An integrated approach to contemporary fish farming practice incorporating traditional knowledge in mid hills in India: A success story

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Different shades of Champawat.

Hill farming is largely characterised by low productivity, small land holdings, scarcity of agricultural land and irrigation facilities, and uneven terrain. The use of steep areas for cultivation also amplifies the chances of soil erosion together with poor retention of water. Low returns in farming and unemployment problems in hilly areas are compelling youth to move to the cities to find livelihoods.

In Uttarakhand State, agricultural activities are gradually gaining momentum, however, a lack of awareness of good practices and access to technology is a major concern, mainly because of the remote location of many farming communities.

With a growing population and gradual improvement in living conditions, the demand for nutritious food is increasing day by day. A national sample survey has revealed while hunger in the country has consistently fallen for example from 15% in 1983 to 2% in 2004-2005, nutritional deficiencies, principally protein, are becoming a major concern. These can lead to underweight and stunted growth particularly in women, and children below five years in age where 33% of individuals are affected (2015, Ministry of Health and Family Welfare). The effect of malnutrition could be more pronounced in rural and hilly areas of the country, mainly due to the prevalence of poverty, poor agriculture productivity and a lack of access to protein-rich food in general.

Harnessing diversified natural resources in a sustained manner to improve livelihoods and accessibility to protein-rich foods in hilly areas of the country is of utmost importance. Efforts in maximising sustained returns from these resources could greatly help farmers and rural communities achieve nutritional security. Adoption of integrated farming practices utilising available land, water and waste products more efficiently can improve farm productivity and income for farmers. With a view to motivate fellow farmers, the achievements of a young farmer, Shri Raghubar Datt Murari of the remote Bheti Village (Champawat) of Uttarakhand, are documented in this article.

Detail of farming activities, area under cultivation, production, gross and net income.

Crop	Area (h)	Production cost	Total production	Gross income Indian Rupees (INR)	Domestic use kg	Sold kg	Net income INR/crop
Paddy	0.5	2000	0.6-0.8 t @ 15 INR/kg	8,000 1,000	All	0	-
Wheat	0.4	2000	0.5-0.5 t q @18 INR/kg	9,000	All	0	-
Maduwa	0.16	400	0.2-0.25 t @12 INR/kg	300	50	200	2,000
Soybean	0.5	1000	0.8-1 @20-30 INR/kg	22,500	100	700	16,500
Cabbage /cauliflower	0.1	1000	0.5-0.7 t @20-25 INR/kg	12,000	100	500	9,000
Tomato (Hemlata, Shahlata)	0.04	800-1000	0.1-0.15 t @15-20 INR/kg	2,250	50	100	1,400
Capsicum (California Wonder)	0.08	3000	0.9-1 t @30/kg	27,000	100	800	21,000
Potato	0.5	25,000	5-6 t @6-10 INR/kg	50,000	600	44,000	19,000
Branjal	0.025	500	0.2- 0.25 t 10-15 INR/kg	2,000	50	150	1,000
Pumpkin	0.02	150-200	0.6-0.7 t @10-15 INR/kg	7,200	100	500	5,800
Cow	2	50,000 45-50/day	8-10 litres @ 20 INR/kg	180/day	6	4	40/day
Poultry	20-25 nos	Rs 1,225 50/p+ Rs 200	10-15 eggs/day @ 5 INR/piece, meat 250-300 INR/bird	Eggs 75/day Meat 6,000	3-4/day eggs 8 piece	8-10 eggs /day 15 piece	50/day 2,300
Honey	20 hives	1,000	35-40 INR/kg @300/kg	12,000	5 kg	35	9,500
Carp culture	0.02	1,500	60-70 INR/kg @120/kg	8,400	10	60	7,200

About Uttarakhand

'Himalaya' signifies the abode of snow in Sanskrit, truly characterising the vast and enduring snow fields of the high altitudes. In the heart of these majestic mountains lies the state of Uttarakhand. With a geographical area of 53,000 km^2 the area was designated as a separate state from erstwhile Uttar Pradesh on 9 November, 2000, becoming the 27th state of the Republic of India.

Uttarakhand lies in the northern part of India amidst the magnificent Himalayas and bears dense forests. The state borders Himachal Pradesh in the north-west and Uttar Pradesh in the south and has international borders with Nepal and China. Most of the state, around 46,000 km^2 is covered in hills with the remaining 7,000 km^2 being plains. A major part of the state is forested, some 34,600 km^2 with annual average rainfall of 1,606 mm. As per 2011 the total population of the state was provisionally estimated at around 10.1 million with a literacy rate of about 79.63%. The thirteen districts can be grouped into three distinct geographical regions, the high mountain region, the mid-mountain region and the Terai (lowland) region. Dehradun is the interim capital city. Uttarakhand consists of two divisions viz. Kumoun and Garhwal, thirteen districts, 78 tehsils, 15,761 inhibited and 1,065 uninhibited villages. Temperatures range from a minimum of -1.3°C (Mukteshwar) and 41.2°C (Dehradun).

Chanmpawat District

In the ancient times this region was the origin of the Naga, Kinnar and Khas Rajas. The available historical pillars, manuscripts, archaeological collections and folk myths described show the greatness of the area during the Mahabharata period.

The lowland Terai area is hot whereas the hilly regions are comparatively colder. In summer, Champawat District is pleasant with temperature varying from 1-35°C. The Terai area around Tanakpur consists mainly of agricultural land with a warm climate, having an average altitude of 200 to 250 meters. The Shivalik Range consists of dense forests with an altitude range of 250 to 1,200 metres and peaks averaging 1,500 metres in height. Agriculture development in the area is limited by the availability of flat land and infrastructure to support intensive farming.

Background information

Mr Raghubar Datt Murari, a young man in his forties from Bheti village and son of the late Shri D.N. Murari, has a post-graduate degree in history from Lucknow University. His family consists of nine members and their main occupation is agriculture. His father was employed in the State Health Department as a Health Supervisor, and frequently used to stay away from home. Hence, from his early school days, Mr Murari was attracted towards agricultural activities and helped

Fish health examination.

Harvesting fish tanks.

Exposure visit of local fish farmers.

his elders. He has an agricultural land holding of about 1.96 ha spread over uneven hilly terrain about 22 km away from Champawat District Headquarters. About 1 ha is irrigated and the remaining 0.96 ha is rain fed land. After completing his Masters degree, he returned to his village with a dream to carry forward his ancestral occupation. His father who retired from active service in year 2000 also extended a helping hand to his son and shared his inherited wisdom and indigenous traditional knowledge.

Practices

In 1989-90, Mr Murari started farming a small in a 0.08 ha area, growing cabbage and cauliflower. Seed was procured from outside. With proper care a production of 5 tonnes/ha of these vegetables was achieved. Wheat, paddy, soybean and, maduwa (finger millet) were also produced. The husks and other by products are used to feed the livestock.

Farming later included cabbage, cauliflower, tomato, capsicum, potato, branjil (eggplant)and pumpkins. A poultry shed was established with 20-25 layers were reared. The nearest market is at Lohaghat, which is about 7 km away from the village.

Fish farming

Under the Grammya scheme of water shed development programme, a 100 m^2 tank was constructed 2003-2004 at a cost of Rs 80,000/-. The construction cost was high as the land was uneven. Rs 62,000/- was given by the Grammya scheme as a subsidy. About 150 larger size (100-150 g) grass carp, silver carp and common carp specimens were collected from a nearby tank and stocked. These fishes attained a size of 350-600 g after around 18 months of culture. In the beginning no one in the area believed that fishes could grow in cement tanks. But seeing the success of fish farming again they collected 600 fry of rohu, grass carp, common carp and silver carp from the Krishi Vigyan Kendra (agricultural extension office, KVK) Lohagha. The average growth of these fishes ranged between 300-500 g. During winter, silver carp and rohu mortality was observed. A total of 40 kg of fish was harvested. Subsequently, another tank with an area of 100 m^2 was constructed, connected to the older tank. Only Rs 12,000/- was spent on constructing the second tank of which an Rs 8000/- subsidy was given by the state department to promote fish culture on a larger scale.

The nearest KVK office extending help in form of seed collected from Pantnagar. A total of about 800 rohu, grass carp, silver carp and common carp seed was stocked. With proper care fish attained a size of 300-700 g, and farmer was able to harvest 60-70 kg of fish. As demand for fish is very

high in the area they sold at a good price of @ Rs 120-140/ kg. From 2008 onwards, larger sized fishes have been kept in a separate tank and the smaller ones are reared separately. During the course of this period, help was received from fish culture experts. Mr Murari was immensely encouraged after seeing the income from the fish sales, which attracted him to this occupation.

Scientists of the ICAR-Directorate of Coldwater Fisheries (DCFR) regularly visit the fish tanks to provide valuable guidance. From time to time regular visits of many dignitaries, farmers, and students have been received by the Mr Murari. He regularly takes part in group discussions with fellow farmers regarding growth, production, disease problems, sales and other important issues. Stocking of quality, large sized seed, adoption of a scientific package of practices and regular interaction with nearby fisheries experts were key factors that boosted his farm productivity and brought all round prosperity in his family. He never hesitates in sharing his achievements and failures with fellow farmers, and to encourage them. He has become a well-known farmer in the area and district. ATMA has awarded him with best farmer's award.

Practices which helped Mr Murari increase fish production included:

- Use of fish culture tanks water in vegetable crops enhanced vegetable productivity with reduction in incurring fertilisation cost.
- Rational stocking (2-3 fish per square metre) of ponds with proper combination of species considering the availability of water, grass and other feed ingredients.
- Collection of water from natural resources through gravitational method reduced the cost of power in pumping water.
- Multiple use of water for drinking, irrigation and fish culture.

Above, below: Farmers learn about breeding grass carp.

Farmer learning grass carp breeding.

Below: Egg-laying poultry.

Participation in value addition training.

Polyhouse grown vegetables.

- Stocking of larger sized exotic carp varieties (grass carp, silver carp) with weight range of 80-120 g along with an improved variety of common carp.
- Regular pond raking for reducing organic load in the pond.
- Partial water exchange.
- Fixing of feeding baskets in fish tanks to reduce the feed wastes and improve feed utilisation.
- To bring down expenditure on feed, a locally prepared fish feed was made using mustard oil cake and rice polish. These items were procured locally and given in dough form. Compared to commercial feed, farm-made feed reduced cost by up to 50%.
- Demand-driven harvesting of fish during extreme winter months, road blockages and special occasion fetched higher prices.
- Visits to nearest fisheries Institutions and regular monitoring of the ponds.

Mr Murari also applied innovations in technology, management practices and knowledge including:

- Conservation of hilly water resources and improving its productivity by implementing fish farming in water storage tanks.
- After utilisation of stored water for fish culture, which increased its nutrient content, the water was used for irrigating agricultural crops, improving their productivity.

Routine feed application.

Small carp tanks laid out in series.

- Providing cost effective transfer of technology through farmer to farmer training in local language.

Factors that led to Mr Murari's success included:

- The firm determination of the retired army Naik Mr Gahtori to serve his own villagers.
- Co-ordination and co-operation of the local farmers in conducting the work.
- Strong linkages and support by the fishery departments, ICAR-DCFR and KVK at Lohaghat.
- Networking with various organisations for diversified activities/operations in the region.

However, Mr Murari faced many constraints on his efforts. These included:

- Initially there was no water storage tank in the vicinity and villagers were procuring drinking water from far-off places with much difficulty.
- The community had a lack of awareness about water storage and the possibility of raising fish in the stored water.
- A lack of adequate infrastructure for large scale fish farming.
- Inadequate availability of flat land in the Himalayan hill region, which makes it difficult to undertake agriculture on a commercial scale.
- Small uneven land holdings and acute scarcity of water in the summer months.
- Due to the high altitude and lower thermal regime, slower growth of stocked fishes resulting to lower fish production.
- Although fish seed is produced in the foothills of the Himalayan region it is very difficult to transport due to the hilly nature of the terrain.

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View of two cement fish tanks.

A water storage tank used as a fish nursery.