



## Trout Farming in Kashmir: A Historical Review and Future Perspectives

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### ABSTRACT

*Trout farming is one of the most successful cold-water aquaculture enterprises in India, with Kashmir serving as its principal center of development. The favorable climatic conditions, abundant spring-fed streams, and rich freshwater resources of the Kashmir Himalayas have facilitated the successful establishment and expansion of trout culture. The introduction of trout during the late nineteenth century marked the beginning of a new era in Kashmir fisheries. Since then, trout farming has evolved from experimental stocking of streams to a commercially viable aquaculture industry that contributes significantly to fish production, employment generation, tourism, and rural livelihoods. This study reviews the origin, historical progression, present status, and future prospects of trout farming in Kashmir, highlighting technological advancements, production trends, constraints, and opportunities for sustainable development. Trout farming is increasingly recognized as a high-value aquaculture sector with substantial potential for expansion in the region.*

**Keywords:** Trout farming, Rainbow trout, Brown trout, Kashmir, cold-water aquaculture, fisheries development, future prospects.

### INTRODUCTION

The Jammu and Kashmir (J&K) emerged as a sovereign state in 1846 when Maharaja Gulab Singh acquired the hilly and mountainous country situated to the east of the Indus and west of the Ravi against the payment of Rs. 75 lakh as an outcome of the Amritsar Treaty (Bamzai, 1994; Sharma, 2003). However, J&K was later acceded to India when Maharaja Hari Singh signed the Instrument of Accession in

response to the events associated with the end of British rule, the partition of the Indian subcontinent, and the Pakistan-sponsored tribal invasion of Kashmir in 1947 (Lamb, 1991; Schofield, 2010).

The erstwhile State of Jammu and Kashmir covered an area of about 222,236 km<sup>2</sup>, extending from 32°17' to 36°58' N latitude and from 73°26' to 80°30' E longitude prior to its reorganization in 2019.

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The region is predominantly mountainous, rising in successive tiers from the plains in the south to high-altitude valleys and snow-clad peaks in the north, encompassing some of the most picturesque inhabited landscapes in the world (Raina, 2002).

The Kashmir Valley possesses unique ecological and climatic conditions that support cold-water fisheries. Snow-fed rivers, perennial springs, and low water temperatures provide an ideal environment for cold-water fish species. Among these, trout has emerged as one of the most economically important fish groups cultured in the region (Jhingran, 1991). The trout species introduced into Kashmir, the most important are the Brown Trout (*Salmo trutta fario*) and the Rainbow Trout (*Oncorhynchus mykiss*). Brown trout, originally native to Europe, was the first trout species successfully established in the natural streams and rivers of Kashmir and became highly valued as a sport fish due to its adaptability and angling appeal (Das & Subla, 1963; Kaul, 2015). Rainbow trout (*Oncorhynchus mykiss*), native to the Pacific coast of North America, was subsequently introduced and emerged as the preferred species for aquaculture because of its rapid growth, ease of artificial propagation, and high market acceptance (Bhat, 2013; Kaul, 2015). At present, rainbow trout constitutes the backbone of commercial trout farming in Kashmir, whereas brown trout continues to play an important role in recreational fisheries and sport angling activities (Kaul, 2015).

The present review was conducted using published scientific literature pertaining to the origin, history, development, and future prospects of trout farming in Kashmir. Information was collected from peer-reviewed research articles, review papers, government reports, technical bulletins, books, conference proceedings, dissertations, and official publications of the Fisheries Department of Jammu and Kashmir.

### **History of Trout Farming in Kashmir**

For the purpose of this review, the century-long evolution of trout fisheries in Kashmir is categorized into four major phases

#### **I) Early Introduction (1898–1900)**

The climatic conditions of Kashmir and the excellent quality of its water bodies, particularly streams, springs, and high-altitude lakes, has been highly suitable for the survival and propagation of trout. Recognizing this potential, Mr. F. J. Mitchell attempted to introduce trout into Kashmir around the close of the nineteenth century. Frank J. Mitchell, a Scottish entrepreneur and carpet manufacturer residing in Srinagar recognized the remarkable similarity between the cold, clear waters of Kashmir and the native trout habitats of Scotland. The perennial spring-fed streams, low water temperatures, high dissolved oxygen concentrations, and gravel-bottomed channels of Kashmir provided ideal environmental conditions for the acclimatization of trout (Mitchell, 1904).

Mr. Frank J. Mitchell, popularly known as the “Father of Kashmir Trout Fisheries,” was a carpet dealer who owned a carpet factory at Basant Bagh in Srinagar, near the Khankah-e-Moula locality. Recognizing the suitability of Kashmir's cold-water streams and springs for trout culture, he initiated efforts to introduce trout into the Valley by importing trout eggs from Scotland, thereby laying the foundation for trout fisheries development in the region (Sehgal, 1999; Qadri, 1983).

The first consignment of trout eyed eggs, comprising approximately 10,000 eggs, was imported from Scotland in 1899 through the courtesy of the Duke of Bedford. The shipment was presented to the Kashmir State through Sir Adelbert Talbot, the then British Resident at Srinagar. However, owing to inadequate transport facilities and the lack of suitable incubation arrangements, the entire consignment was lost during transit and failed to establish trout in the Valley (Sehgal, 1999; Qadri, 1983; Department of Fisheries J&K, 2010).

Undeterred by this failure, Mitchell arranged a second shipment of trout eggs of Brown trout (*Salmo trutta fario*) from Scotland. This consignment arrived in excellent condition on **19 December 1900** under the

supervision of **J. S. Macdonell** and contained approximately **18,000 fry**. Of these, about **1,000 fry were transferred to Panzagam, Dachigam (Harwan area), nearly 24 km from Srinagar**, while the remaining fry were reared in the spring waters associated with Mitchell's carpet factory (Mitchell, 1904; Sehgal, 1999). This achievement laid the foundation for organized trout fisheries in Kashmir and paved the way for the subsequent development of trout culture, sport fisheries, and cold-water aquaculture in the region (Mitchell, 1918; Qadri, 1983; Sehgal, 1999).

The successful introduction and establishment of trout in Kashmir was not solely the achievement of F. J. Mitchell; it was also greatly facilitated by the contributions of two local pioneers, **Pandit Sodhama Miskeen** and **Khwaja Gaffar Joo**. These individuals possessed extensive knowledge of Kashmir's geography, hydrology, and stream ecosystems and played a crucial role in identifying suitable habitats for trout stocking and propagation. Historical records indicate that Mitchell relied heavily on their local expertise during the initial stages of trout introduction and acclimatization in the Valley (Kaul, 2015).

## II) Early Expansion (1903–1947)

In 1903, the Maharaja of Kashmir sanctioned the establishment of a Fisheries Department, marking the beginning of organized fisheries management in the region. Frank J. Mitchell was appointed as its first Director, while Pandit Sodhama served as Inspector. Initially functioning as the Department of Game Preservation, its activities focused primarily on sport fisheries and the protection of aquatic resources. During this period, several rivers and streams, including the Lidder, Sindh, Ferozpur Nallah, Madhumati, Kishenganga, and Chenab, were developed as trout fishing waters, while lakes and springs such as Gangabal and Verinag were stocked to facilitate the spread of trout across suitable habitats (Das and Subla, 1963; Jhingran, 1991).

By the 1920s and 1930s, trout angling had gained considerable prominence and emerged as an important attraction for visiting

European anglers. The success of trout establishment in Kashmir encouraged several princely states to seek technical guidance and trout seed for introduction into their own cold-water streams. As a result, trout culture was extended to regions such as the Nilgiris, Himachal Pradesh, Uttarakhand, and Murree. The growing interest in trout culture was further strengthened by the establishment of a private trout farm by Maharaja Hari Singh at Akkad near Seer Salia in Anantnag district (Sehgal, 1999; Kumar et al., 2011).

The first trout hatchery at Harwan was established by Frank J. Mitchell in the 1903 and served as the nucleus for trout breeding and seed production in the Valley. The hatchery played a crucial role in the acclimatization, propagation, and subsequent distribution of trout to various rivers, streams, lakes, and springs across Kashmir, thereby laying the foundation for organized trout culture in the region (Sehgal, 1999; Kaul, 2015).

A major milestone in the development of trout fisheries in Kashmir was the successful introduction of rainbow trout (*Oncorhynchus mykiss*). In 1912, Frank J. Mitchell succeeded in hatching and rearing fertilized rainbow trout ova obtained from the Bristol Water Works, Blagdon, England. The successful acclimatization of this species marked the beginning of rainbow trout culture in the region and further strengthened the foundation of cold-water fisheries in Kashmir. Subsequently, rainbow trout gained prominence owing to its rapid growth, adaptability to hatchery conditions, and high market value, eventually becoming the principal species cultivated in Kashmir's trout farms (Mitchell, 1918; Hassan and Pandey, 2012;). The successful establishment of rainbow trout in Kashmir also facilitated its dissemination to other cold-water regions of India, contributing significantly to the development of trout culture in the Himalayan states (Sehgal, 1999; FAO, 2001).

After the successful introduction of trout in Kashmir the focus shifted towards the stocking of trout in the streams of Kashmir.

Trout were subsequently released into several streams and rivers of the Kashmir Valley. Among the earliest waters stocked were the Dachigam Stream, Harwan Stream, Sindh River, Lidder River, Erin Stream, Ferozpur Nallah, Pohru Stream, and various tributaries of the River Jhelum. These water bodies possessed characteristics essential for trout habitation, including low temperatures, moderate to swift currents, rocky substrates, and excellent water quality (Sehgal, 1999; Balkhi et al., 2014).

### III) Development Phase (1947–2000)

Following the accession of Jammu and Kashmir to India in 1947, trout fisheries entered a new phase characterized by institutional strengthening, expansion of hatchery facilities, stream management, and systematic stocking programmes (Das and Subla, 1963). During the initial decades after independence, trout fisheries continued to be managed primarily as a sport fishery resource. However, the growing recognition of trout as a valuable cold-water fish with considerable economic and tourism potential encouraged the government to invest in fisheries infrastructure and scientific management (Jhingran, 1991; Sehgal, 1999).

A major milestone in the development of the fisheries sector occurred in 1978 when the Fisheries Department was reorganized (Department of Fisheries J&K, 2020). Prior to this reorganization, departmental activities were largely confined to conservation and sport fisheries owing to limited infrastructure and manpower (Hassan and Pandey, 2012). Following the restructuring, district-level fisheries offices were established and extensive surveys were undertaken to identify potential areas for fisheries development. These initiatives facilitated the planned establishment of trout farms, hatcheries, rearing units, laboratories, fish sale centres, and extension facilities across the state (Bhat and Yousuf (2014).

A major milestone during this phase was the establishment of the Kokernag Trout Fish Farming Project in Anantnag district. The project was initiated in 1984 with financial and

technical assistance from the European Economic Community (EEC) and was conceived as an integrated trout production centre comprising hatcheries, broodstock ponds, nursery raceways, grow-out raceways, water supply channels, and fish health management facilities (Sehgal, 1999; FAO, 2001). Constructed over an area of approximately 40 hectares and supplied by the perennial Kokernag spring system, the project emerged as one of the largest trout farming complexes in Asia (Qadri, 1983; Hassan and Pandey, 2012). The farm substantially enhanced the production of rainbow trout seed and table fish and served as the principal source of trout ova, fry, and fingerlings for government farms as well as the emerging private trout sector throughout Jammu and Kashmir (Sehgal, 1999; Department of Fisheries J&K, 2018).

### IV) Modern Expansion (2000–Present)

The beginning of the twenty-first century marked a new era in the development of trout farming in Kashmir, characterized by rapid commercialization, increased private-sector participation, technological modernization, and strong governmental support (Hassan and Pandey, 2012). The launch of the Pradhan Mantri Matsya Sampada Yojana (PMMSY) in 2020 provided a major impetus to the fisheries sector in Jammu and Kashmir, particularly cold-water aquaculture. The scheme aimed to enhance fish production, generate employment, strengthen fisheries infrastructure, and promote entrepreneurship through financial assistance and subsidy-based support mechanisms. Under PMMSY, trout farmers became eligible for assistance for the construction of raceways, hatcheries, feed units, fish transport facilities, and other aquaculture infrastructure. The programme substantially reduced capital investment requirements and encouraged greater participation of private entrepreneurs and rural communities in trout farming activities. Consequently, a growing number of youth have entered the trout farming sector, and numerous private trout farms have been established across different districts of

Kashmir, contributing to employment generation and the expansion of cold-water aquaculture in the region

### Current Trout Farming Infrastructure

Trout farming in Jammu and Kashmir has developed into a well-organized aquaculture sector supported by both government and private infrastructure. The Department of Fisheries has established a robust network of eight trout hatcheries and over fifty trout rearing units distributed across different districts of the Union Territory, ensuring the production and supply of quality trout seed and table fish. These facilities serve as the backbone of cold-water fisheries development and provide technical support to fish farmers. In recent years, the private sector

has witnessed remarkable growth, driven by government initiatives such as the Pradhan Mantri Matsya Sampada Yojana (PMMSY) and other fisheries development schemes. The private sector also witnessed significant expansion, with over 500 established trout farming units by 2020 (Business Standard, 2019; Department of Fisheries, J&K, 2020). The expansion of raceways, hatcheries, feed mills, and modern aquaculture systems reflects the growing participation of entrepreneurs and progressive farmers in the sector. This strong infrastructural base has significantly enhanced trout production, employment generation, and the overall sustainability of cold-water aquaculture in Jammu and Kashmir.

**Table 1: Trout Rearing Units of Department of Fisheries of J&K**

District	Trout Rearing Units / Hatcheries	No. of Units
Anantnag	Kokernag, Achabal, Tricker/Akad, Pahalgam, Verinag, Panzath, Wanpora Panzath, Dandipora, Nambal, Jogigund	10
Baramulla	Tangmarg, Kalantra, Bela, Kangroosa	4
Budgam	Beerwah, Khag, Basantwooder, Sureyar	4
Ganderbal	Mammer, Margund	2
Kulgam	Kulgam, Chawalgam, Tchansar	3
Pulwama	Aripal, Rajpora, Dhobiwan	3
Srinagar	Laribal, Harwan, Khar Huuz	3
Shopian	Aliyalpora, Zainpora	2
Kupwara	Kutlari, Tangdar, Kalaroos	3
Bandipora	Guzarbal, Shokbaba, Wanpora Gurez	3
Kathua	Khudwa Bani	1
Rajouri	Phalni	1
Doda	Gatha, Bheja	2
Kishtwar	Mughal Maidan	1
Ramban	Karol, Chunna Gool, Kairkot Banihal	3
Reasi	Hariwalal	1
Udhampur	Kirchi	1

(Source - Directorate of Fisheries, Jammu & Kashmir)

### Trout Production

The growth trajectory of trout farming in Kashmir from 1980 onwards reflects a remarkable transition from a small-scale activity to a rapidly expanding aquaculture enterprise. Trout production in the region increased from approximately **20 metric tonnes in 1989** to around **100 tonnes by 2004** (Kaul, 2015; Department of Fisheries, J&K,

2020). By **2009**, annual production had reached nearly **150 tonnes** (Department of Fisheries, J&K, 2020). Further expansion of infrastructure, improved seed production, and increased farmer participation led to a production level of approximately **298 tonnes during 2015–16** (Government of Jammu and Kashmir, 2016). The sector continued its upward trajectory, and by **2019–20**, trout

production had increased to nearly **600 tonnes**, highlighting the significant progress achieved in cold-water aquaculture development in the

region (Department of Fisheries, J&K, 2020; Business Standard, 2019).

**Table 2: Trout Production in Kashmir (1980–2020)**

Period	Production (Metric Tonnes)
1980-81	79
1985-86	144
1990-91	62
1995-96	182
2000-01	792
2004-05	100
2009-10	155
2015-16	298
2019-20	650

(Source – J&K Digest of Statistics)

**Table 3: Present Status of Trout Farming in Kashmir**

Year	Revenue from Trout Sale (₹ Lakhs)	Trout Production (Tonnes)	Trout Egg Production (Lakhs)	Trout Rearing Units/Hatcheries (Nos.)	Private Trout Units (Nos.)
2015–16	276.01	298	120.00	53	388
2016–17	221.56	302	130.00	57	485
2017–18	294.52	482	132.00	58	513
2018–19	329.05	598	137.00	58	533
2019–20	360.16	650	145.00	59	534

(Source - Directorate of Fisheries, Jammu & Kashmir)

## Future Prospects of Trout Farming in Kashmir

### 1. Expansion of Private Sector Farming

The increasing participation of private entrepreneurs is expected to further strengthen trout production in Kashmir. Government support through subsidies, technical assistance, and training programmes has encouraged many educated youth and farmers to establish trout farms, generating employment and promoting rural economic development.

### 2. Financial Support and Subsidy Schemes

Various centrally sponsored and state-supported schemes, including the Pradhan Mantri Matsya Sampada Yojana (PMMSY), Blue Revolution Programme, Rashtriya Krishi Vikas Yojana (RKVY), and other fisheries development initiatives, have provided financial assistance for the construction of raceways, hatcheries, water supply systems,

and fish rearing units. These schemes offer capital subsidies and technical support, reducing investment costs and encouraging greater participation of private entrepreneurs in trout farming. Continued financial assistance is expected to accelerate the expansion of the sector in the coming years.

### 3. Export Potential

Kashmiri trout is highly valued for its superior quality, taste, and nutritional content. With improvements in processing, packaging, and cold-chain infrastructure, trout farming has considerable potential for expansion into national and international markets, thereby increasing revenue generation.

### 4. Eco-Tourism and Recreational Fisheries

The integration of trout farming with eco-tourism and recreational angling offers additional opportunities for income generation. Trout farms can serve as tourist attractions, while organized angling activities can

contribute to local livelihoods and promote sustainable tourism in the region.

### 5. Genetic Improvement Programmes

Selective breeding and scientific broodstock management programmes can improve growth rates, feed efficiency, survival, and disease resistance in cultured trout populations. Such initiatives will enhance productivity and ensure the availability of high-quality seed for future expansion.

### 6. Sustainable Aquaculture Technologies

Future development should emphasize sustainable and climate-resilient aquaculture practices, including water-efficient raceways, improved feed formulations, effective biosecurity measures, recirculating aquaculture systems (RAS), and environmentally responsible farming systems. Adoption of these technologies will be essential for maintaining long-term productivity and sustainability of trout farming in Kashmir.

### CONCLUSION

The history of trout farming in Kashmir spans more than a century, beginning with the experimental introduction of trout in 1900 and evolving into a well-established aquaculture industry with significant entrepreneurial potential. At present, trout culture is supported by an extensive infrastructure comprising eight hatcheries and more than fifty rearing units operated by the Fisheries Department of Jammu and Kashmir, with farming activities distributed across the Union Territory. In recent years, the sector has witnessed substantial growth in private participation, with an increasing number of young entrepreneurs establishing trout farming units. This expansion reflects the economic viability and sustainable development potential of trout farming, highlighting its important role in livelihood generation, rural development, and fisheries diversification in Jammu and Kashmir.

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The authors declare that there is no conflict of interest regarding the publication of this manuscript.

### Author Contribution:

All authors contributed to the critical revision of the manuscript and approved the final version for publication.

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