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"Navigating Challenges And Sustainability In Trout Hatcheries Of Jammu And Kashmir"

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Abstract

Trout hatcheries in Jammu and Kashmir play a crucial role in supporting local fisheries and enhancing biodiversity. This paper explores the current status of trout hatcheries in the region, identifies the key challenges they face, and proposes strategies for sustainable management. The study highlights issues such as environmental degradation, inadequate infrastructure, and the impact of climate change on trout populations. Additionally, it examines the socio-economic importance of these hatcheries to local communities. By integrating sustainable practices, improving infrastructure, and adopting adaptive management strategies, this paper aims to provide a roadmap for the long-term viability of trout hatcheries in Jammu and Kashmir. The findings underscore the need for coordinated efforts between government agencies, local communities, and environmental organizations to ensure the sustainable management of these valuable resources.

Keywords: Trout Hatcheries, Sustainable Management, Jammu and Kashmir, Fisheries, Environmental Challenges, Climate Change Impact, Biodiversity Conservation, Socio-economic Importance

1. Introduction

Trout fish farming and conservation in Jammu and Kashmir (J&K) present significant opportunities owing to its diverse landscape of mountains, rivers, and valleys (Balkhi and Bhat, 2019; Shah et al., 2020). The region's cold-water streams and natural ecosystems are

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conducive to the cultivation of various trout species, offering potential for economic growth, tourism, and ecological preservation (Raina and Petr, 1999).

However, these opportunities are accompanied by challenges stemming from human activities, environmental degradation, and climate change, which threaten trout populations globally (Kovach et al., 2016; Wenger et al., 2011). Habitat deterioration due to factors such as urbanization, agricultural runoff, deforestation, and hydropower development diminishes suitable environments crucial for trout reproduction and survival (Quiroga, 2015). These activities also alter stream morphology, compromise water quality, and disrupt natural flow patterns (Lokteff, 2013).

Trout, a quintessential freshwater species, holds significance not only for its recreational and culinary value but also for its environmental benefits. Trout hatcheries in Jammu and Kashmir play a pivotal role in the region's tourism industry and fisheries management, providing employment and livelihoods to local communities (Sarma, 2018). Thus, balancing conservation efforts with sustainable management practices is essential to harnessing the full potential of trout farming while safeguarding the delicate ecological balance of Jammu and Kashmir's aquatic habitats.

2. Historical perspective of trout fisheries in Jammu and Kashmir

The story of Jammu and Kashmir's trout fishery from a historical viewpoint is one of the confluences of biological abundance, colonial discovery, and the pursuit of enjoyment. It all started in the later part of the 1800s, when British colonial administrators posted in India travelled to Kashmir, a cold mountainous region, in order to escape the hot plains. Inspired by a love of fishing and a desire for their angling, British nobles and officials saw that Kashmir's pure waterways might provide perfect trout habitats, similar to those found in the British Islands. The history of trout fisheries in Jammu and Kashmir began in 1899, when the Maharaja of Kashmir approved the introduction of brown and rainbow trout species into the water streams (Kaul, 2015;Shegal, 2012).The first trout farms were built at Harwan, an urban area of Srinagar, and Achabal, a rural region of Anantnag, in 1901 and 1908 respectively. Anantnag district was named India's "Trout District" in June 2018. The government has helped develop multiple fish farms in this area. The Kokernag fisheries farm in Jammu and Kashmir is Asia's largest trout farm, covering an area of eight hectares. The British-run Kashmir State Fisheries Department handled the first stocking programs and set up hatcheries and rearing facilities to increase the number of trout populations. The Sind River in Sonamarg and the Lidder River in Pahalgam were major hubs for trout stocking and fishing, attracting angling enthusiasts from all over the British Empire to try their luck with the highly sought-after game fish(Department of Fisheries, J & K, 2015). With the introduction of trout fishing, Kashmir saw a new phase of fun and relaxation that made the area popular with fishermen looking for action amid the jaw-dropping Himalayan scenery. Journals and memoirs written by British personnel stationed in Kashmir chronicled their fishing adventures, including the difficulties and successes of slogging through the choppy waters of the region's rivers in search of enigmatic trout. The attraction of trout fishing surpassed colonial barriers, capturing the interest of European dignitaries,

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adventurous tourists, and Indian royalty equally. Along the banks of rivers and lakes, rest stops and fishing resorts developed, providing relief to tired fishermen and acting as gathering places for friendship and fun(Wilson, 1920).
Over the years, the sport of trout fishing in Jammu and Kashmir has flourished from being a specialized activity enjoyed by the upper classes of colonial society to being a beloved hobby enjoyed by people from every aspect of life. Kashmiri fishing enthusiasts, influenced by the methods and behaviours brought over from their British counterparts, have shaped their techniques to fit the particular features of the region's waterways, leaving a rich legacy of angling knowledge behind them.
The history of Jammu and Kashmir's trout fisheries, however, also demonstrates the significant alterations brought about by political turmoil and environmental shifts. The region's natural biodiversity was thrown into doubt after the partition of India in 1947 and following Indo-Pak conflicts, which disrupted the peaceful melodies of Kashmiri life.

Despite these difficulties, government departments and conservation groups joined together to protect the biological integrity of Kashmir's rivers in an effort to preserve and manage trout populations sustainably. The long history of Jammu and Kashmir's trout fishery serves as a tribute to the unbreakable relationship between humans and the natural environment and as a constant reminder of the need for care and preservation in the face of constantly changing terrain (Singh, 2020)

3. Trout Fish Species Diversity

Jammu & Kashmir, located in northern India's Himalayas, is home to a diverse range of plants and wildlife, including many trout fish species. This region's natural rivers, streams, and lakes provide great habitat for trout, making it a popular destination for fishermen and nature lovers alike. Trout fishing has a long history in Jammu and Kashmir, dating back to the British Raj, when brown trout (Salmo trutta) were introduced into the region's waterways for recreational fishing. Since then, trout fishing has been an essential component of the region's culture and business.The most common trout species found in Jammu and Kashmir are the brown trout (Salmotruttafario), rainbow trout (Oncorhynchusmykiss), and snow trout (Schizothorax spp.).Each species has distinct features and ecological needs, which contribute to the total biodiversity of the region (Bhat et al., 2020; Ali et al., 2020).

The brown trout is native to Europeans and was brought into the streams and rivers of Jammu and Kashmir during the British colonial period. The brown trout, known for its striking golden-brown hue with black and red markings, is a preferred catch among fishermen due to its secretive character and fighting spirit. Brown trout flourish in cool, clear mountain streams with rocky bottoms, eating aquatic insects, crustaceans, and tiny fish. Brown trout may be found in rivers like the Lidder, Sindh, and Jhelum, as well as in high-altitude lakes like Gangabal and Krishansar (Rather et al., 2019).

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Rainbow trout are native to North America, but they have been successfully distributed to many other regions of the world, including Jammu and Kashmir. The rainbow trout, known for its brilliant rainbow-colored flanks, is a popular sport fish applauded for its acrobatic jumps and powerful dashes. Rainbow trout enjoy cold, oxygen-rich waters with modest currents, which makes them ideal for the rivers and streams of Jammu and Kashmir. They frequently occur in huge rivers like the Jhelum and Chenab, as well as high-altitude lakes like Dal Lake and Wular Lake (Shah et al., 2020).

The snow trout, also known as Himalayan trout, is a member of the Schizothorax genus that is native to the Himalayas. Snow trout, unlike brown and rainbow trout, are lesser-known among fishermen but play a vital role in the freshwater environment of Jammu and Kashmir. Snow trout live in icy, fast-flowing alpine streams and rivers, where they feed on algae, insect larvae, and tiny crustaceans. Their silvery scales and streamlined body let them to easily negotiate rapid currents. Snow trout are abundant in rivers like the Tawi, Lidder, and Chenab, as well as inaccessible mountain streams and tributaries (Sabha, 2017).

Finally, the variety of trout fish species in Jammu and Kashmir contributes to the region's biological richness and natural beauty. From the elegant brown trout to the brilliant rainbow trout and the hard-to-find snow trout, these fish species are critical to preserving the delicate balance of aquatic ecosystems in the Himalaya. As respected citizens, we must conserve and safeguard these ecosystems to guarantee that trout species survive for future generations to take pleasure in.

4. Breeding Methods

Trout fish breeding procedures in Jammu and Kashmir normally include both natural spawning and artificial propagation methods. The main approaches used are natural spawning, artificial spawning, hatchery management, stripping and fertilization, incubation, fry rearing, stocking (Farooq et al., 2019).

Natural spawning allows mature trout to spawn in their natural environment, such as rivers, streams, or lakes. Natural spawning grounds are often monitored by fisheries agencies and environmentalists in order to conserve them and maintain optimal reproductive circumstances (Bhat et al., 2018). Artificial spawning refers to the deliberate harvesting of eggs and milt from adult trout in hatcheries or controlled settings. This approach enables accurate timing and management of breeding, which is critical for sustaining healthy trout populations. Hatcheries play an important role in trout rearing in Jammu and Kashmir. These facilities provide a regulated environment for egg incubation, fry rearing, and juvenile fish production. Hatchery supervision includes regulating water quality, climate, temperature, and nutrition to guarantee the health and growth of trout fry. During artificial spawning, adult female trout are carefully stripped of their eggs, while male trout discharge milt. The eggs are subsequently fertilized by mixing them with milt. This approach enables fishery managers to

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regulate breeding and maximize genetic variety. Fertilized eggs are allowed to hatch in vessels or tanks with moving water to mimic natural circumstances. Tracking and preserving water temperature, oxygen saturation, and hygiene are crucial throughout the incubation phase to avoid illness and assure embryo viability. Trout fry require specific care and food after hatching in order to grow and develop properly. Hatchery personnel continuously monitor water quality measurements and offer adequate feeds to satisfy the nutritional requirements of the growing fry. Once the fry have reached a proper size and maturity, they can be put in rivers, streams, or lakes to augment natural populations or promote recreational fishing. Stocking programs are carefully regulated to avoid detrimental impacts on local fish species and to preserve ecological equilibrium (Gawa et al., 2017; Ali, 2017).

Government agencies, private hatcheries, and conservation groups use these breeding techniques to help sustain trout fisheries and conserve biodiversity in Jammu and Kashmir's aquatic environments(Gawa et al., 2017;Department of Fisheries, J & K, 2020).

5. Economic Opportunities

Trout fisheries in Jammu and Kashmir provide multiple economic possibilities, benefiting the region's economy in a variety of ways. Trout fisheries generate both direct and indirect job possibilities in rural and town areas through fish farm workers, technicians, feed suppliers, and marketing staff. Trout farming enterprises contribute to reducing unemployment and raising living conditions in rural communities. Trout farming in rural Kashmir can drawn not just visitors and fishermen seeking recreational fishing opportunities, but also government backing. This may boost rural tourism, increase demand for hospitality services, and provide new revenue sources for small businesses (Singh and Chalkoo, 2018; Islam, 2017).

The government of Jammu and Kashmir, in collaboration with other development organizations, frequently provides financial incentives, technical aid, and training programs to encourage trout farming and aquaculture growth in rural regions. Government assistance can help trout farmers start and grow their businesses (Baba et al., 2019). Jammu and Kashmir has a vast number of water bodies suitable for trout aquaculture, with a high potential for export(Gawa et al., 2017). High-quality trout products from Jammu and Kashmir have the potential to be exported to internal and international markets, boosting foreign exchange profits and expanding trade prospects (The Hindu, 2020;Bunkar et al., 2018). Furthermore, value-added items developed from trout, such as fish oils, fish meal, and skin care products, provide significant economic diversification and greater returns on investment. Rural businesses might investigate value-added opportunities by processing trout into fish fillets, smoked fish, dried fish, caviar, and fish oil. Value-added goods attract higher market pricing, which can greatly boost the profitability of trout farming operations. Furthermore, trout fisheries enable advancements and discoveries in aquaculture, genetics, disease control, and the sustainability of the environment. It also enables rural people to broaden their means of income and minimize their reliance on conventional agricultural operations. Farmers can

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enhance their income by engaging in trout farming in addition to other agricultural interests, increasing economic resilience and stability (Hassan et al., 2018).

Overall, the Jammu and Kashmir trout fishing industry has considerable potential for regional economic growth, poverty alleviation, and long-term development. Effective management techniques, investment promotion, socioeconomic upgrades, and capacity building are critical for capitalizing on these possibilities while preserving the long-term survival of trout fisheries and natural resource protection (Qayoom et al., 2019).

6. Threats to trout fishery

Currently, the trout fishery in Jammu and Kashmir faces numerous concerns, including pollution from commercial, agricultural, and home inputs can deteriorate water quality, compromising the health of trout populations and habitat (Qadri, 2020). Habitat destruction, such as deforestation, urbanization, infrastructure development, and toxic metals can cause habitat loss and fragmentation, limiting trout spawning and feeding grounds (Mehmood, 2019). Furthermore, overfishing, illegal mining, and illegal fishing methods can reduce trout populations, altering ecological balance and jeopardizing their sustainability (JK Policy Institute, 2019). In addition the introduction of non-native species, such as exotic fish or aquatic plants, can out-compete native trout species for resources and change ecosystem dynamics (Swain et al., 2017). Climate change-induced changes in water temperature, precipitation patterns, and stream flow can all have an influence on trout habitat appropriateness, spawning success, and population health (Jamwal et al., 2019). Dam and hydropower projects can modify river flow, interrupt normal migration patterns, and fragment trout habitats, posing serious threats to their existence(Enderlin and Yousuf, 1999;Amin et al., 2020). Efforts to minimize these concerns often include habitat restoration, pollution control measures, fishing rule enforcement, invasive species monitoring, and sustainable management methods to preserve the region's trout fisheries' long-term survival.

7. Conservation efforts for trout fisheries in Jammu and Kashmir

Conservation measures for trout fisheries in Jammu and Kashmir include a variety of techniques aimed at protecting natural habitat and encouraging sustainable fishing practices (BalkhiandBhat, 2019). Jammu and Kashmir's trout fishery conservation initiatives focus on habitat protection, seed production, fishing management, and community engagement (Gawa et al., 2017). It is critical to protect trout in their natural environment. This includes protecting rivers, streams, and lakes from pollution, habitat damage, and invasive species that might harm trout populations. Restoration initiatives aim to rehabilitate deteriorated trout habitats by addressing concerns including sedimentation, habitat division, and river deterioration. These efforts include streambank stabilization, riparian vegetation restoration, and erosion prevention techniques(CIFRI, 1977). The health of trout populations depends on maintaining excellent water quality. Conservation efforts frequently involve actions to reduce

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pollution sources such as agricultural runoff, industrial discharge, and sewage contamination, which can decrease water quality and destroy trout habitats. Regulations governing fishing seasons, catch limits, and gear limitations serve to ensure that trout populations remain viable (Sobti, 2020). Regular monitoring of trout populations and habitats aids in determining the efficacy of conservation measures. Fisheries agencies frequently participate in stocking projects to enhance wild trout populations. These projects involve raising and releasing trout into rivers and lakes to supplement populations that have been depleted due to overfishing or habitat degradation(Hamid and Singh, 2019). Educating the local population, fishermen, and visitors on the value of sustainable fishing techniques and the need to protect trout habitats, setting new hatcheries and feed mills may make a substantial contribution to conservation efforts (Gawa et al., 2016). This involves encouraging catch-and-release techniques and limiting the environmental effects of fishing. Involving local people in conservation efforts helps ina sense of ownership and responsibility for trout habitats. Community-based conservation initiatives, such as habitat restoration projects, training to fish farmers,participation in monitoring activities, can serve to build support for conservation efforts (Wagay and Yasmin, 2012).

8. Disease Management

Disease control in Jammu and Kashmir trout fisheries is a multidimensional activity that includes a variety of measures aimed at ensuring trout population health and sustainability. The region's distinct geographical and climatic qualities, including cold-water habitats and pristine alpine vistas, make it a perfect location for trout fishing (Qayoom and Bhat, 2015). These same settings, however, might provide issues for disease control since trout are sensitive to a variety of infections and environmental stresses including warm waters (Global Press News Service, 2019). To address these issues, Jammu and Kashmir's fisheries management authorities have devised extensive disease prevention and control strategies. These efforts include strict biosecurity rules to avoid disease introduction and transmission, regular trout population surveillance and monitoring to detect early symptoms of illness, and water quality management programs to ensure fish health. Furthermore, hatchery management methods prioritize hygiene and sanitation to reduce disease transmission among young fish, while quarantine procedures are used to screen and isolate new fish stocks before introducing them into existing populations. Vaccination and medicine can be used as preventative or therapeutic strategies, although their availability and efficacy can differ. Furthermore, continuing research aims to improve our understanding of the epidemiology of illnesses impacting trout populations and develop more focused management techniques (Magray, 2017). Education and outreach initiatives are critical for spreading knowledge and encouraging best practices among fisheries personnel, farmers, and other stakeholders. Regulatory measures are also in place to prevent activities that might contribute to disease transmission, such as regulating fish migration and enforcing zoning laws. By integrating these varied techniques, trout fisheries in Jammu and Kashmir attempt to protect the long-

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term health and sustainability of their rich aquatic resources while preserving livelihoods and enabling recreational possibilities for both locals and visitors (Gopalakrishnan, 1965).

9. Potential and future directions of trout fisheries

Trout fisheries in Jammu and Kashmir have enormous potential for sustainable development and provide a viable path for the region's economic progress and environmental protection (Dhanze and Dhanze, 2017). Jammu and Kashmir's vast variety of beautiful water bodies, including rivers, lakes, and streams, make it a perfect location for trout rearing and angling. The future of the region's trout fisheries lies in a multifaceted approach that includes expanding trout farming operations, leveraging advances in research and technology, developing angling tourism, establishing strong regulatory frameworks, capacity-building initiatives, promoting sustainable practices, and exploring new markets (Magray, 2016). Trout farming growth has enormous potential to fulfil the growing demand for trout both locally and nationally via smart investment and coordination among government institutions, private sector players, and local communities. Concurrently, research and development initiatives are critical to improving breeding procedures, illness control measures, and feed formulas in order to boost production levels and maintain the sustainability of trout fisheries. Furthermore, promoting fishing tourism may leverage Jammu and Kashmir's scenic beauty and natural resources to attract local and foreign tourists, boosting economic growth and job creation (Mahanta, 2009). To protect the biological integrity of the region's water bodies, appropriate regulatory measures must be implemented, which include strict monitoring of fishing operations, habitat protection efforts, and pollution control programs (Balkhi andBhat, 2019). In addition, investing in capacity-building initiatives that provide local communities, fish farmers, and tourist operators with the necessary skills and information is critical to the long-term health of trout fisheries. Adopting sustainable fishing techniques and eco-friendly tourist efforts would help to reduce environmental degradation and protect the rich biodiversity of Jammu and Kashmir's aquatic ecosystems. Finally, broadening market channels and investigating value-added trout products can open up new revenue streams and encourage inclusive economic growth throughout the area (Vass, 2017). By adopting these future paths, Jammu and Kashmir can maximize the potential of its trout fishery as a driver of socioeconomic prosperity while protecting the natural legacy for future generations.

10. Conclusion

Trout hatcheries in Jammu and Kashmir contribute significantly to biodiversity conservation, fisheries support, cultural heritage safeguarding, rural income enhancement, economic growth, and the promotion of sustainable aquaculture techniques. Trout species suffer a variety of problems, including habitat deterioration, excessive overexploitation, and warming temperatures. To address these difficulties, governments, conservation groups, and local people must work together to develop effective management plans that protect the ecological balance of freshwater ecosystems. By prioritizing habitat protection, ecologically

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sound fishing management, and climate adaptation, we can ensure that trout populations survive for future generations too. Research, infrastructure investment, and sustainable aquaculture methods can improve hatchery operations and ensure trout population stability, despite obstacles.Through collaborative efforts involving government agencies, private sector stakeholders, and local communities, Jammu and Kashmir can unlock the full potential of trout fish and realize its vision of sustainable development and prosperity.

References

Ali, S. (2017). Current status and strategies of rainbow trout Oncorhynchus mykiss farming in India. *International Journal of Aquaculture*, *7*(4).

Amin, N., Khan, S., & Mir, M. F. (2020), Impact of Kishenganga Hydroelectric Project on Susceptibility and vulnerability of Brooder population of different fish species of the Kishenganga river in Kashmir (India).

Baba, S. H., Husain, N., Zargar, B. A., Bhat, I. F., & Malik, I. (2019). Growth of fisheries sector in Jammu & Kashmir. *Journal of Pharmacognosy and Phytochemistry*, *8*(4), 909-912.

Balkhi, M. H., & Bhat, F. A. (2019). Fish biodiversity of Jammu and Kashmir and conservation measures. In *Biodiversity* (pp. 131-141). CRC Press.

Bhat, A. W., Shah, T. H., Bhat, B. A., Balkhi, M. H., Bhat, F. A., Asimi, O. A., ... & Mohamad, I. (2018). Fecundity estimates of rainbow trout OncorhynchusmykissWalbaum (Salmoniformes: Salmonidae) from Kashmir. *SKUAST Journal of Research*, *20*(1), 63-67.

Bhat, F. A., Yousuf, A. R., & Balkhi, M. H. (2020). Diversity of fishes in Jammu and Kashmir state. *Biodiversity of the Himalaya: Jammu and Kashmir State*, 859-887.

Bunkar, K., Gurjar, U. R., &Takar, S. (2018). Economics of Coldwater Fisheries. In *Coldwater Fisheries and Aquaculture Management* (pp. 35-50). Apple Academic Press.

Department of Fisheries, J&K (2015) Government of Jammu and Kashmir. Achievements. http://jkfisheries.in/ achievements (Accessed on 12 January 2020)

Dhanze, J. R., &Dhanze, R. (2017). Potential and Innovative Strategies for the Development of Coldwater Aquaculture in India. *Akhtar*.

ISSN PRINT 2319 1775 Online 2320 7876

Research paper© 2012 IJFANS. All Rights Reserved, UGC CARE Listed (Group -I) Journal Volume 11,Iss 12 , 2022

Director, C. I. F. R. I. (1977). *Report on Dal Lake, Srinagar, Kashmir with suggestions for development of its fishery*.

Enderlin, O., & Yousuf, A. R. (1999). The environmental impacts f the Uri hydropower project on the fish community in the river Jhelum. *River Jhelum, Kashmir valley: impacts on the aquatic environment. SWEDMAR, Göteborg*, 169-186.

Farooq, I., Bhat, F. A., Balkhi, M. H., Shah, T. H., Bhat, B. A., Qadri, S., ...&Ganie, P. A. (2019). Reproductive and breeding biology of Schizothoraxlabiatus, a snow trout found in River Jhelum, Kashmir. *Journal of Environmental Biology*, *40*(3), 291-294.

Gawa, S., Kumar, N. R., Mahida, N., &Hatte, V. M. (2017). Livelihood Option through trout seed production in Jammu and Kashmir: An economic analysis. *Fishery Technology*, *54*(3).

Gawa, S., Kumar, N. R., Prakash, S., Yadav, V. K., Hatte, V. M., &Mahida, N. (2017). Economic analysis of trout feed production in Jammu and Kashmir, India. *Journal of Applied and Natural Science*, *9*(4), 2385-2390.

Gawa, S., Kumar, N. R., Wani, G. B., Hatte, V. M., & Vinay, A. (2016). Mapping the core processes and identifying actors along with their roles, functions and linkages in trout value chain in Kashmir, India. *International Journal of Agricultural and Biosystems Engineering*, *10*(6), 369-373.

Global Press News Service, Kashmir scientists open fish hospital after warming waters kill trout Posted on Apr 24, 2019, https://seattleglobalist.com/2019/04/24/kashmir-scientists-open-fish-hospital-after-warming-waters-kill-trout/83425(Accessed on 28 December 2020)

Gopalakrishnan, V. (1965). *A Report on fish diseases in the trout hatcheries and farms of Kashmir*. Not Available.

Government of Jammu and Kashmir, 2020. Department of Fisheries, Government of Jammu and Kashmir, Achievements. Downloaded from http://jkfisheries.in/achievements.htm on 21.01.2020

HAMID, J., & SINGH, R. (2019). Diversity of Fishes in River Viashaw: The left tributary of River Jhelum of Jammu and Kashmir, India.

Hassan, M., Haq, S. M., Majeed, M., Umair, M., Sahito, H. A., Shirani, M., ...&Yessoufou, K. (2018). Traditional food and medicine: Ethno-traditional usage of fish Fauna across the valley of Kashmir: A western Himalayan Region. *Diversity*, *14*(6), 455.

Islam, R. T. (2017). Fisheries sector in Jammu and Kashmir-Growth and Perspectives. *Fisheries*, 4.

ISSN PRINT 2319 1775 Online 2320 7876

Research paper© 2012 IJFANS. All Rights Reserved, UGC CARE Listed (Group -I) Journal Volume 11,Iss 12 , 2022

Jamwal, A., Phulia, V., & Mushtaq, S. T. (2019). Predictable Threats to Coldwater Fisheries from the Unpredictable Nature of Climate Change: An Indian Perspective. In *Coldwater Fisheries and Aquaculture Management* (pp. 407-418). Apple Academic Press.

JK Policy Institute, 2019, https://www.jkpi.org/risks-of-unchecked-mining-to-trout-fish-in-jammu-and-kashmir/ (Accessed on 24 January 2020)

Kaul, B.L. (2015) Trout fish culture has a history in Kashmir. Greater Kashmir. https:// www.greaterkashmir.com/more/trout-fish-culture-hasa-history-in-kashmir (Accessed on 10 January 2020)

Kovach, R. P., Muhlfeld, C. C., Al-Chokhachy, R., Dunham, J. B., Letcher, B. H., &Kershner, J. L. (2016). Impacts of climatic variation on trout: a global synthesis and path forward. *Reviews in Fish Biology and Fisheries*, *26*, 135-151.

Lokteff, R. L., Roper, B. B., & Wheaton, J. M. (2013). Do beaver dams impede the movement of trout?. *Transactions of the American Fisheries Society*, *142*(4), 1114-1125.

Magray, A. R., Hafeez, S., Ganai, B. A., Lone, S. A., Dar, G. J., Ahmad, F., &Siriyappagouder, P. (2017). Study on pathogenicity and characterization of disease causing fungal community associated with cultured fish of Kashmir valley, India. *Microbial Pathogenesis*, *151*, 104715.

Magray, N. A. (2016). Sport Fishing, an Opportunity for Promotion of Adventure Tourism in Jammu and Kashmir. *International Journal in Management & Social Science*, *4*(11), 112-123.

Mahanta, P. C., Sarma, D., & Joshi, K. D. (2009). Sport Fishing and Livelihood in Upland Himalayan Region.

Mehmood, M. A., Qadri, H., Bhat, R. A., Rashid, A., Ganie, S. A., & Dar, G. H. (2019). Heavy metal contamination in two commercial fish species of a trans-Himalayan freshwater ecosystem. *Environmental monitoring and assessment*, *191*(2), 104.

Qadri, S. (2020). Fish Fauna of Kashmir Valley and Their Conservational Measures for Sustainable Fish Production. In *Biodiversity, Conservation and Sustainability in Asia: Volume 2: Prospects and Challenges in South and Middle Asia* (pp. 521-528). Cham: Springer International Publishing.

Qayoom, I., & Bhat, B. A. (2015). Change in fishing patterns in Jammu and Kashmir provinces of J and K-a comparative study. *Current World Environment*, *10*(1), 179.

ISSN PRINT 2319 1775 Online 2320 7876

Research paper© 2012 IJFANS. All Rights Reserved, UGC CARE Listed (Group -I) Journal Volume 11,Iss 12 , 2022

Qayoom, I.; Akhtar, M.; Dar, S.A.; Khan, S.; Hussain, N.; Bhat, B.A. A study of socio-economic status of fisher communities in district Baramulla of Jammu & Kashmir. *J. Pharmacogn. Phytochem.* **2019**, *8*, 583–586

Quiroga, A. P., Lancelotti, J. L., Riva-Rossi, C. M., Tagliaferro, M., Asorey, M. G., & Pascual, M. A. (2015). Dams versus habitat: predicting the effects of dams on habitat supply and juvenile rainbow trout along the Santa Cruz River, Patagonia. *Hydrobiologia*, *755*(1), 57-72.

Raina, H. S., & Petr, T. (1999). Coldwater fish and fisheries in the Indian Himalayas: lakes and reservoirs. *Fish and fisheries at higher altitudes: Asia*, 64-88.

Rather, M.A., Sofi, F.R., Amin, A., & Saba, K. (Eds.). (2019). Coldwater Fisheries and Aquaculture Management: Technology for Sustainable Food Production (1st ed.). Apple Academic Press.

Sabha, K. K., Najar, A. M., Bhat, F. A., Shah, T. H., Balkhi, M. H., &Shafaat, S. (2017). Fishery, population characteristics and yield estimates of snow trout (Schizothoraxniger) in Nigeen Lake Kashmir. *Journal of Experimental Zoology, India*, *20*(1), 569-571.

SARMA, D., Akhtar, M. S., SHARMA, P., & Singh, A. K. (2018). Resources, breeding, eco-tourism, conservation, policies and issues of Indian mahseer: A review. *Coldwater Fisheries Society of India*, *1*(1), 4-21.

Sehgal, K. L. (2012). History of Coldwater Fisheries in India and some neighbouring countries. *DCFR Silver Jubilee Compendium on Coldwater Fisheries*, 13-23.

Shah, F. A., Maqbool, H., Hafeez, M., & Bhat, F. A. (2020). History, Present Status and Strategies of Rainbow Trout (Oncorhynchus mykiss) Farming in Jammu and Kashmir, India-A Review. *Fishery Technology*, *60*, 149-156.

Singh, S. K. (2020). STUDY ON FISHERIES DEVELOPMENT IN COLD WATER REGION OF JAMMU AND KASHMIR REGION

Singh, S., &Chalkoo, S. R. (2018). Trout Production in District Ganderbal–An Analysis of Economic Challenges. *Aquaculture Studies*, *24*(3).

Sobti, R.C. (Ed.). (2020). Biodiversity: Threats and Conservation (1st ed.). CRC Press.

Swain, S., Felix, S., Anthony, C., &Chhandaprajnadarsini, E. M. (2017). Exotic fish species introduced in India and its impacts. *Scientific India*, 27-29.

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The Hindu, A different kettle of fish: Kashmir wants Europe to taste its trout, July 23, 2020, https://www.thehindu.com/news/national/other-states/trout-farming-creates-ripple-effect-in-kashmir/article67110453.ece (Accessed on 26 July 2020)

Vass, K. K. (2017). Livelihoods through Coldwater Fisheries and Development Strategies. *Akhtar*.

Wagay, M. Y. S., & Yasmin, E. (2012). *Economics of Fisheries in Jammu and Kashmir: A Case Study of District Anantnag* (Doctoral dissertation).

Wali, A., Shah, T. H., Bhat, F. A., Balkhi, M. H., Bhat, B. A., Bhat, T. A., &Mohd, I. (2020). Gut morphometric parameters of rainbow trout (Oncorhynchusmykiss, Walbaum 1792) from Kashmir. *The Pharma Innovation Journal*, *SP*, *10*(10), 277-281.

Wenger, S. J., Isaak, D. J., Luce, C. H., Neville, H. M., Fausch, K. D., Dunham, J. B., ... & Williams, J. E. (2011). Flow regime, temperature, and biotic interactions drive differential declines of trout species under climate change. *Proceedings of the National Academy of Sciences*, *108*(34), 14175-14180.

wilson, J. A. (1920). *Trout fishing in Kashmir*. Thacker Spink.