



Trout culture in Himachal Pradesh: Problems and Prospects

Thakur Pushpa¹, Gupta Pankaj^{2*} and Sharma Vijay Kumar³

¹ Research Officer, Institute of Integrated Himalayan Studies, Himachal Pradesh University, Summer Hill, Shimla-171005 Email: rathourgs@gmail.com

^{2*}Corresponding Author, Sr. Research Officer, Institute of Integrated Himalayan Studies, Himachal Pradesh University, Summer Hill, Shimla-171005 Email: pkpmahajan@yahoo.co.in

³ Project Officer, Institute of Integrated Himalayan Studies, Himachal Pradesh University, Summer Hill, Shimla-171005 Email: vijaysml39@gmail.com

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ABSTRACT

Evolution of cold water fisheries particularly the Trout culture through regular stocking of indigenous fish in the mountain water sources, especially in Himachal is one way which has been followed by the state government. Himachal Pradesh has huge prospects for trout farming particularly in the district Shimla, Kinnaur and Kullu. The water and temperature are promising for its culture. However, there have been limitations of availability of seed and its transportation in the state. Besides this, Environmental factors, topographical constraints, socio-economic difficulties and lack of awareness among the farmers have affected the trout production in the state. These constraints need to be overcome to realize the full potential of trout culture in the state. The status of trout culture and the problems encountered by the people in the state are discussed in the present paper.

Keywords: Trout Culture, trout farming, Rainbow Trout, Indigenous Schizothoracids, exotic salmonids, Brown Trout.

INTRODUCTION

The Indian Himalayan Region (IHR) occupies nearly 16.2 percent of the total geographical area and is a habitat for four percent of the total population of India. The fishery potential in Himalayan region is still unexplored because the cold water resources are located in the inaccessible areas. The water bodies in the Himalayan region houses diverse fish fauna. The huge fishery resources in Himalayan region inhabits around 258 fish species including indigenous Mahseer, Snow Trout, Exotic Trout and Common Carp (Singh *et al.* 2014). Menon in 1962 listed 218 fish species in the Himalayan region. Out of total 1,300 fish species, about 36 species of freshwater fishes are endemic to the Himalayan region (Ghosh, 1997). Hill states gifted with natural lakes and reservoirs could be utilized for fish production. Cold water streams and

rivers in mountainous countries stretching from Hindu Kush and Himalay support the recreational and sport fisheries in the region. Initially introduced for amusement in some rivers and streams of mountains, Trout has succeeded in creating self-reproducing population and later assumed as the commercial pursuit in the region (Petr and Swar, 2002).

In the beginning, the artificial breeding of Trout was undertaken to meet the stocking requirements of rivers streams. Till early fifties, Trout was regarded as a game fish and no one was concerned for its commercial farming. This was mainly due to the absence of technical know-how on Trout culture. The farms were afflicted with poor growth rate, high mortality and invasion of infectious diseases. With the launching of Trout feed in the European markets, the commercial farming of Trout got a break. This transformed the scenario of Trout culture in North America, Denmark and Japan. In India, the Trout farms usually sub-serve the need of anglers. Trout farms have been established primarily for raising the stocking material and later their transplantation in the streams. The farms in Indian states have been set-up for raising the stocking material and releasing them in water streams. Except Achabal and Patlikuhl, all farms are out-dated, primitive and suffering from qualitative and quantitative problems of water. The survival rate from 'eyed ova' to 'fingerling stage' is beyond low when compared to the European farms. During 1982, the European Economic Commission (EEC) started a project on commercial farming of Rainbow Trout in Kashmir. The project helped in re-modelling of Achabal Trout, besides validating the farm technology and production of leading table-sized fish. Later during 1988, a Norwegian aided project was initiated in Himachal Pradesh, with three objectives, viz.:

- (i) Setting-up of a model Trout farm with modern hatchery techniques;
- (ii) Formulation of pelleted Trout feed; and
- (iii) Demonstration of large-scale table-size Trout farming technology.

The trout culture has recently originated in the state of Himachal. Among European Salmonids, Brown Trout was the main fish to be bred and reared artificially. But, now-a-days main focus is on farming of Rainbow Trout. It is the only species among the cold water fishes being reared on commercial scale. Rainbow Trout is the native of Sacramento river region, whereas the Brown Trout is the native of mountain waters of Central and Western Europe. Both fish types belong to the family *Salmonidae*

and order *Isospondyli*. Brown Trout varies in colour and form. The distinguishing characteristics of Brown Trout are red orange spots on body and edge of adipose fin is slanted with red colour.

The skin of Rainbow Trout has small black star-shaped spots. The adults have a shimmering rose-coloured band on their flanks which is mainly visible at the time of reproduction. Rainbow Trout are considered suitable for commercial farming because they can easily accept artificial feed. They can withstand temperature fluctuations and their incubation is shorter, growth is faster, and they are more disease resistant.

Trout was introduced in the Himalayan region in the year 1899, when Mitchell successfully brought the live eyed-eggs of Brown Trout from England, which later hatched in a hatchery in Harwan, Kashmir. The 'eyed-eggs' of exotic Brown Trout were later taken to Kangra and Kullu valleys. These eggs hatched successfully in Mahili hatchery, Katrain in 1909 and hatchings produced were stocked in the streams of Kullu valley. Later a consignment of 5000 eggs of Rainbow Trout 'eyed ova' was transported from Kashmir. The progeny on attaining maturity spawned and fry so obtained was stocked in the streams of Chamba, Mandi, Shimla and Kinnaur districts. The oxygenated freezing cold water along with rich benthic fauna of streams offered congenial conditions not only for these game fishes, but also enabled their breeding and propagation in these streams. Later the excellent catches of Trout were reported by the anglers from different streams of the state. The state government then established a number of Trout farms at Barot, Patlikuhl, Chirgaon and Sangla to augment the stocks in these streams and boost the recreational fishery. Thus, the credit for initiating trout culture in India goes to Mitchell. Both species of Trout not only reached maturity in these waters but also bred successfully and thrived in these streams. The foreign aided projects contributed significantly not only in establishing the state-of-the-art Trout farms, but also gave new orientation to Trout farming technology. These projects also helped in evading the major barriers confronting the commercial Trout farming.

MATERIAL AND METHODS

The study was carried out in the state of Himachal Pradesh and for knowing the trends in Trout production, both primary and secondary data was used.

The secondary data was collected from relevant institutions and the primary data was collected by surveying different Trout farms both government and private. The pre-designed questionnaire was used to gather the information from the farmers involved in Trout culture.

RESULTS AND DISCUSSION

Trout Production Trends

Trout, a fresh water fish is valued as food and sport fish. Agro-climatic zone II and zone III of Himachal have potential of culturing Rainbow Trout. The ecological settings of these two zones are suitable for undertaking cold water aquaculture. Fish production mostly depends on the suitability of species cultured and the condition of pond where culturing is done. The same may be enhanced by maintaining and improving pond. Recent findings indicate that Trout can be cultured at lower elevation even up to 1000 msl provided that the optimal water quality and quantity is confirmed. Trout production can be:

Quantitative:

Quantitative production focuses on the quantity of fish, by ignoring the grade. The total weight of the fish to be harvested is considered more important.

Qualitative:

In this case, the quality of fish, i.e., the uniform size and weight, is given prime importance, while the quantity is given secondary importance.

Economic Production

Trout culture in Himachal aims at producing high quantity fish with great market value. Here both weight and quantity of fish are regarded equally. The river length for Trout fisheries in Himachal Pradesh is about 600 km. which can be judiciously trapped for its culture. The state has some of the finest Trout streams, like Pabbar in Rohru Valley, Baspa in Sangla Valley, Uhl in Barot Valley and river Beas and its tributaries in Kullu Valley. The state took a major leap in the production of Indigenous Schizothoracids, exotic salmonids, such as, Rainbow and Brown Trout. Keeping in view the vast potential of Trout in its perennial rivers, Himachal has emerged as the first state in the country to introduce Trout farming in the private sector besides emerging as number one producer of Trout fish. In 1988, the Norwegian Government came forward to assist the state

government to reinstate the exotic Trout culture, as well as to commercialize the Trout production. The project was initiated in 1989 and was split into two phases, viz.:

- (i) Transfer of technology, and
- (ii) Production phase.

The main aspects of Norwegian Project were to:

- Import fast growing and disease resistant eggs;
 - Develop economically viable palletized feed with locally available ingredients;
 - Train the local staff and farmers; and
- Produce economically viable fingerlings enabling the local farmers to adopt Trout farming.

Table 1 shows that the production of Trout in the state was 0.54 Tonnes during the years 1996-97, which increased to 25 Tonnes in the years 2005-2006 thereby showing a growth rate of 23.13 percent per year up to year 2010-11. During the year 2003-04, a sharp decline was observed in the Trout production due to outbreak of a disease. Then, it started increasing gradually and reached 60 Tonnes in the year 2009-10, 76.958 Tonnes in 2011-12, 205.44 Tonnes in 2012-13 and 351.27 Tonnes in 2014-15. In order to boost-up its production, the state fishery department started inspiring people to opt for Trout farming under different schemes.

Table 1: Trout Production in Himachal Pradesh during 1996-97 to 2015

Years	Production (in Tonnes)
1996-97	0.54
1997-98	1.62
1998-99	13.90
1999-2000	11.29
2000-01	19.89
2001-02	24.02
2002-03	17.33
2003-04	0.31
2004-05	19.34
2005-06	25.00
2007-08	52.00
2008-09	70.00
2009-10	60.00
2010-11	18.71
2011-12	76.958
2012-13	205.44
2013-14	233.49
2014-15	351.27

Source: Directorate of Fisheries, Government of Himachal Pradesh, Bilaspur

In all, there are more than eighty-one private Trout farm in the state, including six being run by the state government. The high altitude of Shimla, Kinnaur and Chamba district offer salubrious environment for Trout culture. Fishery department is planning to set-up more than hundred run-off river farms in Shimla, Kinnaur and Chamba districts. This is likely to help rural communities in improving their standard of living.

District-wise Production Trends

District Chamba:

Chamba, the north-western district of Himachal is the only district in the northern India, which has preserved its ancient cultural legacy. The district is located between North latitude 32° 11' 30" and 33° 13' 6" and East longitude 75°49 and 77° 3' 30", with a geographical area of 6528 square kilometres. It is enclosed on all sides by the mountain ranges. Trout Production in district Chamba during the year 2007 to 2017 is presented in Table 1. In the year 2001, Trout production was 0.200 MT which has increased to 219.50 kg in the year 2007. Though the production trend remains fluctuating but it was highest in the year 2016 as 336.747 Kg.

District Kinnaur:

Kinnaur, comprising of seven distinct valleys and gorges plunging rapidly into Sutlej, is bounded on its northern frontier by the spurs of snowy mountains which separate the district from Spiti. Fishery in Kinnaur was initiated during the third Five Year Plan with the construction of a small Trout farm at Sangla which has a capacity of producing 0.50 lakhs ova yearly. The production capacity of Sangla farm has reached a level of 2.5 lakh ova annually, which is adequate to meet the requirement of entire district. Keeping in view the vast and unlimited cold water resources in Kinnaur, the Indo-Norwegian Trout project was launched in the

district which opened new vistas for commercial Trout production in the state. The possible sources of Trout fish in Kinnaur are rivers, lakes, mountain streams and reservoirs, but the setting-up of power projects, blasting, construction and allied activities are decreasing the fish stock in these water sources. Moreover, lack of expertise and knowledge about the life history, breeding, migration pattern, behaviour, development of cold water fish farming has remained immature in Kinnaur.

The year-wise production of trout in district Kinnaur from year 2007 to 2017 is given in Table 2. The trout production was 67.340 kg in the year 1995 which increased up to 786.00 kg in the year 2002 showing an increasing growth rate of 23.41 percent per annum. The production was nil during 2003-04 because of draught and degradation of natural resources. The progressive efforts made by the Department of Fisheries constantly increased the fish production and maximum production (1448.17kg) was seen in the year 2010.

District Shimla:

District Shimla is located in the North-east region of the state. The total geographical area of the district as per the revenue record is 5,131 sq. km. and the topography of entire district is rugged and tough. Due to topographical variations, the district has varying climatic conditions, which vary from the sub-temperate to alpine with low-lying area experiencing warm season. The crop cultivation in the district varies according to the location and altitude. The district is known for cultivation of cereals, coarse grains, cash crops and stone fruits. Apple and seed potato are cultivated at higher altitudes. The water of entire Pabbar valley from Hatkoti to upstream of Dhamwari is believed to be excellent for Trout. Annual trout production from 2007-17 in district Shimla is presented in table 2.

Table 2: District-wise Trout Production (in Tonnes) in Private Sector 2007-2017

Farm	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Up to March 2017
Kullu	14.5	24.00	27.0	32.00	42.00	43.00	97.00	126.00	175.00	277.40	109.65
Mandi	16.54	24.00	1.16	13.10	13.50	8.00	30.46	35.00	65.00	180.00	160.00
Shimla	-	2.4	2.268	-	-	3.3	10.40	6.00	13.00	29.76	25.00
Kinnaur	-	-	-	-	-	1.8	9.20	8.00	10.00	33.44	15.00
Chamba	-	1.9	0.053	4.00	-	1.36	32.00	35.00	60.00	80.50	75.00
Kangra	-	-	-	0.65	1.7	1.50	7.20	10.56	14.08	17.00	31.00

Source: Directorate of Fisheries, Bilaspur, HP

In Shimla district, the highest total fish production of 3079.35 Kg valuing Rs. 414522.5 was recorded during the year 2016.

District Kullu:

Kullu district is situated between 31°58'00" North Latitude and 77°06'4" East Longitude. Kullu is a transitional zone between the lesser and the greater Himalay and presents a typical rugged mountainous terrain with moderate to high relief. The altitude of district varies from 1300 metres to over 6000 metres from the mean sea level. The higher reaches are conferred with splendid snow peaks and glaciers. The important glaciers of the district Kullu are Kalihen, Beas kund, Saraomga, Tirchu, Parvati, Dibbi and Mantalai. Forests constitute a major proportion of total land and Deodar, Kail, Cheel, Walnut, Rae, Tosh and Ardar are widely distributed in the upper Beas and Parvati valleys. Kullu Valley offers salubrious conditions for Trout fishing in river Beas, which roves through it with its large tributaries, like Sarveri, Parbati, Sajoin and Phojal. The Sajoin and Tirthan rivers which form a tri-junction with Beas are Trout streams. The entire Kullu valley right from Manali to Bhuntar provides excellent pools for fishing especially at Patlikuhl, Katrain and Raison. The Trout production in Kullu district from the year 2007 to 2017 is given in Table 2. Trout in the district was 5.712 MT in the year 1995, which increased to 14618.9 kg in the year 2007. The production was highest, i.e., 16659.33 Kg in the year the year 2013.

CASE STUDIES

There are three Trout farms in Himachal, the case studies of which has been presented in below:

Case Study I: Sangla Trout Farm

Sangla is located at a distance of about 250 km from Shimla. The River Baspa which takes its origin from the glaciers of Great Himalayan ranges, flows through Sangla valley, one of the most beautiful valleys in the western Himalay. The district has a small Trout farm located at Sangla on the left bank of river Baspa. The farm has a total area of 1.5 acre. The farm draws water from Hubra *khad*, which is a tributary of river Baspa. The water is drawn using a 5 inch diameter GI Pipe. Moreover, there are two water springs outside the farm which are supplying additional water of about five litres per second to the farm. The infrastructure available at Sangla farm includes, 14 Raceways (size varies from 7x1. 5x1 m to 15x2x1.30m), 16 Nursery tanks, One

Office-cum-store, One Hatchery, One feed store and farm residential complex.

There are plenty of raceways in the farm, but water supply is a limiting factor. In order to utilize the entire infrastructure available, an additional water supply system from Rukti *khad* has been initiated. Earlier only two species of Trout namely Brown Trout (*Salmo trutta*) and Rainbow Trout (*Oncorhynchus mykiss*) were cultured. To explore new possibilities in the tribal belt, 500 eyed ova of Arctic Char was imported and reared. This fish can withstand water temperature 3 to 4°C below that of Trout. Interaction and conversation with Trout farmers took place in the district to ascertain the problems, which the farmers are facing and the future scenario of Trout farming in the district. During the discussion, farmers deliberated on various aspects of Trout farming, for instance, management of farm, feeding and fish health, post-harvest management. According to most of the farmers the transportation of eggs or hatchlings from Sangla is difficult due to poor condition of the road and there is no provision for safe transport of the same. Many a times the larva die during the transportation.

Most farmers were of the view that there is problem of transporting the produce to market and at village level there is no market, where the produce can be sold. Local people have less preference for Trout and the hotel vendors don't prefer buying the fish for tourists. So the local consumption is comparatively less. Moreover, the chefs in the hotels are not aware of the recent and preferred Trout recipes. It was seen that all water resources are snow-fed and in case of landslides and disasters, the water channels and raceways are damaged, which disrupts the water supply and at times results in large-scale mortality of trout Many a times the construction is a time consuming process which affects the fish pond.

A private farm owner from Sangla revealed that there is lack of post-harvest management technology because the refrigeration facility is not available in the area. The feed and its transportation are very expensive. Non-availability of proper feed is a problematic. Earlier the farmers used purchase the feed from Kullu, which is very far and cost-effective. Moreover, the people here are not aware of the disease management in trout.

After exhaustive discussion and visit to different farms in Kinnaur, it was found that people are keen in

undertaking Trout farming and construction of raceways. Fisheries Officer at Sangla said that Trout farming has high potential in Kinnaur but has not developed at the rate which it should have been because of various topographical limitations, which includes teething troubles of constructing ponds, availability of fingerlings, marketing problem and lack of market access. Trout farming is a laborious job and involves painstaking efforts and interest of the farmer. Once the farm starts giving the profit, farmer's pursuit gets a boost. For getting constant water supply most of the Trout farmers are depend on *kuhls*, the traditional water streams though some have constructed raceway through own resources. The farmers depend on government hatcheries and fish farms for procuring fingerlings.

The Fisheries Officers were of the view that though the project was initiated with great enthusiasm, however, it lags behind in terms of technology transfer, which needs to be updated to make it cost-effective. There are untapped areas in terms of quantity and quality of water supply, feed management, maintenance of cleanliness and disease care. There is need of adapting new hatchery practices and organizing orientation programmes for Trout farmers. The areas where the quantity of water is decreasing, there is need of re-oxygenation and artificial re-circulation of water to meet the challenge. Production of fish feed and its effective administration has to be taken-up on priority basis.

A private Trout farmer revealed that the state is rich in terms of highly valued Trout fish, which has paved its way for exporting to other states. But, improved technical knowledge and better marketing strategies are required for enhancing the production. Majority of Trout fish farmers have constructed the raceways through self-investment. Few Trout farmers availed the sponsorship schemes of state fisheries department.

A Trout farmer while recollecting the flash floods of 2011 narrated that rain caused enormous destruction in the Trout breeding farms in the valley. Private firms were hard hit by the damage and some of the farms were totally washed away.

The Fisheries Officer at also narrated that 450 trout fish worth Rs 5 lakh were found dead at Haripur, Kullu in April, 2017. The farm belonged to private owner and the sudden flow of dirty water into the farm caused contamination of water and resulted in mass causality.

Fish farmers have to suffer because of natural calamity. Lack of proper market and transportation are impeding the private sector Trout farming. Unavailability of fingerlings and fish feed have also been hampering the growth of Trout farming that otherwise has huge potential. The farmers depend on the government for fingerlings and fish feed. The price of trout is between Rs.220-250 per kg, and a farmer earns a profit up to 30 percent. A Trout fish farm generates nearly 215 days of employment in a year and adds to 40 percent of average household income. Smoked, baked, grilled or fried Trout are relished by fish eaters. Trout from Himachal Pradesh reached the hotels and restaurants in Delhi and Mumbai. Trout culture has good prospective in the state but this endeavor has not advanced as fast as it can due to several limitations for instance, essential hydrological conditions for constructing raceways. Location of Trout farms is usually away from farmer's house and the cost of construction of raceways is very high. The fingerlings are not easily accessible for farmers at required place and the cost of feed seems expensive to the farmers. Moreover, it is not readily available. Most farmers report lack of local market for Trout and problems linked with the venture.

There are only few Trout farmers in Kinnaur and most of them face same problems. After interacting with the farmers, it was found that there is a need of imparting farm management training and value addition to the produce to help the farmers for opting latest farm management practices and introduce new Trout cuisines in the menu of local restaurants. In order to make fish farming venture more fruitful, there is a need of proper input supply with proper knowledge about fish farming and its marketing. There is also a need to support and promote the cooperatives, producing agencies and contract farming. Thus, strengthening of fish markets, evolving new market institutions, and adoption of best production practices is the need of the hour.

Case Study II: Dhamwari Trout Farm

Dhamwari Trout farm is located at Dhamwari in 0.6 ha land in Rohru tehsil of Shimla district. Water in the farm has been drawn from Khanyara *khad* at the rate of 150/litres/sec through GI pipe, which can be increased if required. The available infrastructure at farm includes, eleven raceways, one hatchery building, four start feed tanks, two nursery tanks, six hatching troughs, office building and residences.

Capacity of Farm: It has a fish production capacity of five Tonnes.

Hatchery: The hatchery has an installed with a capacity of one lakhs ova & 50000 fingerlings.

Case Study III: Indo-Norwegian Trout Project, Patlikuhl

Rainbow Trout farming was started in Kullu under Indo-Norwegian project a long time back in late eighties, which not only effectively transmitted the technical knowhow of culturing high-value fish species, but opened new avenues for businesspersons and unemployed youth. A number of progressive farmers are currently involved in Trout farming and sending their produce to Delhi and Mumbai. Trout farming technology was brought to the state from Norway in late-eighties, but the technology later became obsolete, which affected the production. The state government showed interest in undertaking farming of Rainbow Trout, which was later supported by Norwegian government and an agreement was signed in the year 1988. The project consisted of two stages: transfer of technology and production phase. During the transfer of technology, modern Trout farms were constructed on Norwegian model. The project envisaged:

- Importing of fast growing and disease-resistant eggs;
- Production of economically viable feed from locally available material;
- Training of local staff and farmers; and
- Production of economically viable fingerlings

A grant amounting three Crores was sanctioned by Norwegian government for:

- Making the project expenditure;

- Bearing the cost of equipment; and training

The state government agreed to bear the cost of construction and salaries of project personnel. First phase of the project started in the year 1989 and first consignment of 'eyed ova' reached Patlikuhl in the beginning of 1991. A factory meant for manufacturing fish feed was started. Record survival of 92 percent 'eyed ova' to 'fingerling' was achieved against the expected 42 percent.

Fish Production in Indo-Norwegian Trout Farming Project at Patlikuhl is a special instance to elaborate the Trout farming in Kullu valley. During the year 2006-07, 14.62 Tonnes trout fish and 3.26 lakhs seed were produced in the farm. During 1999-2007, Trout fish at this farm has increased at the rate of 5.37 percent per year while the growth rate of production of fish seed during the said period was 0.75 percent per year.

During the year 2006, the total income from Patlikuhl farm was Rs. 46.2 lakhs, out of which 21.62 percent consists of income from fish sale and 78.35 percent from the sale of fish seed. Since, 1999-2000, the income from this farm has increased at the rate of 14.53 percent per year, while the rate of growth of income from fish sale and the sale of fish seed comes out to be 29.30 and 13.43 per cent per annum respectively.

Thus, the production trends for district Shimla and Kinnaur remain inconsistent, while for district Chamba there has been gradual increase from 1.36 Tonnes in the year 2012 to 75 Tonnes up to March 2017, similar observations have been made for district Kangra, where the production has increased consistently.

Table 3: Fish Feed Production in Indo-Norwegian Trout Farming Project Patlikuhl

Years	Fish Sale	Fish Seed and Sale	Total
1999-2000	1.65537	14.81721	17.48805
2000-2001	2.53503	18.49176	22.03297
2001-2002	2.56138	21.61626	24.57001
2002-2003	2.01220	17.89532	19.90752
2003-2004	Prevalence of Disease	Prevalence of Disease	Prevalence of Disease
2004-2005	2.77	24.43	27.2
2005-2006	6.0	26.60	32.6
2006-2007	9.99	36.2	46.2
CGR %	29.30	13.43	14.53

Source: Indo-Norwegian Trout Farming Project, Patlikuhl, District Kullu





CONSTRAINTS IN TROUT FARMING

The problems pointed out by the farmers are summarized as:

- High cost of feed;
- Lack of attentiveness related to fish health;
- Lack of awareness regarding post-harvest management;
- Lacking adequate information regarding the farm management;
- Low sale price of Trout;
- Non-availability of adequate feed;
- Inaccessible market for selling the produce;
- Poaching and illegal fishing;
- Poor recovery of Trout larvae due to unavailability of quality starter feed;
- Slow fish growth due to inbreeding; and
- Unfair means of fishing resulting in loss of fish

The findings of the present study are in agreement with the observations made by Khanal & Gautam (2008) who pointed out difficulties in availability of fish fry, technical facets of farming, high production costs, problems in availability of feed as main constraints for trout farming technology at farmers' level in mid and high hills of Nepal. Harald (1985) pointed out environmental degradation, disease and competition for resources as the main constraints in aquaculture development.

CONCLUDING REMARKS

In order to effectively run the Trout farming in the state, there is need of:

- Avoiding the incidence of disease and environmental stress;
- Schedules for health examination of fish;
- Importing the technique to prevent 'mass-killing' at the swim-up fry and fingerlings stages;
- Decontamination of farm tanks; and
- Improved quality and design of feed plant and hatchery equipment with the latest technology

In order to maintain the trout farming as profitable venture in the state, there is need of keeping pace with latest aquaculture practices.

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