

PRESENT SCENARIO OF FISHERIES IN THE HILLS OF SIKKIM

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Abstract: Nature has endowed Sikkim with distinct advantage of abundant water bodies and varied aquatic life. The state has various water resources in the form of rivers, lakes, streams and perennial springs which provides immense scope for the development of inland fisheries both capture and culture. There is an inherent potential of coldwater aquaculture in the state having good water quality and sufficient quantity of cool, clean and flowing water. Initially development programme of fisheries in the state was mainly on conservation of aquatic life and encouraged sport fisheries. But now fisheries activities has been expanded for the promotion of sustainable fish culture as an income generating activities in the rural areas, augmenting nutritious food production, generating supplementary source of income to fish farmers and fisherman, promoting fishery for tourism and conservation of riverine fish germplasm. The fisheries activity is linked with tourism and the educated unemployed youth are motivated towards fish culture practices which help them to lift up the economic condition of the people in the rural area. It has been an important enterprise for livelihood security to the rural people of Sikkim. The present study attempted to analyse the status and role of fisheries in the hill economy of Sikkim. This study also highlights economic performance of fisheries from the last two decades. The present study solely based on secondary data collected from the different secondary sources such as Department of Animal Husbandry, Dairying and Fisheries, Govt. of India and Govt. of Sikkim, Fishery Survey of India, National Fisheries Development Board, Central Coldwater Research Institute etc. Both qualitative and quantitative tools of analysis were carried out. The results were analysed by using the various statistical tools such as bar diagrams, trend analysis etc.

Keywords: Fisheries, coldwater, hill economy, rural development.

I. INTRODUCTION

Sikkim is a tiny state situated in the lap of Eastern Himalayan Region. The nature has endowed Sikkim with distinct advantage of abundance water bodies and varied aquatic life. The state has various water resources in the form of rivers, lakes, streams and perennial springs which provides immense scope for the development of inland fisheries. The state has a huge potential in the fishery sector both for capture and culture fisheries due to the abundance of coldwater resources. Fish farming has become an important source of livelihood for the rural people in the uplands and lowlands areas due to the hilly terrain, agriculture and other allied activities are not only sufficient for the rural development. Initially development programme of fisheries in the state was mainly on conservation of aquatic life and encouraged sport fisheries. But now fisheries activities has been expanded for the promotion of sustainable fish culture as an income generating activities in the rural areas, augmenting nutritious food production, generating supplementary source of income to fish farmers and fisherman, promoting fishery for tourism and conservation of riverine fish germplasm. The fisheries activity is linked with tourism and the educated unemployed youth are motivated towards fish culture practices which help them to lift up the economic condition of the people in the rural area. It has been an important enterprise for livelihood security to the rural people of Sikkim.

II. REVIEW OF LITERATURE

The fisheries sector occupies a very important place in the socio-economic development of the country and it is a source of livelihood for a large sections of economically backward rural population (Ayyapan and Krishnan, 2004; Jana, 2007). It ensures food security as well as tackles unemployment in these regions, which are predominately inhabited by rural populace. It has become an important activity and is recognized as a rich

source of cheap nutritious food (Kumar et al, 2007; Sundararaj, 2007, Kumar, 2007). This sector contributes rural development more effective administration of natural resources and conservation of biological diversity (Dagtekin et al, 2007).

Gopalan (1976) reveals that fisheries play a significant role in developing countries like India. It contributes fish protein to a large population that suffers from malnutrition. It is unlike the cereal protein. Fish contains amino acids such as lysine and this serves as an efficient supplement to the low protein, high carbohydrate diet of developing nations like India. From the above study it is fact that fisheries play an important role for the development of nation having immense water resources.

The most important indigenous cold water fish species are sahar (*Tor* spp), katle (*Neolissocheilus hexagonolepis*) and snow trout (*Schizothorachthys* spp and *Schizothorax* spp). They are excellent from the economic and sport fishery point of view, but many other species are fished for subsistence. Cold water fisheries offer a great opportunity for self employment and income generation among poor people living along rivers, lakes and other natural waters (Shrestha 1995; Subba and Ghosh 1996; Shrestha 1999).

Singh et al (2017) pointed out that Rainbow trout *Oncorhynchus mykiss* has established itself as prime cultivable coldwater species in the Indian Himalayan regions and now farmed on commercial scale. Its production has increased markedly in last ten years (2004 - 2014) from 147.0 to 834.0 tonnes, with a growth rate of 31 percent per annum. Availability of technical know-how of trout farming, breeding and artificial diets has immensely helped in promoting aquaculture of trout in the country. Himalayan region of India is the major producer of rainbow trout (81.2%) while contribution from other regions of the country is meager.

Macharia et al (2015) stated that Rainbow trout aquaculture is a lucrative venture having it to be the second most expensive fish in Kenya after Nile perch (*Lates niloticus*) in both fresh water fish and marine fish. Investment in this area has a very high potential of improving the livelihoods of the rural people in areas where trout fish aquaculture is feasible.

Mahseer (*Tor putitora*), one of the well-known large freshwater game fish of mountain rivers and lakes of most Trans-Himalayan countries, is reported to be declining in their natural habitats due to pollution, overfishing, industrialisation, urbanization and agricultural development causing ecological alterations and physical changes in natural environment in lakes and rivers of mid hills (Dasand Joshi, 1994; Shrestha, 1994). Attempts to culture and conserve *Tor* spp have been initiated in most Trans-Himalayan countries (Joshi, 1994; Shrestha, 1997). To replenish the declining populations of mahseer in its natural habitats attempts are being made to breed and develop culture techniques of the *Tor* species.

Tunde et al (2015) analysed that the Inland fish production is found to be a highly feasible and profitable venture and also a way to use effectively the water resources of all kinds, which are locally available. Sonawane et al (2005) stated that more attention is required for the development of fishery resources through better understanding of ecological principles, production and exploitation techniques. He further says that the co-operative sector has to be organized in such a way that it should become more competitive and better managed. Ele et al (2013), Olaoye et al (2013) found that feed (kg), years of farming experience and stocking density have significant effect on output levels. Their study recommends among others, that fish hatcheries and feed mill should be established in the study area and government should provide credit facilities with small interest rate to fish farmers.

III.OBJECTIVES OF THE STUDY

The objectives of this study are as follows:

1. To know the present status of fisheries resources and role of fisheries in the hill economy of Sikkim.
2. To analyse the trends of fish production in Sikkim and other Himalaya states of India.
3. To address the major issues and strategies for fisheries and aquaculture development in hilly state of Sikkim.

IV. DATA AND METHODOLOGY

The study is solely based on secondary sources. The secondary data and information were collected from the different secondary sources such as Department of Animal Husbandry, Dairying and Fisheries, Govt. of India and Govt. of Sikkim, Fishery Survey of India, National Fisheries Development Board, Central Coldwater Research Institute etc. Along with these various published books, hand books, annual reports released by both State and Central governments, statistical abstracts, and reports studied by various research organizations were also referred in the study. Data on numbers of fish farmers in all the four districts of Sikkim from 2009-10 to 2013-14, fish production from the Himalayan states for the period 2003-04 and 2013-14, and fish production of Sikkim from 2006-2015 were collected. Both qualitative and quantitative analyses were carried out. The results were analysed by using the simple graphical analysis.

V. RESULTS AND DISCUSSIONS

Fishery Resources and Fish Diversity in Sikkim

The estimated total inland water bodies of the state is 0.03 lakh hector, length of rivers is 900 km and area of ponds and lakes are 0.1 and 3.2 thousand ha, respectively. Teesta and Rangeet are the main river system with their numerous tributaries which support the major riverine fisheries resources of the state. The total length of riverine system including the stream, steep or gradual from an altitude of 300 m to 8580 m is about 900 km. The water resources of Sikkim contain 48 fish species belonging to 9 families under 23 genera Most of the species belongs to Cyprinidac family. The most important fish species are Mahaseer (Sahar), Snow trout (Asla), Cat fish (Ther, Gandi), some carps (Budana, Nak Kauta) etc. are found in rivers and streams (Tamang,1999). The fish cultivated area is categorized into two parts. The area which falls above 1500 m sea level is identified as cold water zone and cold water fishes like trout are encouraged for stocking in the streams and lakes for angling purposes and culture in raceway in the private sector specially the rainbow trout brown trout. Below 1500 m from the sea level is identified as carp zone and cultivation of carp fishes like grass carp, silver carp, common carp and other species are suitable for cultural purposes in the lower belt of Sikkim. The total annual fish yield from the riverine resources is 120-150 tons annually and about 1500-2000 villagers living close to the river banks are engaged in part time fishing. This serves as a source of additional income and nutrients to fisherfolk.

Trout Fishery

Earlier, in Sikkim, trout fishery was confined to production and stocking of brown trout fish seed in the coldwater streams and lakes for promoting angling and latter it was extended to rainbow trout farming as an economy activity in the private sector due to the growing population and demand of trout fish in the state. Farming rainbow trout is a profitable alternative to conventional agriculture that can be practiced within very limited land. Due to its taste and medical value this fish is highly preferred over other locally available fishes; hence the total demand of trout is very high. Realizing the benefits of this farming system the government is promoting trout farming among the rural masses as an income generating activity. The government is providing financial as well as technical assistance for trout farming under the scheme named "Trout culture in raceways". There are total five trout farm along with hatcheries set up in Sikkim for brown and rainbow trout seed production. The seed production capacity of the individual hatchery is:

Table1: Trout farm in Sikkim

| Sl.No | Name of the Trout Farm | Loaction | District | Hatchery Capacity |
|-------|---|----------|----------|-------------------|
| 1 | Yuksom Trout Farm | Yuksom | West | 5 lakhs |
| 2 | Uttarey Trout Farm | Uttarey | West | 2 lakhs |
| 3 | Men-Moi-Tso Trout Farm (Brown Trout) | Kupup | East | 5 lakhs |
| 4 | Sharchok Trout Farm | Lachung | North | 1 lakhs |
| 5 | Lachen Trout Hatchery | Lachen | North | 0.50 lakhs |

Source: Directorate of Fisheries, Government of Sikkim.

These trout farm were established for seed production and demonstration purposes. The fingerlings are distributed to the fish farmers in order to encourage them for aquaculture.

Carp Fishery

With the objective to utilize the water resources of mid-altitude level carp fishery is initiated under various beneficiaries scheme in the private water bodies for carp fish production and in the public water bodies for carp seed production for availing to the farmers. The major carp species that has been cultivating are common carp, grass carp and silver carp. Recently a Hungarian strain of common carp and mirror carp has been introduced in the state which is said to have 47% higher growth rate than existing strain of carp available in the state. There are six carp seeds production farm set up in Sikkim for the production of quality carp seed for distribution to the beneficiaries and to stock in village ponds and other different resources of state. The district wise farm and location is shown in table below.

Table 2: Carp farm in Sikkim

| Sl.No | Name of the Carp Farm | Loaction | District |
|-------|-----------------------|-----------|----------|
| 1 | Gayzing Carp Farm | Gyaba | West |
| 2 | Rothok Carp Farm | Rothok | West |
| 3 | Rangpo Carp Farm | Rangpo | East |
| 4 | Rorathang Carp Farm | Rorathang | East |
| 5 | Kabi Carp Farm | Kabi | North |
| 6 | Makha Carp Farm | Makha | East |

Source: Directorate of Fisheries, Government of Sikkim.

Mahaseer Fishery

Mahaseer is one of the very important game fish species which is available in the foothills of the Himalayan river system. It is also called the King of Game Fish locally known as Sahar is available in the lower belt of the river Teesta and Rangit. It is observed that population of Mahaseer has been decreasing in the river system due to habitat destruction by manmade activities across the river and diversion of river water and natural calamities. This species is declared as endangered fish species which is under the threat of becoming rare. The artificial stocking of mahseer seed in necessary to sustain mahseer population in the river system and therefore one small mahseer farm has been constructed at Baguwa in South Sikkim.

Farmers Engaged in Fish Farming

The aquaculture or fish farming has been an additional source of income, employment and protein in the rural and remote parts of Sikkim. Fish farming can be practice in the limited areas of land with other farming activities. In the hilly areas due to fragile and small holding of agricultural land, agriculture and farming is done in small scale which is based on seasonal. A particular farming cannot support the economy of the household unlike in plain farming. So, in the hilly, fish farming has been an additional economic activity which supports livelihood in the rural areas. Diagram below shows the number of farmers practicing fish farming in the hilly state of Sikkim.

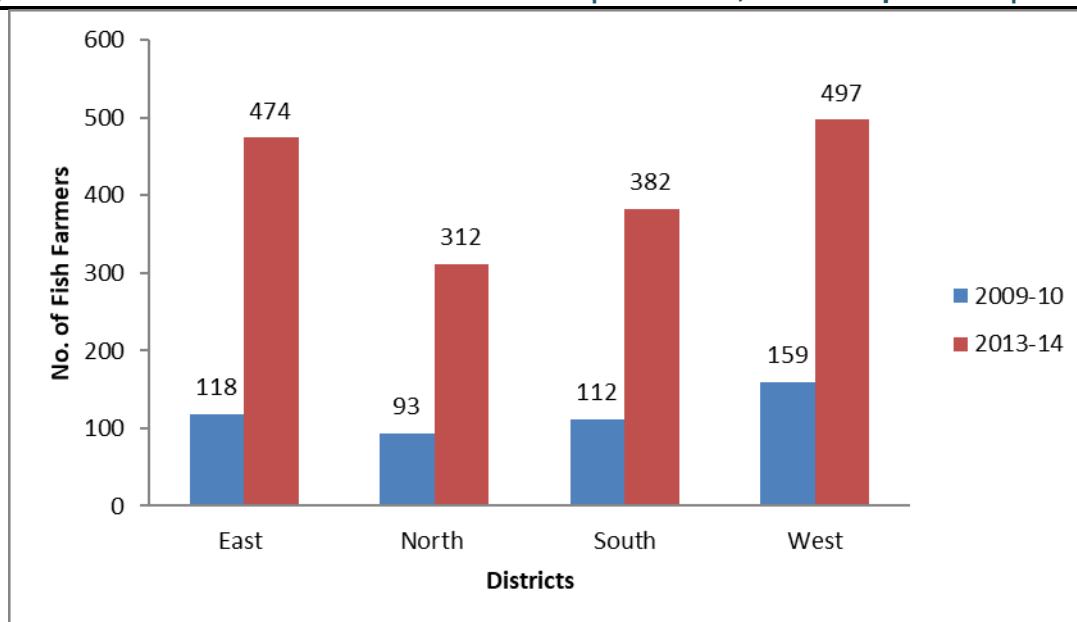


Figure 1: No. of fish farmers in Sikkim.

From this diagram it is clear that fish farmers in all the districts of Sikkim have increased. There is a positive growth of farmers in the state of about 245.44 percent during 2009-10 to 2013-14. West district of Sikkim has the largest fish farmer of about 497 as on 2013-14. West Sikkim has more potential of fish farming having the availability of fresh and cold water that support rainbow trout farming and in lower belt carp farming. In 2009-10, there were only 159 farmers. Within this period of five years there is a 212.58% increase of farmers. Similarly east Sikkim has the second largest number of fish farmers in the state. During 2009-10, there were only 118 farmers which are increased to 474 in 2013-14 and the percentage increased is about 301.69 percent. In east Sikkim also more land is suitable for aquaculture. North Sikkim has the least number of fish farmers in the state because north Sikkim has very fragile land and less land is suitable for farming and habitation in fact the total areas is highest amongst all the district. The slope of the land is very steep and population is less as a result farming activities is less as compared to other districts of Sikkim. During 2009-10 the reported farmers was about 93 and it is increased to 312. Southern parts of Sikkim have the scarcity of water and are not suitable for trout culture. In some parts of it people are rearing carp fishery, because of this problem farmers are less in south. In 2009-10, the numbers of people engaged in fish farming were 112 and it was increased to 382. In addition to these, at present, there are more than 1500 fisherfolk who are actively engaged in catching the fishes from the rivers and streams in Sikkim.

Fish Production from Himalayan States

The Himalaya state of India consists of Jammu & Kashmir, Himachal Pradesh, Uttarakhand, Sikkim and Arunachal Pradesh which are suitable for the cultivation of coldwater fishes. The potential coldwater fisheries resources of India include the long stretch of Himalayas of around 2500 km from Jammu & Kashmir in the West to Arunachal Pradesh in the East and 200-400 km from North to South comprising an area of 5,33,604km² (FAO,2003). There are around 10,000 km long streams and rivers, 20,500 ha high and low altitudinal lakes and 50,000 ha of reservoirs both natural and manmade and 2500 ha brackish water lakes in the high altitudes These varied water resources in the uplands harbour are rich ichthyofaunal diversity comprising large population of indigenous and exotic, cultivable and non-cultivable coldwater fish species which have potential for aquaculture practices as well as capture fisheries. These coldwater resources are suitable for the cultivation of coldwater fishes like trout and exotic carp species (Bora et al).The aquatic resources available are quite valuable for the development of fishery both for food and sport. The mountain areas are mostly landlocked; fish in ponds, lakes, streams, rivers and reservoirs play an important role in providing food, income to people and source of animal protein (Kumar et al, 2012). The following diagram gives the brief view of production of fishes from these five Himalaya states of India.

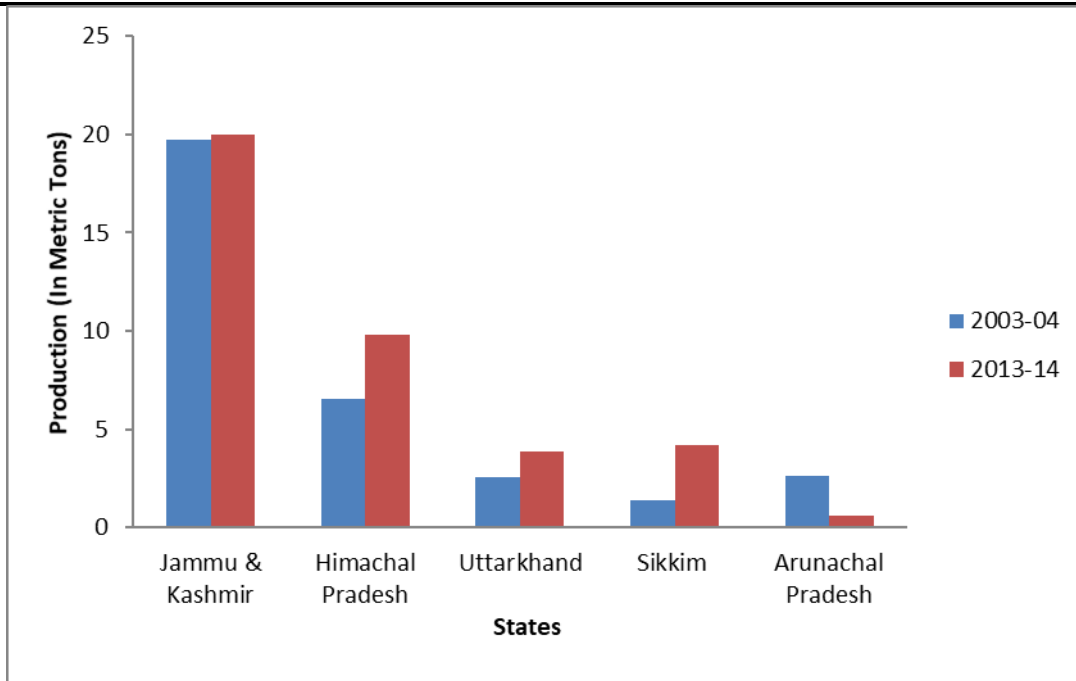


Figure 2: Fish production from Himalayan states of India

Fish production status of a decade is taken for all these five Himalayan states. This figure illustrate that there is not much increased of fish production in Jammu & Kashmir but the production is highest among these states. In 2003-04 the production was 19.75Mt and increased to only 19.98 Mt in 2013-14. Himachal Pradesh is the second largest cultivator and producer of coldwater fisheries in India. Its production increased from 6.53Mt to 9.83 Mt in 2013-14. The production of fish is increased in both the states of Uttarakhand and Sikkim but percentage increase is higher in case of Sikkim. Sikkim being a small states of Himalaya performing well in terms of fish farming with a growth of 200 percent during this decade. Arunachal Pradesh is the only state which is recorded with decline in the production of fish. Its production greatly declined from 2.65 Mt to 0.61 Mt from 2003-04 to 2012-13.

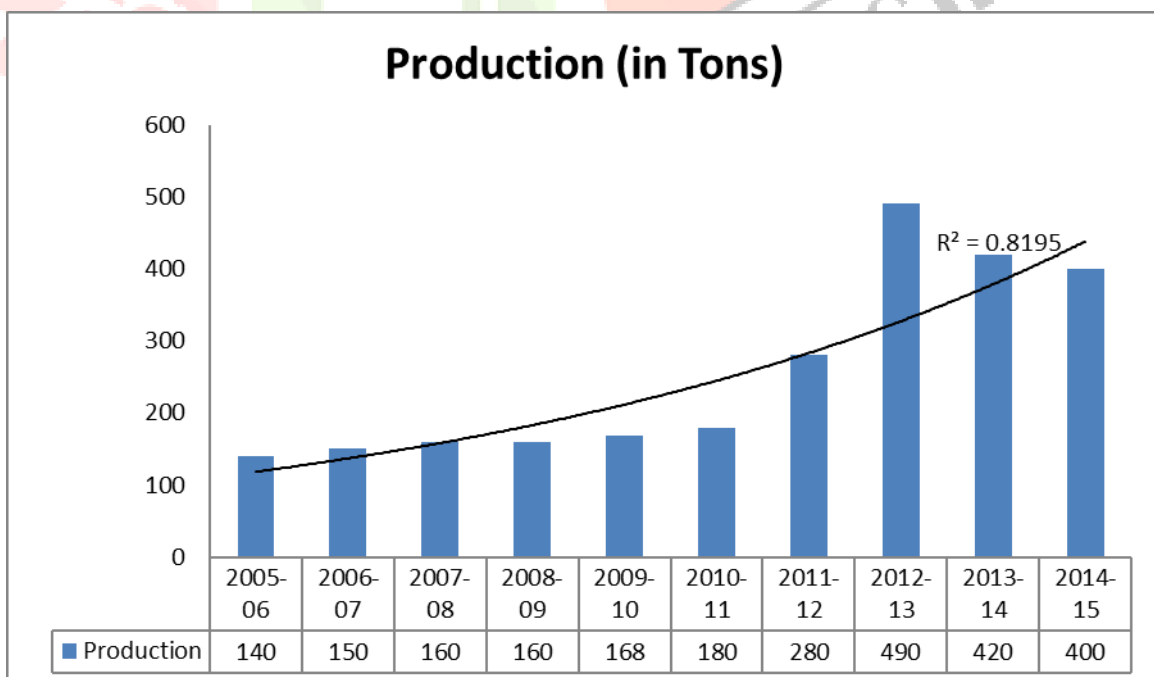


Figure 3: Fish production in Sikkim from 2006-07 to 2014-15

The production of fish in Sikkim was gradually increasing making the highest production in the state in 2012 of about 490 tons. But its performance is decreased from 2012 onwards and during 2014 to 2015, it shows the zero growth rates. If we see the overall trend within this ten years period, it is observed that on an average fish production is moving on the positive trend.

Issues and Strategies for Fisheries and Aquaculture Development in Hills of Sikkim

There are vast water resources in the state which are virgin and unutilised. The perennial springs and streams in the state are flowing from the uplands to low lands which are ultimately going into wasted. In the hill fisheries sector is facing the problems like poor accessibility, difficulty hilly terrain, lack of transportation and proper market, lack of infrastructure for aquaculture etc as a results this sector could not foster to the extended level. Even though the above problems exist in the hill state, following are the some of the strategies that could be undertaken in order to increase the level of production and to bring resources in proper utilization.

1. The water resources of the state could be brings into fish farming and aquaculture development by bringing these resources in an efficient and proper way rather than going into wasted.
2. Awareness on the importance and role of fisheries and aquaculture in the rural development and nutritional value can motivate the younger generations as a result more people can get opportunities in fish farming.
3. Fish is a highly perishable product, so accessibility, cold storage, proper transportation and marketing facilities in the rural areas can foster this sector so that local fish can be easily available in the market.
4. Use of modern technology and training to farmers can increase the level of production.
5. Local fish market centre in the market could encourage the farmers for extensive farming and made available for urban people.

VI. Concluding Observations

The present study analysed that fish farming has been a source of livelihood, additional source of income, earning, employment and nutrition in the rural parts of Sikkim. In the rural areas, people do not buy fishes from the market, they produce and sale in the village itself. It is helping the village to sustain. The government of Sikkim is trying to increase the level of production by encouraging rural people, giving them financial assistance and technical knowhow and by providing various central and state scheme. From the above study it is known that in Sikkim trout such as rainbow trout and brown trout; carps such as grass carp, commom carps and silver carps have been culturing for the purpose of food and sport. Mahaseer is the important game fish available in the foothills of rivers of Teesta and Rangit. In Sikkim, fish farmers in the entire district have been increasing. There is a growth of 245.44 percent during 2009-10 to 2013-14 in the state. Sikkim is showing a positive trend in terms of fish production amongst the five Himalayan states of India even though production is less as compared to some other states. There are some of the problems such as poor accessibility, poor transportation and absence of marketing facilities etc for local fish farmers in Sikkim. As a consequence of these, the fisheries sector haven't foster to the extensive level. So, proper planning, methodologies and implementation are required in order to solve these problems.

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