up of fry at different day in Mandal Fish Hatchery Farm

Photo 37: 2 day old hatchling of Silver Carp

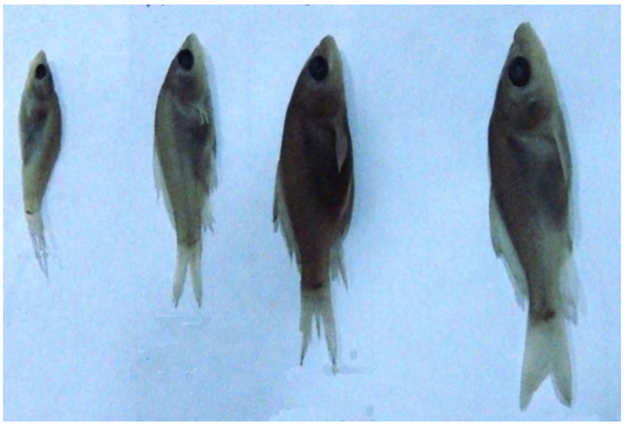

Photo 40: Growth check-up of fry of SC

Photo 38. 4 day old hatchling Common carp

Photo 41: Fry (14 day after hatch)

Photo 39: 4 day old hatchling Silver carp

Photo 42: Fry (21day after hatch)

Photo Plate 8:

Embryos in Mandal Fish Hatchery Farm

Photo43: Fry(28 days after hatch)

Photo 46: Counting Fingerlings for sell

Photo 44: Fry (35 days after hatch)

Photo 47 : Researcher Observing Fry in the rearing tank

Photo 45 : Fry (35 days after hatch)

Photo 48 :Fry and fingerlings