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TROUT FARMING IN SIKKIM: A GLIMPSE AT PRESENT STATUS AND WAY FORWARD

Prakash Sharma • N.N. Pandey • R.S. Haldar • Debajit Sarma

ICAR-Directorate of Coldwater Fisheries Research
Bhimtal – 263136, Distt. Nainital, Uttarakhand

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Authors
Prakash Sharma
N.N. Pandey
R.S. Haldar
Debajit Sarma

ICAR-Directorate of Coldwater Fisheries Research
Bhimtal- 263 136, Nainital, Uttarakhand

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Authors

Prakash Sharma, Scientist

N.N. Pandey, Pr. Scientist

R.S. Haldar, Assistant Chief Technical Officer

Debajit Sarma, Pr. Scientist

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डॉ. जे. के. जेना
उप महानिदेशक (मत्स्य विज्ञान)
Dr. J. K. Jena
Deputy Director General (Fisheries Science)

भारतीय कृषि अनुसंधान परिषद
कृषि अनुसंधान भवन-II, पूसा, नई दिल्ली 110 012
INDIAN COUNCIL OF AGRICULTURAL RESEARCH
KRISHI ANUSANDHAN BHAVAN-II, PUSA, NEW DELHI - 110 012
Ph. : 91-11-25846738 (O), Fax : 91-11-25841955
E-mail: ddgfs.icar@gov.in

MESSAGE

Sikkim is a very important hill state of the country, having enormous water resources in the form of 900 km of rivers and drainages, and 250 numbers of lakes. It is also rich in fish diversity in terms of varied groups ranging from cyprinids to salmonids.

Rainbow trout farming has tremendous potential for augmentation of livelihood security of hill people, and it is being widely expanded, and the technology is widely adopted by the farmers of the state. It will prove to be a successful venture to increase the coldwater fish production for enhancing the profitability of the hill farmers of the region. There are certain issues which has tremendously been affecting the rainbow trout farming. Therefore, it is needed to be dealt with suitable technological interventions along with adoption of policies for it sustainable growth and farming.

Researchable issues have to be given stress, especially in development of low cost feed with locally available ingredients, quality seed production and best management practices for trout farming.

I hope that authors of the bulletin have highlighted in detail of these aspect which will be a valuable document for researchers, policy makers, and trout entrepreneurs for improving the trout production.

I congratulate the Director and authors for timely bringing out this bulletin for the benefit of multiple stake holders.

(J. K. Jena)

FOREWORD

The rainbow trout farming *(Oncorhynchus mykiss)* is the foundation of coldwater aquaculture in the country. It is a prosperous venture in the States of J & K and Himachal Pradesh; and gaining impetus in Uttarakhand, Sikkim and Arunachal Pradesh. If we discuss about the development of coldwater aquaculture in Sikkim particularly the rainbow trout farming, there is a need to expand trout farming in the potential areas of the state for providing nutritional, livelihood security and enhanced income creation for the enterprising population of Sikkim. A significant growth of 500-600g was observed in 12 months in West Sikkim at thermal regime of 14-18 oC.

Two species of trout, viz. brown trout and rainbow trout were introduced from Europe by British settlers in mid-eighteenth century primarily to meet their needs for sport fishing in India. Rainbow trout farming was commercially propagated in India through import of seed (eyed ova) from Europe in batches during 1984-1989. Over the year, the fatigue of genetic vigour has occurred leading to slow growth and productivity. We don't have genetic improvement programme for trout. Therefore, it is imperative to import fresh stock of pure and selectively bred seed material (eyed ova) to develop quality brood stock and to achieve quality seed production in the country.

Trout being a carnivorous species, needs high protein feed. The production of high protein feed at reasonable price in hilly states is a challenge which is also true in case of Sikkim and has been a real problem among trout growers. Partial replacement of fish meal is an area which needs deliberations and more research needs to be undertaken on these aspects. Trout being an expensive fish, it has restricted consumption. Therefore establishment of linkage between the production centre and to the advanced fish consumption base needs to be developed with the help of policy makers .

Raceway is the conventional exercise for trout farming. Introduction of new farming systems like Recalculating Aquaculture System must be explored for enhancing production and avoiding the risk of climate change in the high altitudinal areas where mostly the trout farming are being practised.

I hope the bulletin, we prepared, is having sufficient information regarding the present practise of trout farming in the state of Sikkim and have the future thrust areas which should be dealt with seriously with strong collaborative approach by the research organisation and the line departments, so that, trout faming in the state of Sikkim could be practised at ease attaining more profit in a sustainable manner.

(Debajit Sarma)

ACKNOWLEDGEMENTS

Authors want to thank the entire team of Directorate of Fisheries (DOF), Government of Sikkim; particularly Director, Mr. Sunil Pradhan who allowed us to undertake the survey work in all possible places of the state, and also for providing area specific DOF staffs. They help us in accessing the farmer even in the remote places.

Secondly, authors want to thank Joint Director (JD), Mr. D.B. Rai, who helped us immeasurably by availing himself in visit and survey, providing his officers, and lending his office vehicle for reaching the places of farmers within East Sikkim, particularly Pangthang, Tumin, Tenkilakha, Nimachen, Zuluk, etc. The assistance provided by him and his team members, namely Mrs. Gouri Mukhia (Range Officer, RO), Mr. B.L. Sharma, Mr. Sonam Bhutia (both are Block Officers, BO) and Mr. Kusang Tamang (driver) is highly admirable.

Mr. Naresh Silal (RO, West Sikkim), helped in visiting Sribadam clusters he made the arrangement very much congenial for survey and discussion with local farmers. At Uttarey, he and his team members, namely Mr. Charan Rai and Mr. P.B. Rai helped us in making the survey work easy and smooth. Further, Mr. Silal accompanied us to visit Upper Rimbik clusters as well. We would like to thank such a generous and helpful officer of DOF from the bottom of our heart.

Mr. Yuvraj Sharma (RO, South Sikkim) helped generously in reaching the farmers of the South District. He accompanied the survey trip to Payong and Sokpey of South Sikkim. We are very much grateful for his hospitality and assistantship.

We would also like to thank officers from DOF Headquarter (Gangtok), Mr. C.S. Rai (JD), Mr. Lahang Limbu (Assistant Director), Mr. Surendra Bhandari (RO), Mr. K.P. Sharma (RO), Miss M.K. Subba (BO) and many others, whom we might have missed to mention.

Thank you DOF team once again, for all your support and help during the survey. You all provided generous assistance for gathering real time information regarding the current status of trout farming in the state of Sikkim. We wish you all the best for your future developmental work to bring Sikkim in the forefront of national scenario for trout production. We will also assure you that we, in coming future as well, will provide the best possible and wide spectrum support for the development of trout farming in Sikkim.

Team of Authors

CONTENTS

INTRODUCTION

Rainbow trout (*Onchorynchus mykiss*) is a coldwater fish which belongs to Salmonidae family. Both rainbow and brown trouts (*Salmo trutta fario*) were introduced to Indian water by British during early 1900s. They were brought here for the purpose of recreational angling in the upstream of the Himalayan region in the North and the Nilgiri Hills in the South. The eyed ova of brown trout were first brought to India from Scotland during early 1905. Later in 1918, steelhead strain of rainbow trout was introduced from England, and it was then propagated to different regions of India, namely Nilgiri Hill region of Ooty in Tamil Nadu, Arunachal Pradesh, Sikkim, Himachal Pradesh and Jammu and Kashmir, etc. Brown trout remained in the natural water bodies, and its farming is limited due to its slow growth rate; however, rainbow trout has become the primary candidate species of high altitudinal hill aquaculture. It grows very fast rate in Indian climatic condition as it attains table sized fish in a short span of time compared to other indigenous fish species; on top of that, its price also is high. With this farmer friendly attributes, it has become very popular among the potential farmers. Additionally, seed production technique and the breeding protocol are also available, and these can be easily availed to the farmers for its artificial propagation. The species has a tolerance for wide range of temperature like less than 10 to more than 20°C. This fish has a good resistant to some diseases. It does also fetch a good market value and has a high demand among consumers, especially Himalayan people and tourist visiting hill stations. Therefore, many hilly states have undertaken farming in confined raceways and ranching of seed in the wild water bodies for propagation of farming and also to encourage the fishing tourism in the region to boost their economy.

Rainbow trout farming in India is considerably quite old and it is growing progressively and rapidly. It is majorly cultured in Himachal Pradesh, Jammu and Kashmir, Sikkim and Uttarakhand. Some level of small scale farming is also done in the hills of the Arunachal Pradesh, Munnar in Kerala and Ooty in Tamil Nadu (Singh et al., 2017). The culture can be done in a big or a small way ranging from single raceway to series of raceways. In Himachal and Kashmir, it is being done in a bigger way;

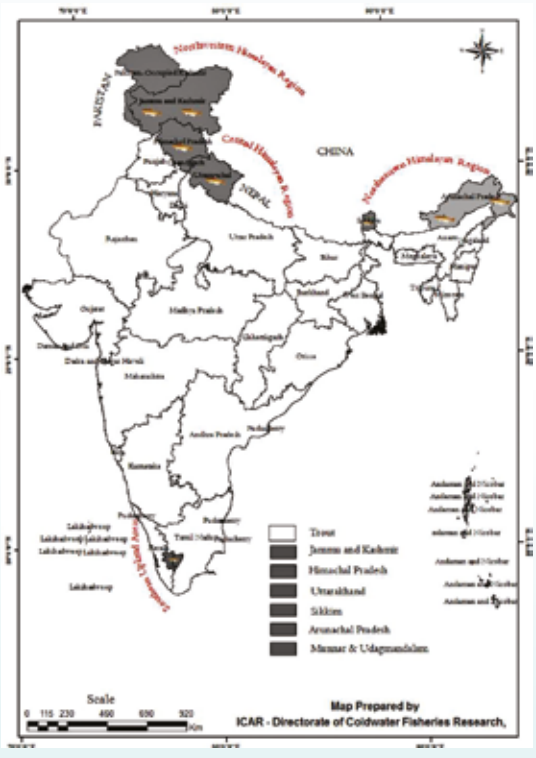

Figure 1.1: Map showing the coldwater region in India doing trout farming. (Figure adapted from Singh et al., 2017)

however, in states like Uttarakhand, Sikkim and Arunachal Pradesh, it is growing from single raceway to multiple raceways in advancing time phases. Currently, Himachal Pradesh and Jammu and Kashmir are the leading trout producing states. However in recent time, trout production in the state of Sikkim is also growing at significant phase. The trout production ventures are being is taken up by the public as well as private sectors of Sikkim in a challenging way to bring the position of Sikkim in front place in national scenario. The map below shows the different areas of culture of rainbow trout in country (Figure 1.1)

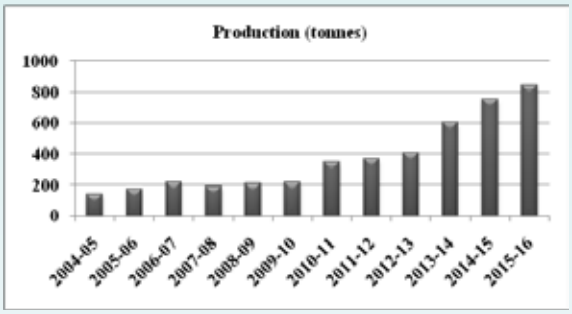

Figure 1.2. Trend of rainbow trout production in country (Figure adapted from Pandey et al., 2015; Singh et al., 2017).

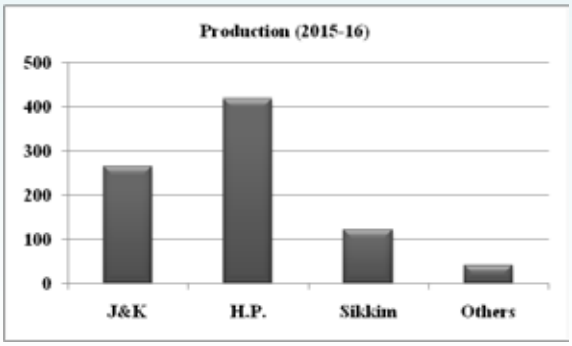

Figure 1.3: Rainbow trout Production by Himalayan state (in 2015-16; adapted from Singh et al., 2017)

The trout production in India has increased remarkably from 755.27 in 2014-15 to 842.23 metric tons (mt) in 2015-16, with a growth rate of 11.51 percent (Singh et al., 2017; Figure 1.2). When we compare the present production (842.3 mt in 2015-16) with those from 2004-05 with only 147 mt is a significant leap, and the credit for achieving this level of success goes primarily to the farmers, then to State Fisheries Departments/Directorates, ICAR-DCFR, Frontier KVKs, etc. (Figure 1.2)

Production of trout in Jammu and Kashmir, Himachal Pradesh and Sikkim was 265, 417, 120 mt respectively, while it other states including Uttarakhand and Arunachal Pradesh it was 40 mt during the year 2015-16 (Figure1.3)

Himachal Pradesh is the leading state in the production of rainbow trout in India (Singh et al., 2017). They contribute approximately 50% of the total production in the country. The state is blessed with the snow fed streams and rivers like Beas, Sutlej and Ravi in the higher reaches of the state. The various states have the varied infrastructure facility available with them for the trout farming. Development of trout rearing facilityhas been increasing steadily from the last two decades. At present, there are around 62 trout farms under Government sector while other more than 1500 numbers of raceways are spread over seven states in the western, north-eastern and peninsular region of the country (Singh et al., 2017). Trout farming practice is more advanced and developed in Himachal Pradesh and Jammu and Kashmir. Their infrastructure and facilities, at present time, include government hatcheries, government fed mills, state farms, private farms, private hatcheries, private feed mills, etc. The list of few infrastructures available with the state in the country is given below (Table 1.1)

Table 1.1: Status of trout infrastructure in India (2015-16; adapted from Singh et al., 2017)

Himalayan states	Trout infrastructures			
	Govt. farm	Private farm	Govt. hatcheries	Govt. feed mill
Jammu Kashmir	42	343	14	3
Himachal Pradesh	5	572	5	2
Uttarakhand	4	15	3	-
Sikkim	5	249	5	2
Arunachal Pradesh	3	-	2	-
Tamil Nadu	1	-	1	-
Kerala	-	2	2	-

Sikkim is a small Himalayan state of India with total area of 7,096 square km. It is surrounded by Nepal, Bhutan, China (Tibet) and Darjeeling (India) on the west, east, north and south respectively. The landscape in the state is absolutely mountainous and altitude ranges from 310 meters in the south to about 8600 meters in the north. Thus, the different range of climatic conditions prevail in Sikkim are sub-tropical (260-1524 meters), temperate (1524- 2743 meters), sub-alpine (2748-3962 meters) and alpine (above 3926 meters) (Tamang, 1992). Rainfall is the almost round the year phenomenon combining pre-monsoon (April-May) and monsoon (May-October) (online information, Meteorological Centre, Gangtok).

Sikkim has been endowed by nature with rich potential of perennial water resources and the perfect climate condition for rainbow trout farming. With the support of Directorate of Fisheries in implementation, monitoring and evaluation, ICAR-DCFR Bhimtal for scientific and technical support, and National Fisheries Development Board (NFDB) for financial assistantship, the trout farming has been steadily improving and growing in rapid pace. The state of Sikkim is one of the fast progressing states in the country in terms of trout farming in the national scenario. The scenic beauty and tourist destination also create wonderful opportunities for the culture of trout where it can be sold at high price in the market which in turn yield lucrative profit margin for the farmers.

In the past few years, with the support from the funding agencies like NFDB, through different schemes, the Directorate of Fisheries (DOF) Sikkim has attracted number of farmers into the business of rainbow trout farming. DOF has provided the attractive Minimum Selling Price (MSP) of more than Rs. 500 per kg. As a consequence, many more farmers have opted trout farming as their primary source of income. The production of rainbow trout has been recorded to increase to 120 mt productions in the year 2015-16 from around 53.4 mt in 2010-11 (Pandey et al., 2015; Singh et al., 2017). There is still a wide spectrum opportunities for increasing the production of trout in the state.

NFDB has been supporting the state for building wide spectrum of infrastructures, starting from trout farm and hatcheries under DOF, trout raceways for the farmers, community trout hatcheries for farmers' cooperatives, installation of trout feed mill, etc. All these funding under various schemes are designed, implemented, monitored, and evaluated by DOF. In a real sense DOF has been playing an architectural role in the spatial development of trout farming in the state by working in a strong collaboration with ICAR-DCFR. Not only the NFDB, even North East Rural Livelihood Project (NERLP; funded by World Bank), under Ministry of Development of North Eastern Region (DoNER; Government of India) has also started providing financial assistantship for building community trout hatcheries in the state.

The present document is prepared to highlight the current scenario of trout farming in Sikkim. For preparing this document, we compiled our all previous records, collected new information from DOF, Sikkim; and also, we did an extensive survey in all possible places of Sikkim where rainbow trout farming is being done. Putting all these information together, this document is prepared. This will prove to be a valuable knowledge based resource for DOF, KVKs, ICAR institute and other academic institutions.

CONTRIBUTION OF DIRECTORATE OF FISHERIES (DOF)

Brief history of DOF

Directorate of Fisheries (DOF) came into existence in 1974, under Forest Department, Government of Sikkim. While, the fisheries activities in real sense started later than 1979 under the guidance of Mr. S.B. Raizada, Mr. K.P. Bhutia, Mr. P.W. Bhutia, Mr. D.K. Pradhan and others.

From 1976 to 1992, many significant developments took place in DOF for the promotion of trout fisheries in Sikkim. These include:

Development those taken place during 1976-80

- Construction of trout farm and hatchery at Memencho
- Construction of trout rearing unit at Yumthang

Development those taken place; during 1980-85 include:

- Construction of trout rearing unit at Uttarey
- Trout Farm at Yoksum

From 1985-90, trout rearing unit at Lachung was constructed

From 1991-92: Formation of Fish Farmers Development Agency (FFDA). Since then only, the concept of fish farming by selected farmers of Sikkim came into being. Under this agency, the DOF officer and staff started to identify potential fish farmers, provided them loan for construction of ponds, provided them seed and technical knowhow, and tought them the science and art of fish farming in Sikkim.

Trout breeding in Sikkim

In early days, DOF used to produce trout seeds of mainly brown trout, for ranching in Memencho, Bethang Tsho, Rong chhu, Tshomgu lake, Rore chhu, etc. Their activities, during 1980s and 1990s, include breeding of brown trout (brooder collected from Memencho lake) at Memencho trout hatchery and production of fry. Fry produced from there were carried to different trout farms like Uttarey, Yoksum, Lachung, Lachen for further rearing to fingerlings and finally ranching in high altitude lakes and streams. During early 1980s, they started to bring rainbow trout seed in the form of eyed-ova from Himachal Pradesh; and these were then transported to hatcheries of Uttarey, Yoksum, Lachung and Lachen for final hatching, larval rearing to fry and fingerling size. Instead of giving to farmers, most of the seeds were taken for ranching in high altitudinal lakes and streams, rest they used to raise in farm for breeding in subsequent years.

Table: 2.1: Trout raceways created throughout Sikkim in different years by DOF.

Year	East	West	North	South
2009-10	Rolep	Upper Rimbik	Lachung	Shimkhola
	Lingtam	Yoksum		
	Lamaten	Ribdi Bhareng		
	Nimachen	Uttarey		
	Tumin	Maneypong		
	Gangtok	Hee Patal		
	Bhusuk			
2010-11	Naitam	Begha	Baythulung	Ghurpisey
	Zuluk	Sopakha	Sentam	Rabitar
	Rolep	Simphok	Passingdam	Temi
	Tumin	Uttarey	Salimpakyel	Damthang
	Lingtam	Hee Patal	Kalaus	Simkharkha
	Nimachen	Upper Rimbik	Singhik	Upper Payong
	Dalapchand	Yuksom		Yangyang
	Phadamchen	Kyongbari		Salep
	Sotak lakha	Sribadam		Parbing
	Upper Martam			Phalidara
	Bashilakha			Polok
2011-12	Rolep	Maneypong	Lachung	Sada
	Regu	Sopakha	Salimpakyel	Chitray
	Zuluk	Uttarey	Tingchim	
	Nampong	Simphok	Lingthem	
	Pangthang	Hee Patal	Dzongu	
	Tumin	Yuksom	Phamthang	
		Ribdi Bhareng		
		Sribadam		
2012-13	Phadamchen	Sribadam	Theng	
	Navey	Yuksom	Lachung	
	Bhusuk			
2013-14	Rolep	Upper Rimbik	Lachung	Sada

Year	East	West	North	South
	Regu	Okharey	Sarchok	Phamtam
	Pangthang	Bakhim		Sokpey
	Tumin			Chourydara
	Lingding			
2016-17	Tenkilakha	Sribadam	Men-rongong	Upper Payong
	Tintek	Uttarey		Sokpey
	Regu	Upper Rimbik		

Data obtained from DOF, Sikkim

Promotion of trout farming by beneficiaries became effective from 2009 onwards; DOF started availing funds for rainbow trout raceways (to interested beneficiaries with suitable land) through NFDB), Rashtriya Krishi Vikas Yojana (RKVY), National Mission for Protein Supplement (NMPS), Blue Revolution Mission and Fisheries Developmental Plan from state government (FDP). DOF has been facilitating the financial assistance to farmers for construction of concrete trout raceways in every possible year.

DOF helped to create clusters of trout farmers in all four districts. Creation of clusters is helping in creating village wise trout-growers cooperative society. In east district, there are so many clusters namely Tumin (including middle-Tumin and Dhanbari, Nimachen-Rolep-Phadamchen-Lingtam (although it is little widely spread), Pangthang-Tintek, Tenkilakha, etc. In west, there are as many as in Sribadam, Uttarey-Sopakha-Simphok-Maneypong, Upper Rimbik, Hee Patal, Yoksum, etc. From north include Lachung, Salimpakyel, Men-Rongong, etc; and from south are Shimkhola, Sada, Upper Payong, Sokpey, etc.

Table 2.2: Year wise increase in numbers of rainbow trout raceways in Sikkim

Year	East	West	North	South	Total
2009 - 10	15	21	12	5	53
2010 - 11	30	36	20	20	106
2011 - 12	7	15	10	8	40
2012 - 13	4	5	11	---	20
2013 - 14	8	7	7	8	30
2014 - 15	---	---	---	---	---
2015 - 16	---	---	---	---	---
2016-17	29	56	7	8	100
	93	140	67	49	349

Data obtained from DOF, Sikkim

The numbers from Table 2.2 indicate numbers of trout raceways, not the numbers of trout beneficiaries. In the initial year, i.e., 2009-2010, total numbers were fifty three, with highest in West and lowest in South. In the following year, total unit went up to one hundred and six. Again in following three years, i.e., 2011-12, 2012-13 and 2013-14 there was drop in the numbers. For the years 2014-15 and 2015-16, fund was not available with DOF to create further more raceways. However, with the advent of Blue revolution mission, the numbers went up by one hundred. Currently, there are total of 349 units of trout raceways.

Trout farms under DOF, Sikkim

East district

Memencho

This trout farm was constructed in 1975. The farm has total eight raceways of standard size which are being used for rainbow trout fry rearing. Hatchery unit with capacity of 5 lakhs green ova is used for breeding and seed rearing of brown trout for which brooders are being collected from Memencho Lake. Brown trout seeds are used for ranching in suitable high altitudinal lakes and rivers. Feeding river is Memencho which feeds the Memencho lake as well.

Kyongnosla

This trout farm was constructed in 2013.It has a hatchery unit of 2 lakhs green ova. This farm has two units of fry rearing fiber tanks and seven feeding trays. Currently water line to feed this farm has been damaged, and the farm needs some renovation and development. However, this farm is the nearest to the capital city.

Image 2.1: Trout hatchery (left) and rearing and broodstock (right) unit at Memencho

West district

Uttarey

This trout farm was constructed in 1980s, later it was renovated in 2012. The farm has the hatchery unit of 1 lakh green ova. It also has 5 fry rearing units with a capacity of 1 lakh fry in each tank and four brooder rearing units with a capacity of rearing 200 kg brooders. Feeder river. This is the most active farm of the state and it is catering all seeds required by the farmers of the state. The farm receives water from the nearest stream which is perennial in nature. Uttarey river flows through its vicinity towards its downhill, within a distance of approximately 100 meters.

Image 2.2: Trout farm under DOF at Uttarey, west Sikkim

Image 2.3: Density of fish stock maintained at Uttarey trout farm, west Sikkim

Image 2.4: Breeding and hatchery management at Uttarey trout farm, west Sikkim

Yoksum

This trout farm was constructed in 1984. It is currently not functional.

North District

Rabum

This trout farm was constructed in 2014. The farm has the hatchery unit with capacity of 3 lakh green ova. It also has multiple numbers of standard raceways for brooder rearing with a capacity of 400kg brooders.

Sarchok

This trout farm was constructed in 1990 and its hatchery was developed in 2012. The hatchery unit has a capacity incubating of 3 lakh green ova.

Singring

Current this farm is damaged by flood.

Lachung

Information not available.

Denga

This trout farm and its hatchery are constructed recently. Its hatchery unit has a capacity incubating of 5 lakh green ova.

Yakthung

This farm and hatchery are under construction.

Image 2.5: Fry rearing and seed distribution activities of DOF at Uttarey trout farm.

CONTRIBUTION OF ICAR-DCFR

ICAR-DCFR being a premier institute for the development of coldwater aquaculture in the country, it shares a strong bond with state fisheries Department/Directorates and frontier KVKs. From past many years, ICAR-DCFR has been working for spatial development of fisheries in Sikkim, starting from formulation of conservation strategies, promotion of mahseer linked ecotourism, providing knowhow in respect to carp farming and high altitudinal trout culture. From time to time, DCFR has been providing the training for the DOF officials, farmers, entrepreneurs, etc.; it has helped the farmers of Sikkim for construction or renovation of trout raceways through various schemes.

More specifically, DCFR has been instrumental in providing hands on training for broodstock management, breeding, hatchery management and fry rearing for production of healthy trout fingerlings. Apart from this, it also has provided the consultancy for improvement and renovation of farm and infrastructural makeover of hatchery at Uttarey. This was carried out to improve broodstock maintenance, better spawning and larval rearing. The technology and consultancy availed at Uttarey was translated in various other trout farms of the state, especially Yoksum, Rabum and Memencho. These collaborative efforts of DCFR and DOF in restructuring and functioning of farms helped the DOF immensely, for production of quality seeds.

Its contribution in availing the consultancy for the establishment of feed mill at Rohtak and Rangpo, has helped the DOF majorly. On top of that, the delivering of technical guidance for feed formulation, manufacturing, storing and distribution, is a milestone for the promotion of fish farming in Sikkim; because it will tremendously help the DOF as well as stakeholders in doubling the production of trout. Presently, Sikkim is facing a major problem of unavailability of trout feed, and this is becoming a limiting factor in further promotion of trout farming. However, in coming years, with collaborative effort from DCFR and DOF, if we can solve the problem of feed, we can bring many more farmers into the business of trout.

At the farmers' front, they worked directly with farmers by selecting and adopting trout growers for direct dissemination of scientific and technical knowhow of trout farming at their doorsteps. For that, they adopted 42 farmers from 7 clusters in West Sikkim and provided the farm level training, so that they can share their success story to the other in an effective method. DCFR has also helped the DOF by arranging the technical program or the awareness about the disease and the effective preventive measures, to the farmer as well as to the DOF officers. Cage farming is one of the recent technologies for aqua culture practices. Trout can be cultured in both raceways and cages, and for that DCFR provided the technical guidance and knowledge about the culture and method of the trout farming in the cages in Memencho lake.

Image 3.1: Practical training given by ICAR-DCFR to DOF staffs at Uttarey

2010-2011

ICAR-DCFR deputed the staff members, Dr N.N. Pandey (Principal Scientist) and Dr. R.S. Haldar (Assistant Chief Technical Officer) for conducting the exploratory survey in the state. With the help of DOF officials, they access the potential areas available in the state for trout farming. They visited all the hatchery and broodstock rearing facilities owned by DOF, and recommended and assisted in their renovation and restructuring. They examined the functioning of farm facilities and hatcheries of DOF, and provided the scientific and technical assistance for their improvement. By doing this, they helped in improving the seed production, and this in turn availed surplus seed for the beneficiaries. They formulated standard operating protocols for farm and hatchery management for improving the health condition of brooders and their progenies. In that protocols they emphasized the daily activities for maintenance of broodstock and seeds mentiontion; and along with that, restoration of the health and hygiene of the facility was also prioritized.

Image 3.2: Practical training given by ICAR-DCFR to trout farmers at Uttarey

2011-2012

During this period, particularly in December, the team of scientist, Dr. N.N. Pandey and Dr. R.S. Haldar, visited the state trout farm in Sikkim and delivered hands on training on trout breeding to DOF staffs and farmers. During that entire training they bred available brooders and produced 90,000 fertilized eggs. They did the same in Yuksom and Nimachen, and produced 5000 fertilized eggs in each facility. In these series of practical training at different hatcheries, they emphasized the importance of farm management for bringing out best brooders, trout breeding, egg incubation, hatching and seed rearing.

They also visited different places to examine the trout raceways constructed by farmers. There they provided the theoretical training regarding the trout farming, feeding management, health monitoring and remediation.

Image 3.3: Training given by ICAR-DCFR and DOF to farmers, on trout farming, at Uttarey.

2012-2013

During December 2012, the team of scientist from ICAR-DCFR, Dr. N.N. Pandey and R.S. Haldar again visited the Uttarey farm; and conducted the two days practical training program on trout breeding at DOF farm and hatchery facility at Uttarey. During that training, they bred 80 fishes and produced 15400 fertilized eggs. They designed and tested the wooden platform, for easily stripping of brooders, at the farm facility for carrying out the breeding.

They also provided the financial assistance to the state farm for buying the broodstock from the farmers with an objective to shuffle and change the existing stocks of brooder for avoiding chances of inbreeding. DCFR also provided continuous technical support to DOF for the brooder and larval rearing. DCFR also provided the feed for the larvae and grow out feed as well. In the West Sikkim, DCFR organised the advisory programs to the farmers about the farms infrastructure and its construction. They advised about the rate of stocking in the pond according to the rate of water flow, the feeding in the pond and about the health maintenance and monitoring during the culture. DCFR team also organized a technical session under the chairmanship of Fisheries Minister of Sikkim along with DOF Secretary, Directors, and other officers, and discussed about the enhancement of trout production in the state through collaborative mode.

Image 3.4: Visits of ICAR-DCFR scientists to various private farms of Sikkim for inspection of tanks, monitoring health condition and growth of fishes and practical demonstration of trout breeding.

2013-2014

During this year, DCFR provided the technical assistance for the installation of cages in Memencho Lake (East Sikkim) for farming of trout in cages. They helped in designing the proper inlet and outlet of Memencho trout farm. The design was provided for the better growth and the production of the trout from the raceway. They also instructed the method for selection and rearing of the healthy broodstock in the tank. During this year, with collective effort of

DCFR and DOF, the broodstock maintained in the state farm of Uttarey was increased from 300kg to 500 kg under the supervision and the financial assistance of the DCFR. Hands on training on trout breeding and culture were conducted at Uttarey for DOF officers, and under this training 3 Lakh eyed ova were produced successfully with 256 brooders in 4 batches. DCFR also released the funds for the enhancement in the infrastructures and hatchery sheds and also the purchase of trays and troughs. During the month of July the tribal trout farmer of Upper Rimbik was affected by the natural disaster of landslide in the region. DCFR provided financial and technical support to rehabilitate those farmers and to renovate raceways.

2014-2015

The team of scientist arranged the awareness and training program in the state farm of Uttarey, West Sikkim, about the culture of rainbow trout in the region. The program was attended by the local farmer and the department officials. The difficulties and problem faced by the farmers were noticed and the suggestion was provided by the team. The different method in the management was explained for the better production of trout in the region.

The team also the visited the farm adopted by the DCFR and observed the condition of brooders, and the performance of the farmer as compared to the previous year. They were advised about the maintenance of the tanks, regular cleaning of tank, maintaining of flow of water, etc. They also advised about the amount of feed to be given in the tank and the interval of time about the

Image 3.5: ICAR-DCFR scientists discussing scope and challenges of trout farming in Sikkim with fisheries Minister, Secretary, Director and other Officers of DOF, Sikkim.

feeding. Team delivered a suggestion and technical advice for the renovation of raceways and maintenance of broodstock in Memencho farm. They also advised the DOF for monitoring and cleaning of cage in regular interval.

2015-2016

DCFR scientist visited and did the survey on the potential trout farming places of the state. With the collaboration with DOF, they also examined the condition and production of trout in the state. They visited the different hatcheries and farm of the West Sikkim including Yuksom, Sribadam, Upper Rimbik and other clusters. They provided the feed, seeds and the financial assistance for the renovation tanks to the farmers at Upper Rimbik.

2016-2017

DCFR team assisted the DOF staffs for implementation of schemes on Blue revolution by providing technical assistantship in selection of farmers' cluster.

PANGTHANG, MIDDLE-TUMIN AND TUMIN-NAMRANG

Image 4.1: Accompanying staffs of DOF, Sikkim, during our visit

Pangthang is a sparsely populated village in the northwest part of Gangtok, on the way to Dikchu and Mangan. Depending on road condition, it is around 15-20 minutes drive from Gangtok. The place is famous for nurseries under Forest Department, GBPIHED (GB Pant Institute of Himalayan Environment & Development), SAP (Sikkim Armed Police) Headquarter, etc.

This village is filled with cardamom field and bamboo forest. It is extended in length along the highway, and is blessed with ample flowing water during monsoon (May-October), as there are series of mighty water falls in that region. Many of these streams and waterfalls are perennial. This village is the nearest to the capital city, therefore, the trout growers of this place get very good market and the price.

Tumin comes after crossing Pangthang, Tintek and Samdong; from Gangtok it takes around an hour and half. It comes under Rakdong-Tintek block. This village is spatially extended, and has fairly good population. Every household has their farming land for horticulture farm and cardamom field.

Image 4.2: Scenic view of Tumin village (left) and a glimpse of our tour to Tumin Dhanbari (right)

Name of the farmers: Mr. Prem Kumar Rai/ Ms. Pramila Rai (Profile picture belongs to the person who is taking care of their third tank, as he was there for interview).

Village: Pangthang, 8-mile, near Gangtok

Number of tanks: Three, two tanks are in their residential area. Out of these two, one is small (20x5x4; length, width and depth in feet) for rearing

of fingerlings and advance fingerlings, and other (50X7.5x5.5; length, width and depth in feet) for the grow-out and broodstock rearing. The third tank is located in their separate land within Pangthang (20x10x2; length, width and depth in feet). Third tank is one year old. It is full of marketable size fish. Currently, they are selling fish from the third tank.

Image 4.3: Rainbow trout farm of Mr. Prem Kumar Rai. A. is a small rearing tank, B. is regular raceway (during our visit they were cleaning the tank that is why water is lowered). C. is the third tank, D. represents water feeding and E. is the stream in close proximity (less than two meters) of the third tank.

Source of water: Perennial and available within the vicinity, plentily available during monsoon months starting from May to October. Water source in the third tank area during monsoon has potential to feed at least five tanks. Overall, based on the water availability, they can manage 7-8 tanks. Further, based on the availability of water, especially from May to October, and its coinciding with the season of optimal temperature, the location and resources are so perfect, and prove boon for the better growth of trout.

Started farming in 2012. The third tank is one year old. Old tanks were damaged by earthquake. Later, they repaired by self financing and restarted the farming. In the very first year, they could not sell as they faced severe mortality being a first timer. In second year, they managed to sell 250kg @ Rs. 600-800 per kg.

In the third year, with the addition of one more tank, i.e., second one, they raised the selling of their farm product to 500kg @ Rs. 600-800 per kg. Normally production per year is around 400-

500kg and they sell @ Rs. 600- 800/kg (favorable place for marketing due to its close proximity to capital city).Therefore, total income, on an average, comes to Rs. 3,20,000-4,00,000 per year.

Stoking: They go with the stocking density of 1000-1500 per tank depending on availability. For the last three years. They are producing fingerlings in their farm itself. Otherwise when they failed to so, then they bring seeds from DOF supply.

Feed and feeding: They depend on the feed given by the DOF, when there is a shortage; they feed their fish with wheat flour. The protein content of wheat flour is less than 10% but trout feed need more than 40% protein. For the early feeder in nursery rearing, they feed with beef, poultry liver, boiled egg yolk, powdered/crumbled feed, etc. @ 5-8 times a day. As they start to take regular crumbles and pellets then they reduce the frequency to 2.

Breeding: Apart from farming and marketing they have started breeding and seed rearing of trout. The training on breeding and hatchery management was provided in collaboration of ICAR-DCFR and DOF. They have been breeding trout for three years and produce on an average 5000 fingerlings in their facility. Their main constraint is the irregularity in feed availability.

Disease: Until now they have encountered some fungal infection and whirling syndrome; according to them, they appear simultaneously if tanks are not cleaned properly after feeding and in hatchery condition as well. In 2015, they faced around 70% mortality due to whirling syndrome, which eventually goes away with proper feed and feeding management.

Market: According to them, marketing is smooth and it is based on demand from local area, and hotels and individual consumers from Gangtok. The present price per kg as well is very much promising in terms of yielding best profit margin. Market includes local area and Gangtok. They generally go for harvesting and selling their farm product based on demand; therefore, there is rare chances of loss through spoilage.

Constraints: Primary constraint is irregularity in supply of feed or non availability of feed in time. Because of the lack of certainty in feed supply, they are not going to the commercial scale otherwise they have tremendous water resource for upgrading the farm.

Image 4.4: Newly constructed lone trout raceway owned by Kopila Pandey

Name of the farmer: Mrs. Kopila Pandey

Village: Pangthang, Gangtok

Number of tanks: Two, one is for carp which was built long back, and the other for the trout is built recently. The trout tank is built with own money, as she got inspired by the performance of Mr. Prem Kumar Rai.

Size of the tank: 55x7x4 (Length, width and depth in feet).

Source of water: Perennial within a distance of 500 meters, based on the water availability she can manage at least two trout raceways.

Year of construction: 2018. She has not started stocking yet.

Name of the farmer: Mr. Sonam Lepcha/ Mr. Chungsay Lepcha (son; this profile image belongs to Sonam Lepcha's wife)

Village: Middle-Tumin

Number of tanks: Currently two, otherwise they had three tanks, one is damaged by earthquake. All three tanks are funded by DOF under various NFDB schemes. Two tanks are currently functional, one is of regular size of 50x7x4 (length, width and depth in feet), the other smaller is 50x7x4 (length, width and depth in feet). The size of damaged tank is also 50x7x4 (length, width and depth in feet).

Source of water: Perennial within a distance of 500-1000 meters, otherwise in monsoon, water is plentily available in the vicinity.

Started farming in 2012: They follow best farm management by manipulating the feeding management. In the smaller tank, they stock as many as possible, around 1000-1200 numbers of fingerlings; and in the middle one, they put only 300-400. They feed the fish in the middle tank optimally for better and faster growth. According to their experience, ration is fixed approximately 2 kg (depending to stocking density) in the middle tank (1 kg morning and 1 kg evening).

According to them, fish reach the marketable size in 4-5 months, almost 500 to 700 grams on an average. Once they sell out maximum from middle tank, then they sort out the bigger ones from the smaller tank, shift them in middle, feed them well and sell them in 3-4 month. They follow the best stunting, sorting and re-feeding techniques for short term fast growth farming. This farm fall in the altitudinal range of 472 feet, perhaps because of this, fish gets the optimal temperature (until now we do not have temperature data) for faster growth.

Image 4.5: Trout raceways owned by Sonam Lepcha and his son. Remains of damaged tank extreme left top (left), and currently he has some fish (marketable size) in the middle tank (right)

Feed and feeding: They primarily depend on the feed supplied by DOF and use that feed judiciously and efficiently. For the very early fingerlings they feed crumbled/powdered feed 4 times daily, and once they start taking the regular pellets of 2mm size then they shift to two times.

Market: According to them, mortality occurs during stocking (March-April) and once they get acclimated it stops. They have experienced maximum mortality during first year of stocking. After that things are normal. Yearly, they sell around 300-400 kg @ Rs.800-1000/kg. They find some market in Tumin but mostly in Gangtok based on demands from hotels and homes of affluent.

Integration: Their trout raceways are in the upstream of cardamom filed and nursery; and they use the nutrient rich outlet water of raceways for irrigating cardamom field and nursery. According to them, this practice of utilizing outlet water has helped them in the raising output of cardamom nursery and cropping.

Constraints: Feed is not available in optimum; if available also, there is no continuity of supply. When regular trout feed is not there, growth drastically goes down.

Name of the farmer: Mr. Taranidhi Luitel

Village: Tumin-Namrang

Number of tanks: Two, both are funded by DOF under various NFDB schemes around seven years back, they are currently functional, and these are twin tanks with regular size of 50x7x4 (Length, width and depth in feet).

Source of water: Perennial and ample volume, potential to feed 5-7 tanks, within a distance of within 100-200 meters, otherwise in monsoon, water is plentily available in the vicinity.

Started farming in 2012: He has been farming for more than five years, other than the shortfall due to mortality and lack of knowhow regarding marketing in first year, he has been managing to sell, on an average, 300-400kg per year @ Rs.800-1000 per kg. According to him, fish reach the marketable size in 5-10 months, almost 700 to 1000g on an average. He follows approximately 10-12 month of farming cycle, and depending on feed availability (and consequently the growth situation). He starts selling after 5-6 months, sorting out the bigger one from the tank and letting the smaller to grow for next harvest. He follows the pattern of stocking in the month of March-April and starts harvesting (the bigger ones) from July-August, continue until December (allowing them to grow in long time-optimal temperature seasons), January, and even upto February, depending on the existence of the stock.

Stocking: He maintains the stocking density 2500 fingerlings per tank. He told that he generally, meaning-every year, is facing some degree of mortality during stocking and it eventually goes off once they get acclimated to feed of appropriate size. This sort of mortality is induced by new environment as well as discontinuity in rhythm of previous feed and feeding regimen. He

faced the maximum mortality during the first time stocking, probably because of the lack of experience in handling them, being a first timer.

Feed and feeding: He follows the normal feeding management, i.e., feeding two times daily. He also depends on the feed supplied by DOF. In lean period, his fish remain starved or they have to rely on wheat flour. For the very early fingerlings, he feeds crumbled/powdered feed 4 times daily, and once they start taking the regular pellets of 2mm size then he shifts to two times.

Image 4.6: Trout raceways owned by Taranidhi Luitel. Left magnification (highlighted in yellow) indicate volume of inlet water and the indigenous technique of enhancing dissolve oxygen and right magnification shows the school of table size fish ready for marketing.

Marketing: He finds some market in Tumin but mostly in Gangtok and local place itself. He goes for selling on demand only, otherwise if he does harvesting once-then he has to face loss due to spoilage.

Disease: Not so much, mortality during stocking is a common phenomenon with whirling syndrome, and it goes off with proper feed and feeding.

Constraints: His main constraint is the unavailability of feed on time and in required quantity. And this leads to poor growth, lower survival, lowering of overall productivity; as a consequence of this he is not encouraged to add few more tanks although he has the potential to go upto seven.

SRIBADAM

Sribadam is a beautiful place of West Sikkim, situated at an altitude of about 7000 ft, and it is around 106 km from Gangtok. The place is naturally adorned green forest, milky white but pristine streams and waterfalls. It has a small but clean and orderly township spatially surrounded by village, and also has sacred monasteries. The localites are mostly agrarian because the land is fertile for cultivation of cardamom, kiwi, maize, horticulture crops and medicinal herbs. Sribadam has earned special position in the state for being the best in milk, fish and cardamom production.

Image 5.1: Bird eye view of Sribadam village

The farmland of this village has abundant supply of free flowing perennial water resources, a boon for Himalayan aquaculture; as consequence, numbers of trout farmers are growing year after year. With the technical, financial and moral support of DOF, there are eight households (and 21 units of raceways) who are currently doing trout farming in a promising way. DOF has also helped them in forming trout farmers' cooperative society, they even have sanctioned community trout hatchery. Farmers in this village are very optimistic in taking the trout farming to the next level, and they even are planning to sell their farm output to mainland of Indian and abroad as well.

Image 5.2: Water resources of Sribadam village

Name of the farmers: Mr. Kal Bahadur Gurung/Mr. Rolen Gurung (Brother)

Village: Sribadam

Number of tanks: Four, two (twin constructed side by side) were constructed before 2012 under the various schemes for promotion of trout farming under DOF, Their size is 50x7x5 (length, width and depth in feet). Two (twin constructed side by side) are new (2017) tanks (57x7x4; length, width and depth in feet, depth is variable for maintaining the slope towards the outlet) funded by DOF under Blue Revolution mission. These two tanks are new and therefore, currently are not in operation. Tanks are constructed in the vicinity of cardamom field and horticulture farm; therefore, they are using the nutrient rich outlet water for these crops.

Source of water: Perennial, and during the monsoon months starting from May to October, it is available plentily with the potential to operate more than 5 tanks. The source of water is 200-300 meters away from tanks.

Started farming in 2012: First two years they experienced mortality, and as a consequence of this, they could sell only 100-150kg per year in those years. Better farming and optimal farm output was achieved only after 2014-2015. During these years, they afford to sell 300-400kg per year. They have achieved the highest selling upto 700kg in a year (from only two tanks) @ Rs. 600-800 per kg. They follow approximately 10 month of farming, and depending on feed availability, and consequently the growth status (whether the fish has attained the table size or not), they start selling after 5-6 months (sorting out the bigger one from the tank and letting the smaller to grow for next harvest). According to them, this will allow all the fish to reach optimal marketable size. On an average, they get 700-800g in 10 months of farming, provided feed is continuous and of good quality. They go for stocking in the month of March-April, start harvesting (the bigger ones) from July-August, continue until December, January, and even upto February, depending on the existence of the stock.

Stocking: They have been stocking with 1500 fingerling per tank, and out of those, according to them, approximately 500 fingerlings either die or wash away with water. Most of the stocking materials, i.e., fingerlings, are obtained from local fish farmer cooperative or government trout farm, Uttarey, West Sikkim.

Feed and feeding: They primarily depends on feed supplied by DOF, they procure feed also from Hyderabad through cooperative effort. During lean season, when feed is not available, they have to depend on locally made feed out of wheat flour, slaughter house waste (especially poultry liver) egg, refined oil, etc. According to them, ingredient such as poultry liver and eggs are expensive and they do not turn out to be economical.

Disease: Until now they have encountered some fungal infection; according to them, this appears if tanks are not cleaned properly after feeding. In early fry and fingerling stages, during the time of stocking, they have notice whirling syndrome; this goes away after feeding them with poultry liver and egg yolk along with the crumbled feed.

Market: According to them, marketing is going smoothly without any difficulty, and the price as well is very much promising in terms of yielding best profit margin. Market includes Sribadam, Soreng, Gyalshing, Jorethang and Gangtok. They generally go for harvesting and selling their production based on demand; therefore, there is no chances of loss through spoilage.

Constraints: Primary constraint is irregularity in supply of feed or non availability of feed in time.

Image 5.3: Trout raceways owned by Kal Bahadur Gurung and his brother.

Image 5.4: The intensity of water feeding in trout raceways of Kal Bahadur Gurung.

Name of the farmers: Mr. Samdup Bhutia / Mrs. Ashmit Bhutia (wife)

Village: Sribadam

Number of tanks: Five, out of which 3 are financed by DOF, and 2 are self financed. The financed tanks are given by DOF in different years under various schemes. The first DOF funded tank was constructed 2013, and its size is 60x9x4 (length, width and depth in feet). His self financed tanks are bit smaller than the former one (it constructed to accommodate in available space). Two are new tanks (57x7x4; length, width and depth in feet, depth is variable for maintain the slope towards the outlet) funded by DOF under Blue Revolution mission in 2017. These two tanks are new and therefore, currently not in operation.

Source of water: Perennial and available throughout the year, within a distance of 500-1000 meters. They have collected the water from various sources to ensure continuity even in the breakage of one or the other line. According to them, during the monsoon months, starting from May to October, water is available plentily with a potential to operate 10 tanks.

Started farming in 2013: They started farming 5 years back with one tank. In his first year of farming, they experienced some significant mortality of stocks-probably due to the lack of experience being a first timer. But gradually they could afford to sell 300-400kg per culture period. After 2015, with the addition of two more tanks they raised the selling to 500-600kg per cropping cycle. They follow approximately 10-12 months of farming. Depending on growth of fish (whether the table size is attained or not) and consumers' demand, they start selling after 5-6 months and continue until 10-12 months. They do so by size selective harvesting, sorting out the bigger one from the tank. Following this strategy, they allow almost all the fishes to

reach the marketable size of 500g and above. Sooner or later all fishes, on an average, will grow to the size of 500-1000g, provided the supply of feed is continuous and of good quality. This way they take the advantage of size differentiation in farming cycle; and in doing so, they get the extended time of harvesting and marketing avoiding the spoilage (compared to the situation of bulk harvesting).

Stocking: Generally, they go for stocking with 3000 fingerling per tank, and out of which, according to them, approximately 500-1000 either die or wash away with water. Most of the stocking material they produce themselves. If there is mortality in their nursery then they rely on government trout farm, Uttarey, West Sikkim for seeds. Stocking is done generally in the months of March-April, and the harvesting starts from July-August sorting out with bigger ones. It goes on until December, January, and even upto February, depending on the existence of the stock.

Feed and feeding: They primarily depends on the feed supplied through DOF, they also brought feed from Hyderabad (UNO feed @ Rs 92/kg) with cooperative effort. That feed as well, according to them, yielded good growth but not as good as the one supplied by DOF. When feed is not available, they prepare feed in their farm itself using wheat flour, slaughter house waste (especially beef liver and lungs) egg, refined oil, etc. According to them, feeding 2-3 times a day, they could achieve average growth of 800-900g during 10-12 month of culture time. They are feeding them twice a day in advanced fingerling, but they feed 3-4 times to early fingerlings with crumbled/powered feed, beef liver and boiled egg yolk.

Image 5.5: Trout raceways owned by Samdup Bhutia and his wife.

Breeding: With the help of technical support and training given by DOF in collaboration with ICAR-DCFR Bhimtal, especially under the guidance of Dr. N.N. Pandey and Dr. R.S Haldar (Principal Scientist and Technical Officer respectively), they started breeding in 2014. In that year, they produced 8000-9000 fingerlings. In 2015, they produced 16000-17000 fingerlings out of which they stocked 5000 in their own tanks, and the rest they sold to the local farmer @ Rs. 8 per fingerlings. In 2016, they produced 22000-25000 fingerlings. In 2017, they could get 90000 eggs out from 160kg of broodstock of size 2-2.5kg female (2 years old, especially shooters) and 700-800g male. Out of these 90000 eggs, they managed to get 46000 fingerlings. They used those seeds for stocking in own tanks, and in other local farmers'. Broodstock used in breeding were raised in their farm. According to them, yolk sac absorption takes place within a week time, and exogenous feed requires within a week of hatchings. They use powdered/crumbled feed, poultry liver, beef liver, egg yolk, etc., as starter feed. To the first feeder, they feed 8 times daily upto 10 days, and after that, they feed them with crumbled feed until they start to take regular pellets.

Disease: They also have experienced some fungal problems in hatchery condition and during early stocking time. They treat the fungal infected fish with 50 second dip in normally edible saline solution. According to them, early sign of fungal infestation in the tank is the abnormal froth production. Fungus infected fish later developed skeletal deformity.

Image 5.6: Hatchery (top left), fry rearing (top right and middle left), selling (weighing and packing), trout farming business of Samdup Bhutia.

Market: According to them, until now marketing has been smooth, and the price, i.e., Rs. 600-800 per kg, is also satisfactory in terms of profit margin. Their market includes Sribadam, Soreng, Gyalshing, Jorethang, Namchi and Gangtok. They generally go for harvesting and selling their production based on demand; therefore, there is no chances of loss through spoilage.

Award: He was awarded as the best trout farmer and breeder by College of Fisheries, Lembucherra, Tripura (Central Agricultural University, Imphal).

Constraints: Primary constraint is irregularity in supply of feed or non availability of feed in time.

Image 5.7: Trout raceways of Samdup Bhutia during 2015 and brooder inspection for breeding in 2015.

Name of the farmers: Mr. Buddhi Raj Gurung/Mr. Arjun Gurung (son)

Village: Sribadam

Number of tanks: Three, first tank were constructed in 2011, it was financed by DOF under promotion of trout farming scheme. Its size is 50x7x4 (length, width and depth in feet). Two are new tanks (57x7x4; length, width and depth in feet, depth is variable for maintain the slope towards the outlet) funded by DOF under Blue Revolution mission in 2017. These recently built two new tanks are stocked with fingerlings for the first time after conditioning with water for many days. Tanks are constructed in the vicinity of cardamom field and horticulture farm; therefore, they are using the nutrient rich outlet water to irrigate these crops.

Source of water: Water source is perennial, plentily available within a distance of 500 meters. In winter, level goes little low but in monsoon months, from May to October, it is abundant to support the existing three tanks.

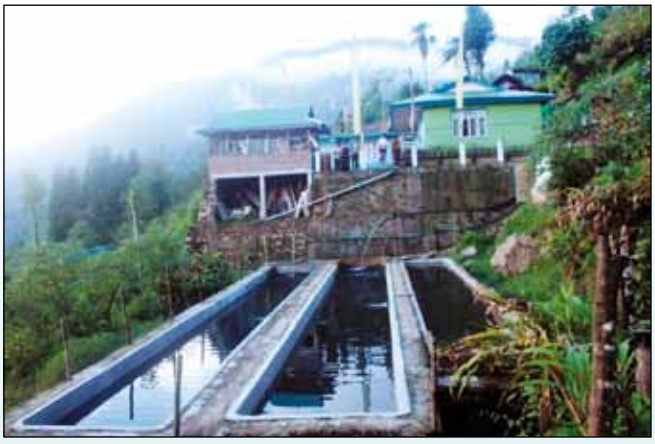

Image 5.8: Trout raceways owned by Buddhi Raj Gurung.

Started farming in 2012: The initiated year, i.e., 2012 was tough for them because they had to face heavy mortality possibly driven by improper water management and inadequate feed and feeding, being the first timer

with limited to no experience. As a consequence of this, they managed to sell around 100kg with the stocking of 500 fingerlings. From following year, they raised the stocking to 1000 fingerlings and consequently raised the selling to 200-250kg range. In 2016 and 17, selling was around 300kg with the stocking density upto 3000 fingerlings. According to them, at higher stocking density, growth was slow and mortality was high. From 2018 onwards, they have 3 functional tanks and they expect to increase their farm output by 3 times, provided availability of seed, feed and quality of water remain appropriate and uninterrupted. They follow 10-12 months of farming, and start selling after 5-6 months, sorting out the bigger one from the tank, and letting the smaller to grow for next harvest. On an average, they get 500-800g in 10 months of farming, provided feed is continuous and of good quality.

Stocking: They go for stocking in the month of March-April. They initiated the stocking in 2012 with 500 fingerlings per tank, in following year it was raised to 1000. In recent years, it is around 3000, as seeds were available plentily in 2015, 2016 and 2017. Seeds, during these years, were provided by the breeder from neighbourhood. Earlier, they had to get fingerlings from government trout farm, Uttarey.

Feed and feeding: They primarily depend on the feed supplied by DOF. In the meanwhile, they procured feed from Hyderabad also, through cooperative approach. In the case of emergency, they prepare on farm feed with wheat flour, slaughter house waste (especially poultry liver), egg, refined oil, etc.

Disease: They have encountered whirling syndrome in early fingerling, especially during the time of stocking, along with other chronic symptoms like skeletal deformity, erratic swimming and dark coloration.

Image 5.9: Unique method of water feeding in trout raceways of Buddhi Raj Gurung.

Market: According to them, marketing is easy and the price (Rs. 600-800 per kg) is best with rewarding profit margin. Market includes Sribadam, Soreng, Gyalshing, Jorethang and Gangtok. Marketing strategy is similar to previous farmer.

Constraints: Primary constraint is irregularity in supply of feed or non availability of feed in time.

Name of the farmer: Mr. Ambar Bahadur Gurung/Mr. Dilip Kumar Gurung (son)

Village: Sribadam

Number of Tanks: Three, one tank was constructed prior to 2014, funded by DOF for promotion of trout farming. Its size is 50x7x4 (length, width and depth

in feet). Two new tanks (57x7x5; length, width and depth in feet, depth is variable for maintain the slope towards the outlet) funded by DOF under Blue Revolution mission in 2017. These two tanks are new and are freshly stocked with fingerlings.

Image 5.10: Trout raceways owned by Ambar Bahadur Gurung.

Source of water: Perennial and plentily available, especially during the monsoon months starting from May to October, i.e., right around the potential cropping cycle. The source of water is 500 meters away from tanks.

Started farming in 2012: They started farming in 2012. However, they experienced some significant mortality (especially at the time of stocking and seasonal shifting and also due to the lack of experience.

Gradually, they developed their own strategies of farm management, starting from preparation of tank prior to stocking, maintaining of flow rate of water, feeding management, protection of tank from influx of mud during monsoon, etc. During the initial year, they could sell only around 100kg. After 2014-2015, they gained some experience and training, and improved the farm output to 200-300 kg per year and sold @ Rs 600-800 per kg. They follow approximately 10-12 months of farming, depending on the intensity of sell. According to them, they start selling after 5-6 months of stocking, depending on growth and feed availability. The average growth in their farm is around 500-100g. From 2018 onwards, they have 3 functional tanks and they expect to increase their farm output by 3 times, provided the availability of seed, feed and quality of water remain appropriate and uninterrupted.

Stocking: They started farming with stocking density of 400 fingerlings per tank (stocked in the month of June-July), and later increased gradually upto 3000 through 1500 and 2000, depending upon seed availability. In former, stocking density they experienced faster growth while in the

Image 5.11: Pre-feeding (before supplying to grow-out tank) settling of dirt in water in his raceway.

later, growth was slow possibly-governed by carrying capacity of the tank.

Feed and feeding: They primarily depend on feed supplied by DOF. They use this feed judiciously to feed for the entire crop cycle. In the case of non availability of the feed, they prepare on farm feed with wheat flour, slaughter house waste (especially poultry liver), egg, refined oil, etc. They generally are going for 3-4 times feeding during earlier part of farming cycle; and later, reducing to 2 times.

Disease: Whirling syndrome in early fingerling, probably because of undernourishment, during the time of stocking. Fungal infection during monsoon due to increase in turbidity is also a serious concern.

Market: Market includes Sribadam, Soreng, Gyalshing, Jorethang and Gangtok.

Award: He was awarded by DOF, Sikkim, in 2013, as the best trout farmer for his commendable effort in farm management.

Constraints: Primary constraint is irregularity in supply of feed or non availability of feed in time.

Name of the farmers: Mr. Dambar Bahadur Gurung/Ms. Alka Gurung (daughter)

Village: Sribadam

Number of tanks: Three, first tank were constructed in 2012, and its size is 50x7x4 (length, width and depth in feet). Two are new tanks (57x7x5; length, width and depth in feet, depth is variable for maintain the slope towards the outlet) funded by DOF under Blue Revolution mission in 2017.

Source of water: Water source is perennial plentily available within a distance of 500 meters.

Started farming in 2012: With their single tank started the venture in 2012. Had encountered some bumps down the road, namely mortality, slow growth, lack of marketing knowhow, etc. Once, they achieved upto 1.5 kg in a year with best management practices. In current years, they have been selling 200-300kg with their one tank and (@ Rs. 600 per kg. First year, they could sell only 100 kg, @ Rs 500 per kg. That year they encountered significant mortality and poor growth probably because of not having enough experience. From second year onwards, mortality was lowered, growth was enhanced with best farm management and improved farming, and they could double the farm output. From 2018 onwards, They three 3 functional tanks and they expect to increase their farm output by 3 times, provided the availability of seed, feed and their quality remain appropriate and uninterrupted.

Stocking: Initial year he started with 500 fingerlings, later increased to 1500/2000 depending on seed availability. Currently he is stocking upto 3000 depending.

Feed and feeding: They primarily depend on feed supplied by DOF, and they use this feed judiciously to feed for the entire crop cycle. In the case of unavailability of the feed, they prepare

Image 5.12: Trout raceways owned by Dambar Bahadur Gurung in 2018.

Image 5.13: Trout raceway of Dambar Bahadur Gurung during 2015.

on farm feed with wheat flour, slaughter house waste (especially poultry liver), egg, refined oil, etc. They are feeding them twice a day in advanced fingerling, while they feed 3-4 times to early fingerlings with crumbled/powered feed, beef liver and boiled egg yolk.

Disease: Whirling syndrome in early fingerling, probably because of undernourishment, during the time of stocking.

Market: According to them, marketing is going smoothly without any difficulty, and the price as well is very much promising in terms of yielding best profit margin. Market includes Sribadam, Soreng, Gyalshing, Jorethang and Gangtok. They generally go for harvesting and selling their farm product based on demand; therefore, there is no chances of loss through spoilage.

Constraints: Primary constraint is irregularity in supply of feed or non availability of feed in time.

Name of the farmers: Mr. Pem Tshering Bhutia/Mr. Dawa Tshering Bhutia/ Mr. Tenzing Bhutia (sons)

Village: Sribadam

Number of tanks: Four, two tanks were constructed in 2012, and its size is 50x7x4 (length, width and depth in feet). Second was constructed in 2013, and two more were added in 2017 (50x7x4; length, width and depth in feet, depth is variable for maintain the slope towards the outlet) funded by DOF under Blue Revolution mission.

Source of water: Water source is perennial around 1-1.5 km from the tank they have connected the water line from 4-5 places to meet the demand, as well as to compensate when there is breakage in any of the line or shortage in any of the source.

Started farming in 2013 (stocking detail included): Farming was started in 2013 with a stocking density of 500 fingerling per tank. They managed to sell around 150 kg @ Rs 500 per kg in that year and earned around Rs. 75000. In 2014, they had 2 tanks and they stocked 500 fingerlings in each tank, and finally sold 322 kg of fish @ Rs 500 per kg, making total earning of around Rs.160000. In 2015, they stocked 1500 fingerling per tank and sold around 400 kg @ Rs 500 per kg, and earned around Rs. 200000. In 2016, they stocked around 1500 fingerling per tank and sold around 520kg @ Rs. 500 per kg and earned around Rs. 260000. In 2017, they stocked 2000 fingerlings in each of their 4 tanks and sold around 830kg @ Rs. 600 per kg and earned around Rs. 500000.

Image 5.14: Trout raceways owned by Pem Tshering Bhutia.

Image 5.15: Pem Tshering Bhutia receiving award at ICAR-DCFR on National Fish Farmers Day.

Feed and feeding: They primarily depend on feed supplied by DOF, they procure feed also from Hyderabad through cooperative effort. During lean season, when feed is not available, they have to depend on locally made feed out of wheat flour, slaughter house waste (especially poultry liver), egg, refined oil, etc. They are feeding them twice a day in advanced fingerling, but only 3-4 times to early fingerlings with crumbled/powered feed, beef liver and boiled egg yolk.

Disease and Mortality: They have been encountering only 10% mortality when seed is healthy and of optimal size, especially supplied by DOF from Uttarey farm. When seed was not good they had to face more than 50% mortality mostly with whirling syndrome and blackening of body. According to them, the early stocking mortality may be related to poor seed quality induced by inferior feed and improper feeding management during nursery rearing. When they are fed well the syndrome and mortality were found to be vanished.

Market: According to them, marketing is going smoothly without any difficulty, and the price as well is very much promising in terms of yielding best profit margin. Market includes Sribadam, Soreng, Gyalshing, Jorethang, Namchi and Gangtok. They generally go for harvesting and selling their production based on demand; therefore, there is no chances of loss through spoilage.

Award: He was awarded as the best trout farmer by ICAR-DCFR, Bhimtal, Uttarakhand in 2018, for his significant contribution in the field of trout farming.

Constraints: Primary constraint is irregularity in supply of feed or non availability of feed in time.

Name of the farmer: Mr. Tik Bir Gurung

Village: Sribadam

Number of tanks: Two, constructed in 2017 under blue revolution mission funded by DOF, and their size is 57x7x4.5 (length, width and depth in feet, depth is variable for maintain the slope towards the outlet). **Source of water:** Perennial, and during the monsoon months starting from May to October, it is available plentily with a potential to operate more than 5 tanks. The source of water is 500 meters away from tanks.

Started farming: In 2018

Stocking: He has stocked with 1000 fingerling per tank, and out of those, according to him, approximately 300 fingerlings have either die or washed away with water. Most of the stocking material, i.e., fingerlings are obtained from local fish farmer cooperative or government trout farm, Uttarey, West Sikkim.

Feed and feeding: Currently he is depending on feed supplied by DOF. He is feeding them twice a day in advanced fingerling, while he fed 3-4 times to early fingerlings with crumbled/ powered feed, beef liver and boiled egg yolk.

Image 5.16: Trout raceways owned by Tik Bir Gurung. He has built double dirt settling tanks so that only clean water will go the raceways through parallel mode of feeding

Name of the farmer: Mr. Pem Tsheten Bhutia

Village: Sribadam

Number of tanks: Two, first tank was constructed in 2014 for grass carp farming. Later he realized he can grow trout instead of grass carp because other households in the same village were successfully doing rainbow trout farming, and earning in multiple folds. Then he constructed another tank in 2017, and started trout farming in his two tank (30x8x4; length, width and depth in feet).

Source of water: Perennial, and during the monsoon months starting from May to October, it is available plentily with a potential to operate more than 5 tanks. The source of water is 1000-1500 meters away from tanks.

Farming and Stocking: He has started stocking with 1000 fingerling per tank. Most of the stocking material, i.e., fingerlings are obtained from local fish farmer cooperative (most of them died with unknown reason) and government trout farm, Uttarey, West Sikkim.

Feed and feeding: He feeds with farm made feed prepared out of wheat flour, slaughter house waste (especially poultry liver), egg, refined oil, etc.

Disease: He is a beginner, and he had encountered some mortality probably because of lack of experience.

Market: No idea.

Constraints: Primary constraint is irregularity in supply of feed or non availability of feed in time.

Image 5.17: Trout raceways built by Mr. Pem Tsheten Bhutia with his own money

UTTAREY

Uttarey is a small village located on the northern slope of Singalila range in West Sikkim at an altitude of about 6600 feet. It is located near the border of Nepal. It is slowly emerging as a satellite township with its unique amenities of rural tourism. It is 140 and 150 km from Gangtok and Siliguri respectively. This beautiful village with abundant natural beauty lies amidst a valley of herbal plants surrounded by hills which bloom in a never-ending array of Rhododendrons. Uttarey is one of the gateways of Singalila trek, way to Nepal by trekking. Considering all assets together, it is popular among tourists for its serene environment, climate, trekking, food and beautiful home-stays around the Uttarey valley (once upon a time it was a big lake). While coming to the place you will have to cross Singshore bridge, said to be the second highest in Asia.

Image 6.1: View of Singshore bridge on the way to Uttarey from Dentam

Similar to Sribadam, Uttarey as well is an agrarian village; it has a small township surrounded by villages from all side. The common agriculture and allied farming activities of the people of Uttarey include cardamom, maize, broom grass, horticultural crops, cattle, poultry and piggery. The village includes Sopakha, Simphok, Maneypong, Uttarey and Begha. Taking all these villages together we get a very big cluster of trout growers. Based on our discussion with locals, we came to know that this village has a trout growers' cooperative society with 21 members (may be the number has gone up by now, since they have not included the farmers who are benefitted with Blue Revolution mission yet). It is the oldest village of Sikkim so far the history

of trout breeding and farming is concern. Uttarey river is the boon for the village for providing abundant cool-and-free flowing water appropriate for trout farming.

Image 6.2: Water resources and cardamom field of villages in Uttarey. Singshore river (top left) comes on the way to Uttarey, it may be a good water resource for creating trout farmers' cluster in surrounding villages in its upper reaches. Uttarey river in lower Maneypong area (top right), it looks highly oxygenated. Small seasonal bridge over Uttarey river, made by locals to connect Maneypong and Sopakha (middle left). Cardamom field (middle right) of Maneypong at the bank of Uttarey river, this appears to be the potential trout farming field. The Highly oxygenated Uttarey river in its upper reaches of Uttarey near Lingay-Sopakha village (bottom).

Name of the farmers: Mrs. Sushila Rai / Mr. Purna Bahadur Rai (husband)

Village: Uttarey

Number of tanks: Two, one was constructed before 2012 with size of 50x7x4, length, width and depth in feet (provided by DOF and funded by NFDB and RKVY). Second tank was constructed in 2017 of size 57x7x4.5 (length, width and depth in feet, depth is variable for maintaining the slope towards the outlet) funded by DOF under Blue Revolution mission. Tanks are constructed in the vicinity of cardamom field and horticulture farm; therefore, they are using the nutrient rich outlet water for these crops.

Source of water: Perennial, and during the monsoon months starting from May to October, it is available plentily with a potential to operate more than 5 tanks. The source of water from Uttarey river is around 400-500 meters away from their tanks.

Started farming in 2012: On an average they have been selling 300-350kg of fish per year @ Rs. 600-800 per kg. Besides selling, they keep some best growing fish as a brooder also. They follow approximately 10-12 months of farming, and depending on growth (if some fishes are 300-500g) and market demand, they start selling after 5-6 months, sorting out the bigger one from the tank and letting the smaller to grow for next harvest. This allows them to sell for extended period and based on demand. Following this strategy, helps them to get good price, and regular money. According to them, on an average, they get 700-1000g (depending on types of feed and their supply) in 10-12 months of farming, provided feed is continuous and of good quality. They go for stocking in the month of March-April and start harvesting, the bigger ones, from July-August and continue until December, January, and even upto February, depending on the existence of the stock.

Image 6.3: Trout raceways owned by Sushila and Purna Bahadur Rai.

Very recently they started to operate one more tank (the one they got in Blue Revolution mission) otherwise they had only one since 2012. They have been continuously farming trout realizing huge profit margin. If they are provided with two more tanks, i.e., 2+2=4, then they will definitely make more than 12 lakhs per annum, following their present management practices, provided the supply of good quality trout feed remains continuous.

Stocking: They have been stocking with 1000-1500 fingerlings per tank depending on availability, and out of those, according to them, approximately 100-200 fingerlings die. Fingerlings are obtained from government trout farm, Uttarey, West Sikkim or from own farm. In 2014 and 2016 they stocked fingerlings produced in their farm.

Feed and feeding: When the quality feed is good then they get growth upto 700-1000g in10-12 months farming cycle. Otherwise, when regular trout feed is not available, they feed them with pig feed; with this, according to them, they get growth upto 300-600g. For the young ones they provide boiled egg yolk, slaughtered house waste especially liver and lung, powdered/ crumbled feed, etc. The feeding frequencies for the young ones were ranging from 5-8 times a day, depending on their developmental stage.

Disease: They have encountered some fungal infection during rainy season or during seasonal shifting, or any time if tanks are not cleaned properly after feeding. Whirling syndrome in early fry and fingerling stages, during the time of stocking, if feed and feeding is not proper is a common phenomenon. This goes away after feeding them with liver (from any animal slaughter house) and egg yolk along with the crumbled feed.

Market: According to them, marketing is basically based on demand, and the price as well is very much promising, i.e., Rs. 800 per kg in present time. Market includes Uttarey, Dentam, Pelling, Gyalshing, Jorethang and Gangtok.

Breeding: They bred trout in 2013 and 2015 and were able to produce 4000-5000 fingerlings.

Constraints: Primary constraint is irregularity in supply of feed or non availability of feed in time. Moreover, there is no consistent source of trout feed from where they can be assured for supply on time at fixed and reasonable rate. Because of the fear of unavailability of feed, they are not able to culture trout with 200 percent confidence. Otherwise, according to them, based on currently available water resources, they can afford to manage 4-5 tanks. If they do so, they can raise their annual income to 10-15 lakhs. Provided if he has few more tanks, he wants to go for rearing stunted trout fingerling for culturing in his own farm.

Name of the farmer: Mr. Aitahang Subba

Village: Uttarey

Number of tanks: Three (including one small rearing tank), the first regular size tank was completed in early 2011, provided by DOF with NFDB and RKVY funds, with size of 50x7x4 (length, width and depth in feet). Second tank was constructed in 2017 of size 57x7x4.5 (length, width and depth in

feet, depth is variable for maintaining the slope towards the outlet) funded by DOF under Blue Revolution mission. Tanks are constructed in the vicinity of cardamom field and horticulture farm; therefore, he is using the nutrient rich outlet water for these crops.

Source of water: Perennial, and during the monsoon months starting from May to October, it is available plentily with a potential to operate more than existing tanks. His tanks are situated uphill from the Uttarey river, which otherwise is just 100-200 meters far. Therefore, he had to get water from quite a distance away, by spending Rs. 25,000.

Started farming in 2011. He follows the farming cycle of 10-12 months depending on selling intensity. He starts to harvest 5-6 months after the onset of farming. Average size of fish during harvest is 500-600g. During first 2 years, he could sell around 100-150kg per year; and from there on, he gradually went upto 300kg or slightly more per annum until 2016. In 2017, he sold 350kg of fish @ Rs 700(farm price)-800(market price) per kg of fish. While harvesting, he follows the practice of sorting out the bigger one from the tank and letting the smaller to grow for next harvest. According to him, this will allow some fraction of left smaller one will get bigger in 1-2 months, depending on feed and feeding, so that he can harvest those in next 1 or 2 months. He practices this method until the tanks get empty at the end of cycle. Following this strategy helps them to get good price, and regular source of money in an interval of a month or two.

Stocking: He has been stocking with 1000-1500 fingerlings per tank depending on availability. He told that he faces the ugly mortality of around 100-200 in normal circumstance (not in outbreak). Fingerlings are obtained from government trout farm, Uttarey, West Sikkim.

Feed and feeding: He depends on trout feed supplied through DOF but when the feed is not available he feeds them with pig feed, poultry feed and even extruded soybean chunks, depending on the availability. He follows different feeding strategies for different states of stocks; multiple feeding frequency for smaller (divided ration) and fewer for bigger (of around palm size; the palmlings).

Disease: He has encountered some fungal infection during rainy season (mainly due to influx of mud and dirt in water) or during seasonal shifting, or any time if tanks are not cleaned properly after feeding. He treats them with $KMNO_4$ solution as directed by DOF officers. Whirling syndrome in early fry and fingerling stages, during a time of stocking, if feed and feeding is not proper is a common phenomenon. This goes away after feeding them with liver (from any animal slaughter house) and egg yolk along with the crumbled feed.

Image 6.4: Aitahang Subba, a progressive farmer, receiving Award at COF-Lembucherra, Tripura.

Market: According to them, marketing is

basically based on demand, and the price, as well, is very much promising. Market includes Uttarey, Dentam, Pelling, Gyalshing and Gangtok. He is a very meticulous farmer. He uses a beautiful method of packing trout in bark of banana trunk for keeping the stuff cool and free from spoilage until it hits the market place.

Awards: Recently he got award from College of Fisheries Lembucherra Tripura (CAU) for his outstanding performance in trout farming.

Constraints: Primary constraint is irregularity in supply of feed or non availability of feed in time. Moreover, there is no consistent source of trout feed, from where they can be assured for supply on time at fixed and reasonable rate.

Image 6.5: Farm activities of Aitahang at his farm, trout harvesting, packing (using bark of banana trunk), and storing (prior to marketing)

Name of the farmer: Mr. Jas Bahadur Rai

Village: Uttarey

Number of tanks: Two, first tank were constructed in 2012, second tank was constructed in 2014 and their size is 50x7x4, length, width and depth in feet. Both are provided by DOF under various schemes of NFDB and RKVY. Tanks are constructed in the vicinity of cardamom field and horticulture farm; therefore, he is using the nutrient rich outlet water for these crops. Currently one tank is functional while the other is leaking and it requires some work. He is looking for any sort of possible funding to carry out this repair work. He is content with his existing two (if it get repaired) tanks because he has limitation of manpower to operate more than two tanks.

Source of water: Perennial, and during the monsoon months starting from May to October, it is available plentily with a potential to operate more than 5 tanks. The source of water from Uttarey river is around 100-200 meters away from their tanks.

Started farming in 2013: In the first year, he could sell 40-50 kg only because that year he experienced some significant mortality due to the lack of experience because that was his first exposure to trout farming. Then, in the year 2014-2015, he managed to sell an average of 300-400kg of fish, at an average rate of Rs. 700-800 per kg. He follows 10-12 months of farming, depending on intensity of sell and market demand. He starts selling after 5-6 months as soon as they reach 300-500g size, and off course if there is a demand. He follows size specific harvesting, sorting out the bigger one from the tank and letting the smaller to grow for next harvest. He love to do so, because this allows him to sell for extended period and doing this, he gets good price and money at regular interval of one to two months. He goes for stocking in the month of March-April, and start harvesting (the bigger ones first), from July-August.

Stocking: He has been stocking with 800-1000 fingerlings per tank depending on the availability. He also is experiencing mortality of around 100-200 in normal circumstance possibly driven by failing to acclimate with feed or seasonal change or increase in turbidity of water during raining. Fingerlings are obtained from government trout farm, Uttarey, West Sikkim.

Image 6.6: Trout raceways owned by Jas Bahadur Rai

Feed and feeding: He depends on trout feed supplied through DOF but when the feed is not available he feeds them with pig feed, poultry feed and even extruded soybean chunks, depending on the availability.

Disease: He has noticed that during rainy season, influx of turbid water in tanks leads to fungal disease. Whirling syndrome during harvesting is common phenomenon.

Market: Same as above.

Constraints: Same as above.

Name of the farmer: Mr. Ashok Subba

Village: Uttarey

Number of Tank: One, it was constructed in 2012 (provided by DOF under promotion of trout farming scheme funded by NFDB and RKVY), and its size is 50x7x4 (length, width and depth in feet).

Source of water: Perennial, and during the monsoon months starting from May to October, it is available plentily with a potential to operate more than 5 tanks. The source of water from Uttarey river is around 200-250 meters away from their tanks.

Started farming in 2013: Until date, he is managing to sell 40-50kg for every year, possibly because of lack of proper management. He is selling on an average @ Rs. 700-800 per kg. He follows approximately 10-12 months of farming, and depending on growth (if some fishes are 300-500g) and market demand, he starts selling after 5-6 months, sorting out the bigger one from the tank and letting the smaller to grow for next harvest. According to him, on an average, he gets 300-500g, depending on types of feed and their supply. He goes for stocking in the month of March-April and starts harvesting, the bigger ones, from July-August.

Stocking: They have been stocking with 1000-1500 fingerlings per tank depending on availability, and out of those, according to them, approximately 500 fingerlings die. Fingerlings are obtained from government trout farm, Uttarey, West Sikkim.

Image 6.7: Trout raceway owned by Ashok Subba

Feed and feeding: He depends on trout feed supplied through DOF. When the quality feed is good then he gets good growth in 10-12 months farming cycle. Otherwise, when regular trout feed is not available, he feeds them with pig feed; with this, according to them, he gets growth upto

300g. For the young ones he provides boiled egg yolk and powdered/crumbled feed mix. The feeding frequencies for the young ones were ranging from 5-8 times a day, depending on their developmental stage.

Disease: He has been facing some fungal infection in his farm during rainy season or during seasonal shifting, or any time if tanks are not cleaned properly after feeding. Whirling syndrome in early fry and fingerling stages, during a time of stocking, is also commonly seen phenomena.

Market: According to them, marketing is basically based on demand, and the price as well is very much promising, i.e., Rs. 800 per kg in present time. Market includes Uttarey, Dentam, Pelling and Gyalshing.

Constraints: Primary constraint is irregularity in supply of feed or non availability of feed in time.

Name of the farmer: Mr. Hastaman Gurung

Village: Begha, Dentam, West Sikkim.

Number of tanks: Four, one is provided by DOF in 2011, under the scheme for promotion of trout farming, through NFDB and RKVY (57x7x4; length, width and depth in feet). Other tanks (built in 2013, 2014 and 2015) are of smaller sizes (2 numbers of 30x8x4; length, width and depth in feet; and one 10x4x3; length, width and depth in feet) and are self financed.

Source of water: Perennial, and during the monsoon months starting from May to October, it is available plentily with a potential to operate more than 5 tanks. The source of water from Nangsangay river is around 200-250 meters away from his tanks.

He started farming in 2011: He began selling in 2012. In first year, he sold around 150kg @ Rs. 500 per kg. In 2013, he sold 100kg @ Rs. 500 per kg. From 2014-2017, he sold on an average 100-150 kg @ Rs. 700-800 per kg fish. He follows 10-12 months of farming, and depending on growth (if they reach 300-500g) and market demand, he starts selling after 5-6 months. He follows size specific harvesting, sorting out the bigger one from the tank and letting the smaller to grow for next harvest. This allows him to sell for extended period and based on demand. Following this strategy helps him to get good price and regular money. According to him, on an average, they get 500-700g (depending on types of feed and their supply). He stocks in the month of March-April and starts harvesting (first-bigger ones), from July-August.

Stocking: He has been stocking with 500-1000 fingerlings per tank depending on availability. Fingerlings are obtained from government trout farm, Uttarey, West Sikkim or from own farm. In 2015, 2016 and 2017 he stocked fingerlings produced in his farm.

Feed and feeding: He depends on trout feed supplied through DOF. When regular trout feed is not available, he prepares farm feed with extruded soybean chunks, wheat flour, maize flour mixed with beef/buffalo blood. For the young ones, he feeds with boiled egg yolk, slaughtered house waste (especially liver and lung), powdered/crumbled feed, etc. The feeding frequencies

Image 6.8: Trout raceways owned by Hastaman Gurung

for the young ones are ranging from 5-8 times a day, depending on their developmental stage.

Disease: Some fungal infection during rainy season or during seasonal shifting, or any time if tanks are not cleaned properly after feeding. Whirling syndrome in early fry and fingerling stages, during a time of stocking, if feed and feeding is not proper.

Market: According to them, marketing is basically based on demand, and the price as well is very much promising, i.e., Rs. 800 per kg in present time. Market includes Uttarey, Dentam, Pelling, Gyalshing and Gangtok.

Breeding: He successfully bred trout in 2015, 2016 and 2017 (was not successful due to fungal attack), and was able to produce 1000-2000 fingerlings. In 2015 only 500-600 hatchlings were produced; and in 2016-2017 on an average of 4000 hatchling were produced. Out of those, only 1500 reached to fingerling. The reason of mortality was primarily fungal attack induced by feeding and nutritional deficiency or deterioration of water quality. Early feeding (starter feed) was mainly based on the boiled egg yolk and ground/crumbled and powdered feed.

Constraints: Primary constraint is irregularity in supply of feed or non availability of feed in time. Moreover, there is no consistent source of trout feed from where they can be assured for supply on time at fixed and reasonable rate. Because of the fear of unavailability of feed, he is not able to culture trout with confidence. Because of the lack of feed:

Expected growth cannot be attained

Larval survival and larval growth get impaired

Malnourished larva is not competent, and they die in stocking tanks if proper care is not offered, in terms of feeding nutritious feed.

Image 6.9: Trout breeding, seed rearing and harvesting activities of Hastaman at his farm

Name of the farmer: Mr. G. B. Rai

Village: Uttarey

Number of tanks: Two, both were constructed in 2012 (one is provided by DOF funded by NFDB and RKVY, other is self financed), and their size is 50x7x4 (length, width and depth in feet).

Source of water: Perennial, and during the monsoon months starting from May to October, it is available plentily with a potential to operate more than 5 tanks. The source of water from Uttarey river is around 300-400 meters away from their tanks.

Started farming in 2013: He started selling of 70-80kg per year during the first year and

currently he is selling around 150kg @ Rs. 700-800 per kg of fish. When the good quality feed was available supplied through DOF, growth went upto 500-700g in10-12 months of farming cycle.

Stocking: He has been stocking with 500-1000 fingerlings per tank depending on availability; and out of those, according to him, approximately 200-300 fingerlings die. Fingerlings are obtained from government trout farm, Uttarey, West Sikkim. He goes for stocking in the month of March-April and starts harvesting from July-August and continues until December.

Image 6.10: Trout raceways owned by G. B. Rai

Feed and feeding: He depends on trout feed supplied through DOF. When regular trout feed is not available, he feeds them with pig feed. For the young ones he provides boiled egg yolk, slaughtered house waste (especially liver and lung), powdered/ crumbled feed, etc.

Disease: Same as above

Market: Same as above.

Constraints: Same as above.

Name of the farmer: Mr. Kul Bahadur Rai

Village: Uttarey

Number of tank: One, constructed in 2012 (provided by DOF, funded by NFDB and RKVY), and their size is 50x7x4 (length, width and depth in feet). Tanks is constructed in the vicinity of cardamom field; therefore, he is using the nutrient rich outlet water for these crops.

Source of water: Perennial, and during the monsoon months starting from May to October, it is available plentily with a potential to operate more than 5 tanks. The source of water from Uttarey river is around 200 meters away from their tanks.

Started farming in 2012: He started selling of 40-50kg per year during the first year; and currently, he is selling around 150 kg @ Rs. 700-800 per kg of fish. When the good quality feed was available supplied through DOF, growth went upto 500-700g in 10-12 months of farming cycle.

Stocking: They have been stocking with 500-1000 fingerlings per tank depending on availability, and out of those, according to them, approximately 100-200 fingerlings die.

Image 6.11: Trout raceway (left) owned by Kul Bahadur Rai, ICAR-DCFR team doing sampling for health assessment

Fingerlings are obtained from government trout farm, Uttarey, West Sikkim. He goes for stocking in the month of March-April and starts harvesting from July-August and continues until December.

Feed and feeding: He depends on trout feed supplied through DOF. When regular trout feed is not available, he feeds them with pig feed. For the young ones he provides boiled egg yolk, slaughtered house waste especially liver and lung, powdered/crumbled feed, etc.

Disease: Same as above

Market: Same as above.

Constraints: Same as above.

Name of the farmer: Ms. Lilawati Rai (Her son is in the profile image)

Village: Uttarey

Number of tank: One, constructed in 2012(provided by DOF, funded by NFDB and RKVY), and their size is 50x7x4 (length, width and depth in feet). Tanks is constructed in the vicinity of cardamom field; therefore, he is using the nutrient rich outlet water for these crops.

Source of water: Perennial, and during the monsoon months starting from May to October, it is available plentily with a potential to operate more than existing tank. The source of water from Uttarey river is around 200 meters away from their tanks.

Started farming in 2012: He started selling of 40-50kg per year during the first year and currently he is selling around 130-150kg @ Rs. 700-800 per kg of fish. When the good quality feed was available supplied through DOF growth went upto 500-700g in10-12 months of farming cycle.

Stocking: They have been stocking with 500-1000 fingerlings per tank depending on availability, and out of those, according to them, approximately 100-200 fingerlings die. Fingerlings are

obtained from government trout farm, Uttarey, West Sikkim. He goes for stocking in the month of March-April and starts harvesting from July-August and continues until December.

Feed and feeding: Same as above.

Disease: Same as above

Market: Same as above.

Constraints: Same as above.

Image 6.12: Trout raceway (left) owned by Lilawati Rai

Name of the farmer: Mr. Hetu Prasad Subba

Village: Uttarey

Number of tanks: One, provided by DOF through the scheme of blue revolution in 2017. Tank is in the vicinity of cardamom field so that he can use outlet water for irrigation of cardamom especially in winter.

Source of water: Perennial, and during the monsoon months starting from May to October, it is available in plenty with a potential to operate more than 5 tanks. The source of water from Uttarey river is around 200-250 meters away from their tanks.

Not yet started for farming

Image 6.13: Trout raceway (left) owned by Hetu Prasad Subba

NIMACHEN AND ZULUK

Way to Nimachen, Phadamchen, Lingtam, Kupup and Zuluk from Rhenock-Reshi of East Sikkim is popularly known as the Silk Route. This is a famous tourist destination because of its natural beauty, luxury homestays and authentic cuisine. Nimachen is famous for Ramitey view point, from where Kanchenjunga in the morning sunrise looks divine and heavenly. Other well known tourist destinations include Thambi view point, 95 turns (the famous view of Zuluk), rhododendron garden, etc. Because of this flourishing tourism, the value of agricultural farm output is getting high. The price and market for trout in the region is very lucrative. Moreover, the environmental and climatic feasibility for trout farming is very much conducive with availability of surplus cool surface water. On top of that, market for trout is becoming promising in a sustainable manner due to growing rural tourism induced. There is a very good scope for opening barbecued trout eateries along the silk route during the peak of tourist season by the local farmers themselves; this will definitely ensure them the best profit margins.

The places around Nimachen and Phadamchen to Zuluk had many trout farms during 2013-2015, but gradually the practice is dropping because of some constraints like unavailability of regular trout feed. Phadamchen and Nimachen together had a very good cluster and effective co-operative. The time has come to bring back the trout farming scenario of this place by proving them all possible scientific and technical support.

Image 7.1: Team members for Nimachen visit

Name of the farmers: Mr. Kee Tshering Sherpa

Village: Nimachen

Number of tanks: Two, both tanks were constructed on or before 2012 with size of 50x7x4, length, width and depth in feet (provided by DOF and funded by NFDB and RKVY). Tanks are constructed in the vicinity of cardamom field; therefore, he is using the nutrient rich outlet water for this crop.

Source of water: Perennial, and during the monsoon months starting from May to October, it is available plentily with a potential to operate more tanks. The source of water from is around 2-2.5 km away from their tanks, and he is transporting water through pipes.

Started farming in 2013: On an average he has been selling 150-200kg of fish per year @ Rs. 800-1000 per kg. In the initial year the farming was unsuccessful and he had to face the problem of mortality, due to his first exposure to trout farming. That year, he could sell only 30-40kg from both tanks. He follows 10-12 months of farming, and depending on the size of fish (it should be 300-500g) and market demand, he starts selling after 5-6 months, sorting out the bigger one from the tank and letting the smaller to grow for next harvest. According to him, on an average, he gets 300-700g (depending on types of feed and their supply) in 10-12 months of farming. He stocks in the month of March-April and starts harvesting from July-August and continue until February, depending on the existence of the stock.

Stocking: He has been stocking with 500 fingerlings per tank depending on availability, and out of those, according to them, approximately 100-200 fingerlings die. Fingerlings are obtained from government trout farm, Memencho, East Sikkim.

Feed and feeding: He depends on trout feed supplied through DOF. When the quality feed is good then he gets growth upto 700-1000g in10-12 months farming cycle. He observed that the growth of the fish was better when fed with the regular trout feed provided by DoF, but when during unavailability the growth was not good. The maximum growth he observed was of 1.5 kg in 11 month culture.

Image 7.2: Trout raceway owned by Kee Tshering Sherpa.

Disease: Fungal infection and whirling syndrome, but eventually goes off with proper feeding. Sometimes skeletal deforming are also being observed.

Market: According to them, marketing is basically based on demand, and the price as well is very much promising, i.e., Rs. 800-1000 per kg in present time. Market includes local homestays, Lingtam, Rongli and Rhenock.

Constraints: Primary constraint is irregularity in supply of feed or non availability of feed in time. Moreover, there is no consistent source of trout feed from where he can be assured for supply on time at fixed and reasonable rate.

Name of the farmer: Mr. Gopal Pradhan

Village: Zuluk

Number of Tanks: Six (3 sets of two tanks), first set of tanks were constructed in 2011, provided by DOF under a scheme funded by NFDB and RKVY. Its size is 50x7x4 (length, width and depth in feet).

Source of water: Perennial, and during the monsoon months starting from May to October, it is available plentily with a potential to operate more tanks. The source of ater from is around 2 km away from his tanks, and he is bringing the water through pipelines.

Started farming in 2012 (stocking and breeding included): On an average, he has been selling 300-700kg of fish per year @ Rs. 800-1000 per kg. In the initial year, he sold around 250 kg (allowing most of them to reach at least 800-1200g size on an average). The maximum size of trout attained in his farm is upto 4.5kg. In 2013, he stocked only 200 fingerlings, some died later. Out of these, he managed to sell around 150kg (allowing most of them to reach at least 1000g on an average). In 2014, he stocked 250-300 fingerlings per tank but in that year, he had some significant mortality. In 2015, with same rate of stocking density, he managed to sell around 400kg from his 4 operational tanks. In 2016, he sold around 300kg. In 2017, he could sell something around 500-700kg. In 2018, until September, he managed to sell more than 500kg, and some more are still there. He follows 10-12 months of farming and selling in bunches during tourist seasons. Fingerlings are obtained from government trout farm, Memencho, East Sikkim or from own farm. From 2016, he has been stocking the fingerlings, bred and raised in his own hatchery. He has been producing around 5000-10000 fingerling now.

Feed and feeding: He depends on trout feed supplied through DOF. When the quality of feed is

Image 7.3: Trout raceways owned by Gopal Pradhan and his innovative method of oxygenation of water.

Image 7.4: Gopal Pradhan awarded as best trout farmer, for his best contribution in trout farming.

good then he gets growth upto 700-1000g in10-12 months farming cycle. He observed that the growth of the fish was better when fed with the regular trout feed provided by DOF, but during its unavailability the growth was not good. The maximum growth observed was 1.5 kg in 11 months culture period.

Disease: Fungal infection and whirling syndrome, but eventually goes off with proper feeding. Sometimes skeletal deforming is also being observed.

Market: According to him, marketing is basically based on demand, and the price as well is very much promising, i.e., Rs. 800-1000 per kg in present time. Market includes his own homestay, Lingtam, Rongli and Rhenock.

Trout tourism: He started the concept of trout tourism long back. He provides trout feed in pouches to the visiting tourists at nominal charges; and allow them to feed and let them watch the active feeding behaviour of trout. He even offers delicious trout cuisine to visiting tourist. Thereby, he is initiating and popularizing trout tourism in Sikkim.

Awards: There are several from state government alone. Some significant ones from out of state of Sikkim include: The best trout farmer award from ICAR-DCFR, 2018, and the best fish farmer award from CAU-College of Fisheries, Tripura

Constraints: Primary constraint is irregularity in supply of feed or non availability of feed in time. Moreover, there is no consistent source of trout feed from where he can be assured for supply on time, at fixed and reasonable rate. There is a an scope for development of existing trout farming in his farm; he even want to encourage other neighbours to come into farming by providing them good quality seeds. However, the unavailability of feed is restricting him to do so.

Image 7.5: Feeding of trout at Gopal pradhan's farm (top left), his regular feed (top right; when DOF supplied feed exhausts), and harvested trout (bottom right)

UPPER PAYONG AND SOKPEY

Villages of south Sikkim such as Lingee, Payong and Sokpey are situated on southern hill slope above Teesta river, opposite to Tumin village of East Sikkim. The shortest routes to reach these villages are via Singtam-Makha to Lingee and Payong, or to Sokpey through lower Payong. These villages are pristine with their natural beauty with capping lush green forest on the top, beautiful view of Teesta and Tumin village to its opposite, uninhabited slope of virgin village of Dzongu (North District) on northern side. With all these attributes, along with surprisingly appearing milky streams and waterfalls along the road, makes the village worth visiting. These positive attributes support the potential of these villages for rural tourism. Denizens of this place are mainly involved in agricultural, horticultural, cattle, piggery and poultry farming. Cardamom is the principal cash crop for them, along with dairy, poultry and piggery as secondary. Fish farming, especially trout farming, is gradually coming up in upper Payong and Sokpey. In year 2017, under Blue Revolution many farmers from upper Payong and Sokpey got financial assistantship, pipelines, fish seeds and feed from DOF for initiating trout farming.

Although new, but gradually trout farming activities are becoming popular in these villages. As a consequence of this, the scope for creation of two clusters, and eventually two units of trout

Image 8.1: Glimpses of our visit to Upper Payong and Sokpey

growers' co-operative is seemingly possible in upper Payong and Sokpey village. Very recently Sokpey village got community trout hatchery through NERLP funding.

Name of the farmer: Mr. Prem Bahadur Rai

Village: Upper Payong, South Sikkim

Number of tanks: One, This tank was constructed in 2015, with financial support provided by DOF, under scheme funded by NFDB), and its size is 27x10x5 (length, width and depth in feet).

Source of water: Perennial, and during the monsoon months starting from May to October, it is available sufficiently through streams with a potential to operate more tanks. The source of water is within around 500 meters away from their tanks, and he is transporting water through pipes.

Started farming in 2015: He started farming in 2015 and in that year he sold around 100kg of fish, and earned Rs. 60,000 from the first year of culture. The price of the fish during the sale was @ Rs. 600-700 per kg. He discontinued farming in 2016 due to the non availability of seed. Again, started farming in 2017, and was able to sell around 100kg @ Rs. 600-700 per kg. He follows 10-12 months of farming, and depending on the size of fish (it should be 300-500g) and market demand, he starts selling after 5-6 months, sorting out the bigger one from the tank and letting the smaller to grow for the next harvest. According to him, on an average, he gets 300-700g (depending on types of feed and their supply) in 10-12 months of farming. He stocks in the month of March-

Image 8.2: Trout raceway owned by Prem Bahadur Rai, and his innovative method of oxygenating water.

April and starts harvesting from July-August, and continue until December and January depending on the existence of the stock.

Image 8.3: Feed supplied by DOF, at Prem Bahadur's farm, and his innovative method of insect collection and feeding to trout at night with hanging electric bulb.

Stocking: He has been stocking 1000 fingerlings per tank depending on availability. Out of those, according to him, approximately 100-200 die. Fingerlings are obtained from government trout farm, Uttarey, West Sikkim. He has to transport seeds from Uttarey, and that also at high rates, i.e., Rs. 20 per fingerling including transportation cost. In the initial farming, DOF provided around 1000 fingerlings for the culture, and from later years, he had to buy from them.

Feed and feeding: He depends on trout feed supplied through DOF. When quality of feed is good then he gets growth upto 700-1000g in10-12 months farming cycle.

Disease: Did not mention

Marketing: He sells the fish on demand, and the places where his fish supplied are Singtam and Gangtok.

Constraints: The main constraints are the unavailability of feed and seed. Feed is not available continuously, and the seed are to be transported from far areas like Uttarey, and that is also at Rs 20 per seed.

Name of the farmer: Mr. Abiraj Katuwal

Village: Sokpey, South Sikkim

Number of tanks: Three, first tank was constructed in 2014, (provided by DOF under scheme funded by NFDB), and its size is 50x7x4 (length, width and depth in feet). Rest two tanks were funded by NERLEP along with community hatchery of capacity 1 lakh eyed ova, during 2017. Their size is 50x7x4 (length, width and depth in feet). Tanks are constructed in the vicinity of cardamom field; therefore, he is using the nutrient rich outlet water for this crop.

Source of water: Water available is sufficient and perennial, and it is supplied from streams which are located at a distance of 20 meters from the culture tank. During monsoon months, starting from May to October, it is available abundantly with a potential to operate more than 5 tanks.

He started farming in 2015: In the initial year of 2015, significantly he loses the stock by heavy

mortality. The entire left over farm product was consumed at home and neighborhood. There was no commercial selling in 2015. Following year, i.e., in 2016, he stocked 1000 fingerlings, and farmed to an average size of 1kg in 10-12 months period, depending on the feed given by DOF. That year, he could sell 300kg @ Rs. 600-700 per kg fish. Again in 2017, he stocked 1000 fingerlings; similarly, depending on feed supplied by DOF, he got the similar average growth. That very year, he sold around 350 kg @ Rs. 600-700 per kg. He follows 10-12 months of farming, and depending on the size of fish (it should be 500g and above) and market demand, he starts selling after 5-6 months, sorting out the bigger one from the tank and letting the smaller to grow for next harvest.

Image 8.4: Trout raceway and community hatchery along with raceways (under construction) owned by Abiraj Katwal.

Stocking: He has been stocking 1000 fingerlings per tank depending on availability; out of those, according to him, approximately 100 fingerlings die. e gets fingerlings from government trout farm, Uttarey, West Sikkim. They have to transport seeds from Uttarey, and also at high rates, i.e., Rs. 20 per fingerling including transportation cost. In the initial farming, DOF provided around 1000 fingerlings for the culture, and from the later years, he had to buy from them.

Feed and feeding: He depends on trout feed supplied through DOF. He uses the feed so judiciously and efficiently so that he doesn't have to depend on other source for the whole farming period.

Disease: Fungal infection and Whirling syndrome at the time of stocking.

Marketing: Local village, Singtam, Gangtok, etc.

Constraints: The main constraints here, for the culture, are the feed and seed. The feed is not available continuously.

Name of the farmer: Mr. Navraj Gurung

Village: Sokpey, South Sikkim

Number of tanks: 02

Year of construction: 2017; provided by DOF, funded by NFDB under Blue Revolution mission.

Source of water: Perennial, within 100 meters away from tanks

Size of tanks: 57x7x4 (length, width and depth in feet, depth is variable for maintain the slope towards the outlet)

Image 8.5: Twin tanks of Navraj Gurung

UPPER RIMBIK

Upper Rimbik is small village located near Pelling (one of the popular tourist destinations in West Sikkim). It is mostly covered with lush green forest and ever flowing perennial streams and few waterfalls. It is located at an altitude of 2000 feet and is 130 km away from the state capital, Gangtok. The people here mainly take agriculture as an occupation. Here the main cash crops grown are the cardamom, ginger, etc., which flourish in the cold and humid region. People are also slowly adopting aquaculture as a source of extra income because of the availability of water and opportunity provided by DOF.

Currently, trout farming activity has stopped by most of the farmers, but DOF is working hard to re-establish the farming. In order to achieve so, they have sanctioned community trout hatchery to their cooperative, and on top of that, many new beneficiaries got one or two tanks under Blue revolution mission from this village.

Image 9.1: DOF supplied pipe for newly constructed trout raceways in Upper Rimbik (top left). Trout farming cluster of Upper Rimbik lies at the confluence of two perennial streams; one is coming from north (top right) and other from east (bottom). Using of water from stream coming from north is easy as it comes from higher elevation to the existing cluster.

Name of the farmer: Mr. Sancharaj Limbu /Mr. Mani Kumar Limbu (son)

Village: Upper Rimbik

Number of tanks: Two, first tank was constructed in 2012, second was in 2014, provided by DOF under various scheme funded by NFDB and RKVY, and their size is (50x7x4; length, width and depth in feet).

Source of water: Water source is perennial with nearby two perennial streams, flowing within the vicinity of this place. The source of water is 200-300 meters away from tanks.

Started farming in 2013. One tank was damaged by landslide and later it was renovated by ICAR-DCFR fund. They used to stock 500 seeds per tank and the growth was recorded as 400-500g. They used to sell from 2013 to 2015 (not in 2014) with 80-100 kg of fish @ Rs. 300 per kg. They follow approximately 10-12 months of farming depending on the growth of fish, availability of feed and market demand. They used to start selling after 5-6 months, sorting out the bigger one from the tank and letting the smaller to grow for next harvest. They stopped the farming two years back.

Stocking: They used to stock 500 seed per tank, stocking material, i.e., fingerlings were obtained from government trout farm, Uttarey, West Sikkim. Stocking used to be done in the month of March-April.

Feed and feeding: They were mainly depending on the feed supplied by DOF but during in its unavailability they usually used to feed with wheat flour, maize flour etc. They are not culturing the fish since 2016.

Image 9.2: Trout twin-raceways owned by Sancharaj Limbu

Market: Within village and the markets of Pelling (as Pelling is nearby and it is a famous tourist place with numerous hotels) and Gyalshing.

Disease: Until now they have encounters some fungal infection, and according to them, this appears if tanks are not cleaned properly after feeding. In early fry and fingerling stages, during a time of stocking, they have noticed whirling syndrome; this goes away after feeding them with poultry liver and egg yolk along with the crumbled feed.

Constraints: Their primary constraints are unavailability of trout feed, trout seed, market and price. Since this areas is not yet approached by tourists and it rather is in a remote place.

Name of the farmer: Mr. Bhakta Bahadur Limbu /Mr. Durga Hang Limbu (son)

Village: Upper Rimbik

Number of tanks: Two, first tank were constructed in 2011, second was in 2014 (provided by DOF under the scheme funded by NFDB and RKVY), and their size is 50x7x4 (length, width and depth in feet).

Source of water: Perennial, two perennial stream flowing vicinity of this place. During monsoon months starting from May to October, it is available plentily with a potential to operate more than 5 tanks. The source of water is 200-300 meters away from tanks.

Started farming in 2011. One tank was damaged by landslide in 2013, and later it was renovated by ICAR-DCFR fund in 2014. They used to stock 500 seeds per tank, and the growth was recorded to be 600-800g (maximum weight went upto 1.2 kg fish also). They could sell in 2011with 50-60 kg of fish @ Rs. 300 per kg. In 2012, they sold around 100kg. In 2014, they stocked 1000 seeds in two tanks and sold around 100 kg. They follow approximately 10-12 months of farming, and depending on the availability of feed and demand of fish, they start selling after 5-6 months, provided fishes are of marketable size of 300g and above. They stopped farming since 2015 due to many constraints.

Socking: They used to stock 500 seeds per tank, stocking material, i.e., fingerling obtained from government trout farm, Uttarey, West Sikkim. Stocking used to be done in the month of March-April.

Feed and feeding: They were mainly depended on the feed supplied by the DOF but during its unavailability they usually used to feed with wheat flour, maize flour etc.

Image 9.3: Trout raceway owned by Bhakta Bahadur Limbu

Market: Within village and the markets of Pelling and Gyalshing. They do not have enough idea regarding marketing at peak of tourist seasons like other farmers from Sribadam and Uttarey do.

Disease: Until now they have encounters some fungal infection. According to them, this appears if tanks are not cleaned properly after feeding. In early fry and fingerling stages, during a time of stocking, they have notice whirling syndrome; this goes away after feeding them with poultry liver and egg yolk along with the crumbled feed.

Constraints: Their primary constraints are unavailability of trout feed, trout seed, market and price. They need proper training regarding farm made feed preparation during emergency

Effective feed utilization by following best feeding strategy.

Name of the farmer: Mr. Ram Chandra Limbu /Mr. Mani Hang Limbu (son)

Village: Upper Rimbik

Number of tanks: Two, first tank was constructed in 2011, second tank was in 2014 (provided by DOF under various scheme funded by NFDB and RKVY), and their size is (50x7x4; length, width and depth in feet)

Source of water: Perennial, two perennial streams flow in the vicinity of this place. During the monsoon months, starting from May to October, it is available plentily with a potential to operate more than existing tanks. The source of water is within 300-400 meters away from tanks.

Started farming in 2013: They used to stock 500 seeds per tank, and the growth was recorded to be 300-500g. They sold in 2012 to 2015, on an average about 100kg, @ Rs. 300 per kg. They follow approximately 10-12 months of farming, and depending on the availability of feed and demand of fish, they start selling after 5-6 months, provided fishes are of marketable size of 300g and above. They stopped farming since 2016.

Socking: They used to stock 500 seeds per tank, fingerlings obtained from government trout farm, Uttarey. Stocking used to be done in the month of March-April.

Feed and feeding: They were mainly depending on the feed supplied by the DOF but during its unavailability they usually used to feed with wheat flour, maize flour etc.

Market: Within village and the markets of Pelling and Gyalshing.

Image 9.4: Trout twin-raceways owned by Ram Chandra and Mani Hang Limbu.

Disease: Same as above

Constraints: Their primary constraints are unavailability of trout feed, trout seed, market and price.

Name of the farmer: Mr. Agam Bahadur Limbu (Profile image belongs to his wife)

Village: Upper Rimbik

Number of tanks: One, tank was constructed in 2011 (provided by DOF under various scheme funded by NFDB and RKVY), and size is (50x7x4; length, width and depth in feet).

Source of water: Perennial, two perennial streams flow in the vicinity of this place. During the monsoon months, starting from May to October, it is available plentily with a potential to operate more than existing tanks. The source of water is within 200 meters away from tanks.

Started farming in 2013: 500-1000, depending on availability, seeds per tank, and the growth was recorded as 400-500g. He sold from the year 2012 to 2015, about 60-80kg @ Rs. 300 per kg. He used to follow approximately 10-12 months of farming, and depending on the availability of feed and demand of fish, he starts selling after 5-6 months, provided fishes are of marketable size of 300g and above. They stopped farming since 2016.

Socking: He used to stock fingerling obtained from government trout farm, Uttarey. Stocking used to be done in the month of March-April.

Feed and feeding: He was mainly depending on the feed supplied by the DOF but during its unavailability they usually used to feed with wheat flour, maize flour etc.

Market: Within village and the markets of Pelling and Gyalshing.

Image 9.5: Trout raceway owned by Agam Bahadur Limbu

Disease: Same as above

Constraints: Their primary constraints are unavailability of trout feed, trout seed, market and price. According to the farmer, growth slows down with unavailability of feed, and it is really hard for them to rear starving fishes.

Name of the farmer: Mr. Kul Bahadur Limbu/Mr. Pahal Man Limbu

Village: Upper Rimbik

Number of tanks: Two, first tank were constructed in 2011, second was in 2014 (provided by DOF under various scheme funded by NFDB and RKVY), and their size is (50x7x4; length, width and depth in feet).

Source of water: Perennial, two perennial streams flow in the vicinity of this place. During the monsoon months, starting from May to October, it is available plentily with a potential to operate more than existing tanks. The source of water is within 200 meters away from tanks.

Started farming in 2012: One tank was damaged by landslide in 2013, later it was renovated by ICAR-DCFR fund in 2014. They used to stock 500 seeds per tank and the growth was recorded as 400-500g. They started selling from the year of 2012 with less than 100kg fish @ Rs. 300 per kg. They couldn't continue farming in 2013-2015 due to raceway damage by landslide. Later, in 2014, they renovated with ICAR-DCFR fund. They restarted farming in 2016 and sold around 75kg. In 2017, they sold around 140 kg @ Rs. 600 per kg.

Socking: They used to obtain fingerlings from government trout farm, Uttarey. Stocking used to be done in the month of March-April.

Feed and feeding: They were mainly depended on the feed supplied by the DOF.

Market: Within village and the markets of Pelling and Gyalshing.

Disease: Same as above

Constraints: Their primary constraints are unavailability of trout feed, trout seed, market and price.

Image 9.6: Trout raceway owned by Kul Bahadur Limbu

TENKILAKHA- GANCHUNG

Tenkilakha- Ganchung village is located nearby Pakyong (Known for Sikkim's lone airport, Greenfield airport) within 4-5 km. From Gangtok it is about 25 km toward south east. The cluster consists of nine beneficiaries with laterally attached twin tanks constructed within the financial year of 2017. Financial assistance (along with water pipes, seed and feed) for constructing these nine sets of twin tanks was provided by DOF, under Blue Revolution or *Neel Kranti Mission* (Ministry of Agriculture and Farmers Welfare, Department of Animal Husbandry, Dairying & Fisheries). The village is blessed with perennial source of water from stream, Pachey-khola, which is within 1000 meters from their tanks.

Image 10.1: Survey team, Scientist from ICAR-DCFR and Block Officer from DOF, Sikkim along with local farmers.

This cluster will become one of the accessible clusters from capital city. This proximity to city will avail all facilities in transfer of feed, seeds, and farm products. Further, regular visit by local DOF personnel will be easy. The site is in close jurisdiction of Joint Director-Mr. D.B. Rai, Range Officer- Gauri Mukhia and Block Officer- B.L. Sharma. Since there are total of 9 households in the cluster; therefore forming farmers' cooperative will be much easier.

Cooperative if formed will be very much beneficial in the form getting inputs like feed and seeds as well as to cooperative sell the output in decided locations like Gangtok, Pakyong, Ranipul, Singtam and Rangpo. Further scientific interventions through scientific institutes may also be possible because it is locate in prime area.

Name of the farmer: Mr. Sukraj Rai

Village: Tenkilakha- Ganchung, Pakyong, East Sikkim

Number of tanks: 02

Year of construction: 2017

Source of water: Perennial, 150 meters away from tanks

Size of tanks: 57x7x4 (length, width and depth in feet, depth is variable for maintain the slope towards the outlet)

Image 10.2: Twin tank of Sukraj Rai

Name of the farmer: Mr. Krishna Kumari Rai (profile image belongs to husband)

Village: Tenkilakha-Ganchung, Pakyong, East Sikkim

Number of tanks: 02

Year of construction: 2017

Source of water: Perennial, within 1000 meters away from tanks (straight distance)

Size of tanks: 57x7x5-6 (length, width and depth in feet, depth is variable for maintain the slope towards the outlet)

Image 10.3: Twin tank of Krishna Kumari Rai

Name of the farmer: Mr. Subash Rai

Village: Tenkilakha-Ganchung, Pakyong, East Sikkim

Number of tanks: 02

Year of construction: 2017

Source of water: Perennial, within 1000 meters away from tanks (straight distance). Tanks are in the middle of cardamom, broom-grass field and cultivable land. The outlet water rich in nutrient can be used for irrigation of the same.

Size of tanks: 58x7x4-5 (length, width and depth in feet, depth is variable for maintain the slope towards the outlet).

Image 10.4: Twin tank of Subash Rai

Name of the farmer: Mr. Jit Kumar Rai

Village: Tenkilakha-Ganchung, Pakyong, East Sikkim

Number of tanks: 02

Year of construction: 2017

Source of water: Perennial, within 1000 meters away from tanks.

Size of tanks: 58x7x4-5 (length, width and depth in feet, depth is variable for maintain the slope towards the outlet).

Image 10.5: Twin tank of Jit Kumar Rai

Name of the farmer: Mr. Nabin Rai

Village: Tenkilakha-Ganchung, Pakyong, East Sikkim

Number of tanks: 02, tank is surrounded by cardamom field

Year of construction: 2017

Source of water: Perennial, within 400 meters away from tanks (straight distance). Tanks are in the uphill of floriculture unit, and the outlet water rich in nutrient can be used for irrigation of the same.

Image 10.6: Twin tank of Nabin Rai

Image 10.7: Feed used Nabin Rai's Farm: Crumbled feed for fry and early fingerling and pellets for advanced fingerlings.

Size of tanks: 58x7x4-5 (length, width and depth in feet, depth is variable for maintain the slope towards the outlet).

He has stocked 1000 fingerlings in one of his tank. According to him growth is coming good with regular feeding and maintenance of water by sufficient flow through. However, perhaps due to the new tank and lack of experience for the first time, he experienced some mortality during first few months of stocking.

At present fishes are in good health and growth and water looks crystal clear. He has maintained the appropriate height of fall of water at the inlet for maintaining the required dissolve oxygen.

He is well trained in following the stringent feeding management

Broadcasting of crumbled pellet twice a day for early fingerlings (he is practicing this at present).

Broadcasting of 2 mm pellet twice a day for advanced fingerlings and bigger ones.

Broadcasting of 4 mm pellet twice a day for bigger ones.

Name of the farmer: Mr. Ran Bahadur Rai

Village: Tenkilakha-Ganchung, Pakyong, East Sikkim

Number of tanks: 02

Year of construction: 2017

Source of water: Perennial, within 500 meters away from tanks (straight distance). Tanks are in the uphill of cardamom field, and the outlet water rich in nutrient can be used for irrigation of the same.

Size of tanks: 58x7x4-5 (length, width and depth in feet, depth is variable for maintain the slope towards the outlet).

Image 10.8: Twin tank of Ran Bahadur Rai

Name of the farmer: Mr. Phurba Dorjee Sherpa

Village: Tenkilakha-Ganchung, Pakyong, East Sikkim

Number of tanks: 02

Year of construction: 2017

Source of water: Perennial, within 1000 meters away from tanks (straight distance). Tanks are in the uphill of kitchen garden, and the outlet water rich in nutrient can be used for irrigation of the same. This will possibly help in augmenting the productivity of vegetable, especially in winter.

Size of tanks: 58x7x4-5 (length, width and depth in feet, depth is variable for maintain the slope towards the outlet).

Image 10.9: Twin tank of Phurba Dorjee Sherpa, covered with net for protecting fingerlings against predators (left), water feeding through net (for filtered water in rainy season and for maximum dissolve oxygen generation (middle) and haul of fingerlings in his tank.

TROUT FARMERS' CO-OPERATIVE

Now a day's agricultural farming has evolved in profitable entrepreneurships with some modifications in its mode of operation. Earlier, individual farmer had to deal with challenges of farming activities (arrangement of seed materials, fertilizers, pesticides, etc.), and marketing issues individually. Dealing with such obstacles at personal level was real hard for marginal farmers with limited resources. Realizing such problems at farmers end, government brought the concept of cooperative societies. With the advent of such concept, farmers do not have to deal with problems alone; they can collectively share and solve problems. Formally, the concept of co-operatives was introduced in India during 1904. It was brought with an objective to mitigate the problems of rural indebtedness but later it evolved in more refined and entrepreneurial form with varied activities such as production, farming, marketing and processing.

In Indian scenario, at village/block levels there are many cooperatives for different field of agricultural activities like cooperatives of cattle farming, horticultural farmers, fish farmers, etc. Co-operatives avail financial support to farmers in need at a cheaper interest, and best quality of seeds, feed, medicines, etc., at reasonable price. It also facilitates storing, transporting and marketing of farm product in an efficient and cost effective manner.

DOF, Sikkim, also initiated the creation of fish farmers' cooperatives in different possible pocket of the state, based on available number of farmers in clusters. They helped in formation of cooperatives, separately, for carp and trout growers. Furthermore, they helped the cooperatives to open two fish markets, through financial assistantship of NFDB, at two locations; one at Gyalshing for West and South districts, and the other at Gangtok for North and East districts. For selling their farm products, trout growers from Sikkim can send their farm output collectively through local cooperatives to marketing cooperative of Gyalshing and Gangtok. In doing so, individual trout farmers in a cooperative society can sell their farm products at lucrative MRP set by the DOF. Further, this will help in ruling out the hassles created by unwanted middlemen.

Trout growers' co-operatives are there in Sribadam, Uttarey, Upper Rimbik, and many other places. In these co-operatives, DOF have availed trout hatcheries (of 1 lakh capacities of eyed ova) through NFDB funding. Each hatchery will have concrete enclosed of sufficient space for accommodating 12 hatching trays. Co-operative members can carry out breeding and seeds rearing collectively in their community hatcheries, and they can/will avail quality seeds to all the members of the group at nominal rates. They can also sell the surplus seeds outside of cooperative for revenue generation.

Sribadam co-operative

This co-operative is one of the actively functioning trout farmers' co-operatives in Sikkim. Presently, it has membership of seven household, and has total of 24 functional tanks in it. Mr. Pem Tshering Bhutia is the present president of this co-operative. In coming years, with increase in number of trout growers in Sribadam area, the membership may go high. Recently, they

got financial support for construction and establishment of trout hatchery from DOF under Blue Revolution mission. In their co-operative, this hatchery will be operated under the direct supervision of Mr. Samdup Bhutia, who is an experienced trout breeder of Sribadam, and he has the practical experience of handling this business for many years. We carried out the simple financial calculations of hatchery outputs. Further, we also calculated the feed requirement by total existing tanks in that co-operative, and the detail is presented below.

Trout hatchery

This hatchery will have the capacity of 1,00,000 eyed ova, and this will yield at least 80,000 fingerlings in one operational cycle, taking into account of 20% mortality (hypothetical). Hatchery will have 12 troughs for egg incubation.

The cost of fingerlings for co-operative members will be Rs. 8/-, and for other it will be Rs. 10/-.

Since, there are 24 tanks in that co-operative, and they stock @ 2000 fingerlings per tank. Then total numbers of fingerling requirement for Sribadam cluster will be 48,000.

Rest, approximately 32,000 fingerlings can be sold outside the co-operative.

Image 11.1: Community hatchery under Sribadam trout farmers' cooperative (under construction, but expected to come into operation by December, 2018).

Now let's calculate the gross earning of the hatchery:

48,000 fingerlings @ Rs. 8 will yield Rs. 3,84,000/-

32,000 fingerlings @ Rs. 10 will yield Rs. 3,20,000/-

So, gross earnings will be Rs. 7,04,000 lakhs per operation period of 3-4 months.

Feed requirement

Since, there are currently 24 functional tanks in this co-operative. The average stocking density, they follow, is 2000 fingerlings per tank, if farm management runs perfectly.

If we assumed 10-20% mortality, then there would be 1600-1800 individual fish per tank.

If the growth is 500g (on an average) for the culture period; however, they have mentioned almost 700-1000g as the average growth.

The total biomass at the times of harvesting will be 800-900kg from every individual tank.

If the feed conversion ratio (FCR) of feed to the fish is 2:1, then 2kg feed will give 1kg fish. Therefore, the feed requirement per tank will come to around 2 800/900kg.

For one tank, feed requirement will be around 1600-1800kg.

Therefore, total feed requirement for the 24 tanks will come to around 24 1600/1800kg, i.e., 38,400-43,200kg.

In Sribadam trout farmers' co-operative, the total feed requirement per operational cycle will be 38,400-43,200kg.

If we split 38,400-43,200kg for twelve individual months, then the feed requirement per month will be 3,200-3,600kg.

Therefore, to operate the existing 24 tanks of Sribadam cooperative society we need around 3,200-3,600kg feed per month.

The monthly feed requirement per tank will come to around 130-150kg.

Depending on stocking density, growth rate and total biomass (it may change with periodic harvesting as well), the calculation can be adjusted.

Uttarey co-operative

This also is an actively functioning trout farmers' co-operative in Sikkim. It has membership of around 15 household and has total of 21 tanks in it. Mr. R. B. Rai is the present president of this co-operative. Recently they got financial support for construction and establishment of trout hatcheries from DOF under Blue Revolution mission.the hatchey is constructed in a place with plenty of perennial water source nearby.

Trout hatchery

This hatchery will have the capacity of 1,00,000 eyed ova, and this should be able to yield at least 80,000 fingerlings, taking into account of 20% mortality (hypothetical). Hatchery will have 12 troughs for egg incubation.

The cost of fingerlings for co-operative members will be Rs. 8/-, and for other it will be Rs. 10/-.

Since, there are 21 tanks in that co-operative, and they stock @ 2000 fingerlings per tank. Then total numbers of fingerling requirement for the village of Sribadam cluster will be 42,000.

Rest, approximately 38,000 fingerlings can be sold outside the co-operative.

Image 11.2: Community hatchery under Uttarey trout farmers' cooperative, it is expected to come into operation by December, 2018

Now let's calculate the gross earning of the hatchery:

42,000 fingerlings @ Rs. 8 will yield Rs. 3,36,000/-

38,000 fingerlings @ Rs. 10 will yield Rs. 3,80,000/-

So, gross earnings will be Rs. 7,16,000 lakhs per operation period of 3-4 months.

Feed requirement

Since there are currently 21 functional tanks in this co-operative. The average stocking density they follow is 2000 fingerlings per tank (if farm management runs perfectly).

If we assumed 10-20% mortality then there would be 1600-1800 individual fish per tank.

If the growth is 500 gm (on an average) for the culture period.

The total biomass at the times of harvesting will be 800-900kg from every individual tank.

If the FCR of feed to the fish is 2:1, then 2kg feed will give 1kg fish. Therefore, the feed requirement per tank will come to around 2 800/900kg.

For one tank, feed requirement will be around 1600-1800kg.

Therefore, total feed requirement for the 21 tanks will come to around 21 1600/1800kg, i.e., 33,600-37,800kg of feed.

In Uttarey trout farmers' co-operative, the total feed requirement for one operational cycle will be 33,600-37,800kg.

If we split 33,600-37,800kg for twelve individual months, then the feed requirement per month will be 2,800-3,150kg.

Therefore, to operate the existing 21 tanks of Uttarey co-operative society, we need around 2,800-3,150kg feed per month.

The monthly feed requirement per tank will come to around 135-150kg.

Depending on stocking density, growth rate and total biomass (it may change with periodic harvesting as well), the calculation can be adjusted.

Upper Rimbik co-operative

This co-operative is one of the trout farmers' co-operatives in Sikkim. It has membership of 18-19 households, and has total of 15 tanks which are functional. Recently they got financial support for construction and establishment of trout hatcheries from DOF under Blue Revolution mission.

Trout hatchery

This hatchery will have the capacity of 1,00,000 eyed ova, and this should be able to yield at least

80,000 fingerlings, taking into account of 20% mortality (hypothetical). Hatchery will have 12 troughs for egg incubation.

The cost of fingerlings for co-operative members will be Rs. 8/-, and for other it will be Rs. 10/-.

Since, there are 15 tanks in that co-operative, and they stock @ 2000 fingerlings per tank.

Then total numbers of fingerling requirement for Rimbik cluster will be 30,000.

Rest, approximately 50,000 fingerlings can be sold outside the co-operative.

Image 11.3: Community hatchery under Upper Rimbik trout farmers' cooperative. Under construction

Now let's calculate the gross earning of the hatchery:

30,000 fingerlings @ Rs. 8 will yield Rs. 2,40,000/-

50,000 fingerlings @ Rs. 10 will yield Rs. 5,00,000/-

So, gross earnings will be Rs. 7,40,000 lakhs per operation period of 3-4 months.

Feed requirement

Since, there are currently 15 functional tanks in this co-operative. The average stocking density they follow is 2000 fingerlings per tank (if farm management run perfectly)

If we assumed 10-20% mortality then there would be 1600-1800 individual fish per tank.

If the growth is 500 gm (on an average) for the culture period.

The total biomass at the times of harvesting will be 800-900kg from every individual tank.

If the feed conversion ratio of feed to the fish is 2:1, then 2kg feed will give 1kg fish. Therefore, the feed requirement per tank will come to around 2 800/900kg.

For one tank, feed requirement will be around 1600-1800kg.

Therefore, total feed requirement for the 15 tanks will come to around 15 1600/1800kg, i.e., 24,000-27,000kg of feed.

In Upper Rimbik trout farmers' co-operative, the total feed requirement per operational cycle will be 24,000-27,000kg.

If we split the 24,000-27,000kg for twelve individual months, then the feed requirement per

month will be 2,000-2,250kg.

Therefore, to operate the existing 15 tanks of Upper Rimbik co-operative society, we need around 2,000-2,250kg feed per month.

The monthly feed requirement per tank will come to around 135-150kg.

Depending on stocking density, growth rate and total biomass (it may change with periodic harvesting as well), the calculation can be adjusted.

ISSUES AND WAY FORWARD

The growth rate of expansion of trout farming in Sikkim is really encouraging. As of now there are 349 trout raceways in private sectors. Apart from discontinuity in the span of 2014-2016, there has been a good increase in numbers of units every year. Simultaneously, the production of trout is also increasing. On the other hand, common people are also becoming aware of existence of trout as edible fish, locally farmed and fresher than other regular fishes in the market. As a consequence market for trout, within the state is also increasing. Based on our conversation with farmers, productivity of farm is also increasing with increase in experience of the farmers. Farmers who have been doing diligently are found to be inspired to take the farming to entrepreneurial scale, provided the supply of water, seed and feed remain abundant and continuous. After realizing the benefits of trout farming, farmers encouraged and inspired to expand the business. Among many of them, we surveyed, some are taking extra interest and financial risk to create additional tanks in their facility for doubling their income. They are dreaming to take a leap from subsistence farming to commercial one.

Looking at the available information, at present time, many clusters of trout farmers have formed in the state. Later these clusters have evolved into the form of co-operatives. Apart from very few independent/individual progressive farmers, most of the progressive farmers are from co-operative groups. Effective co-operatives are bringing all of them together in the progressive mode, for the development of all members; and seeing their progress many more are being recruited to their group with the advance of time. Gradually, trout farmers of the state are realizing the benefits of being a member of co-operative; and as a consequence, many other small to large clusters are also converting into co-operatives.

DOF is also working parallel to the pace of progress of trout business in private sectors of state. They are also creating public infrastructures for maintenance of brooders and production of surplus seeds. DOF have created trout farms and hatcheries in all districts except in south. To meet the demand of feed in Sikkim, DOF has installed two fish feed mill (with a capacity of 156 kg/hr), at two places; one at Rangpo (East District), and other at Rothak (West District). Apart from running their farm operation, DOF is working with farmers and their cooperatives to facilitate all possible technical and financial support for their upliftment.

More importantly, ICAR-DCFR is also providing all possible scientific and technical assistance to the farmers, their cooperatives and DOF staffs in the form of training, demonstrations, advisories and consultations.

With all these positive and progressive steps, a bright future of trout farming is apparently impending in prosperous and sustainable manner. The development of trout farming in the state is moving from initial lag to the present log phase; and consequently, farmers are also taking the business as a means of achieving their prosperity instead of just the livelihood. However, down the line there are many hurdles which need immediate attention and refinement, and if not

taken care of in immediate future, then they may hinder the growth of the sector. These issue, and suggested solutions include

Mortality at the time of stocking

This can be easily mitigated by following better practices for pre-stocking farm/tank preparation and its conditioning, procurement of advanced and healthy fingerlings for stocking, monitoring of water quality prior to stocking, disinfection of stocking material, and designing and implementation of better feed and feeding strategy for early stocks.

Non availability of feed

To address this issue, a detail survey of availability of possible (based on price, nutrient composition, acceptability, etc.) ingredients is needed to be carried out for formulating cost effective diets. DOF has already installed two feed mills, and if feed ingredients and formulation is ready, feed production can be initiated by either DOF itself or farmers' cooperative bodies. So that the farmers may get easy and anytime access to feed procurement. ICAR-DCFR is working in the line of formulating cost effective trout grow-out feed by incorporating some sustainable source of plant based protein reach ingredients. Side by side, institute is also working on formulation and validation of trout starter feed. In coming years they will be tested at farmers facilities for dissemination of technology after validating at end users facility.

Insufficient seed

DOF and ICAR-DCFR can work in parallel and partnership (and has been working for years too) for breeding and seed rearing related activities. Where ICAR-DCFR will provide all possible scientific and technical assistantship to DOF farm facilities for bring in the best hatchery practices. Even DOF has provided the community hatcheries to different co-operatives for healthy seed production at the vicinity of their farm facility. This will not only solve the problem of seed scarcity but also avail the seed at cheaper rates.

Marketing issues

DOF has formed trout farmers cooperatives, these cooperatives in turn run and regulate cold storage equipped fish market in each district. By doing this, the influx of middleman can be reduced, and that in turn can ensure best margin for farmers and lowest possible price for the consumers. Further, the concept of coinciding the harvesting time to tourist or festival season may help the farmers in getting best possible profit margin.

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ICAR-Directorate of Coldwater Fisheries Research
Bhimtal – 263136, Distt. Nainital, Uttarakhand