



# Temperature Impacts on Fish Production in South Asia: A Comprehensive Review

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**Abstract:** Temperature is one of the most critical environmental determinants influencing fish production, particularly in tropical and subtropical regions such as South Asia. With ongoing climate change, rising temperatures and increased variability in thermal regimes are significantly affecting aquaculture and capture fisheries. This review synthesizes empirical and theoretical literature on temperature impacts on fish growth, reproduction, survival, disease dynamics, and overall productivity in South Asia, focusing on countries such as Bangladesh, India and Pakistan. Evidence suggests that moderate increases in temperature may enhance metabolic and growth rates within optimal thresholds; however, extreme heat stress leads to reduced feed efficiency, increased mortality, and disease outbreaks. The review highlights adaptive strategies, including selective breeding, improved pond management, and climate-resilient aquaculture systems. Policy implications for sustainable fish production under changing thermal regimes are also discussed.

**Index Terms** - Climate Change, Temperature, Aquaculture, Fish Production, South Asia

## I. INTRODUCTION

Aquaculture is one of the fastest-growing food production sectors globally, with South Asia playing a dominant role. Countries such as Bangladesh and India rank among the top fish-producing nations, contributing significantly to food security, employment, and export earnings. Fishery and Aquaculture contribute to global food security and around 3 billion people around the world depends on this sector for their animal protein intake (FAO, 2024). However, climate change, particularly rising temperatures, is increasingly threatening the sustainability of fish production systems. Climate change is a statistically significant alteration in climate properties that persists for decades or longer, resulting from both natural variability and human activities (IPCC, 2022)

South Asia is considered a climate hotspot due to high dependence on natural resources, dense population and vulnerability to extreme weather events. Like most of the tropical region, the south Asia also very susceptible towards these changes (Pörtner et al., 2014). Temperature affects fish through direct physiological pathways and indirect ecological mechanisms. The survival capacity of fishes largely depends on water temperature (Fu et al., 2018).

Despite clear evidence of temperature effects on aquatic ecosystems and fisheries, these impacts are often overlooked in climate adaptation policies (Badjeck et al., 2010). Analyzing long-run equilibrium relationships between climate variables specially temperature and fish production, and understanding adjustments to short-run deviations, is critical for effective, evidence-based decision-making and resource allocation.

Among the key fish-producing countries like, Bangladesh, Pakistan and India are pivotal to the global fisheries and the strategic implementation in the production and management system is the key for sustainable production. So, understanding the gap between conceptual framework of temperature impact on fish production and adaptive strategy is essential for designing resilient aquaculture systems. Through this study we could give an empirical view of temperature effect on fish production by strong evidence with literature and suitable strategy that will open new insights for policy makers in south Asia region.

## II. RESEARCH METHODOLOGY

Fish production also related with feed utilization, reproduction, oxygen dynamics and disease and health. Focusing the above-mentioned situation, this study investigated the direct and indirect impact of temperature on fish production by reviewing and collecting data from various sources. We conducted a systematic review of literature (Fig. 1) based on the Web Science, Google Scholar, PubMed, and Scopus databases.

Additional information was collected from government and non-government organizations and their databases, such as the Department of Fisheries (DoF), Bangladesh Fisheries Research Institute (BFRI), different agricultural and science and technology universities in Bangladesh, and open databases, particularly the digital repository of libraries of different universities (<http://dspace.bau.edu.bd>, <https://www.library.juniv.edu/>, <http://library.bracu.ac.bd/>, and <https://www.griffith.edu.au/library>). In case of lack of information, the optimal range of temperature of fish production of different country are studied and compared. The information was summarised in the tables in the results section.

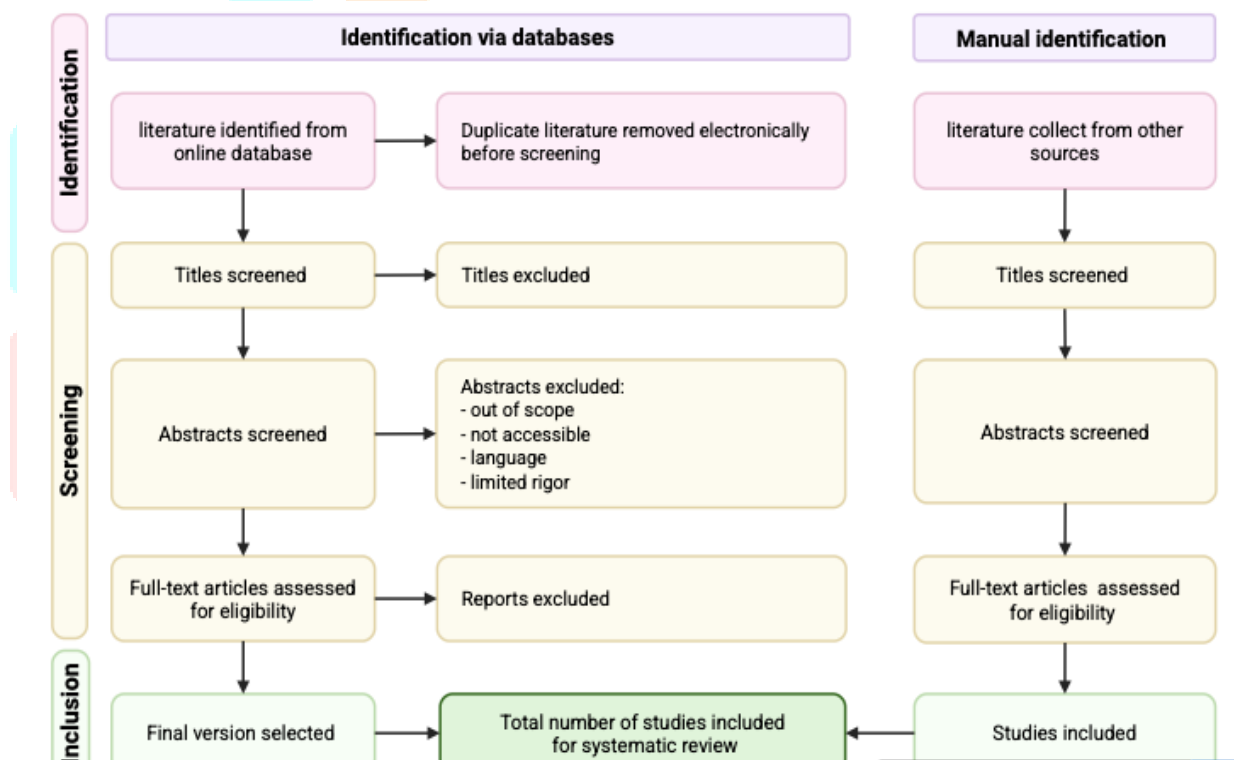


Figure 1: The screening process of the literature

## III. RESULTS

The fish production includes from the brood rearing stage to grow out stage up to sell. The production cycle includes some critical stage like breeding, spawning and rearing. All stages are highly influenced by the temperature. Besides these, one of the most important phases of fish production cycle is the disease. The occurrence of fish disease typically temperature oriented and some cases species specific. However, due to similarity in fish culture system, fish species and weather changing pattern, in the south Asia the fish diseases also match. For better understanding the results of the literature are summarized into three categories. It will help reader to know the specific effect of temperature.

### 3.1 Fish growth

Indian major carp, Common carp, Tilapia and Pangas are the most cultured species in south Asia. For this fishes growth temperature plays vital role from the egg production to grow out stage (Table 3.1). Breeding, reproduction performances, feed intake, feed conversion efficiency and growth are highly

dependent on temperature but differs with species. In India for Common carp culture 28–32°C considered optimal. Contrastly, for Tilapia breeding the preferable temperature is less than 32°C in Bangladesh.

Table 3.1: Temperature effect on fish growth

Study	Country	Species	Temperature Range	Key Findings
A.S. Desai and R.K. Singh (2009).	India	Common carp	28–32°C	High feed conversion efficiency and optimal growth
Hossan et al. (2013)	Bangladesh	Tilapia	<32°C	Reproductive performance improved
Rahman, A. (2024).	Bangladesh	Tilapia	25–30°C	Optimal breeding occurrence

### 3.2 Fish diseases

There are various factors (environmental parameter to nutrition) that works to produce disease. Broadly, the fish affected by the virus, bacteria, fungus, parasite and other noninfectious disease producing parameters. But most of the cases, temperature spikes the transmission or infestation process. Literature found that bacterial, viral and fungal disease transmission increased with favorable temperature in India (Table 3.2) whether temperature variation responsible for different disease in Bangladesh.

Table 3.2: Temperature relationship with disease

Study	Region	Disease Type	Temperature Effect
Mallick, A., & Panigrahi, A. K. (2018).	India	Bacterial, viral, fungal	Increased transmission
Majumder et al. (2015)	West bengal, India	Parasitic	Temperature variations control the parasite infestations
Hossain et al. (2007)	Bangladesh	Various	Linked with temperature spikes

### 3.3 Fish mortality

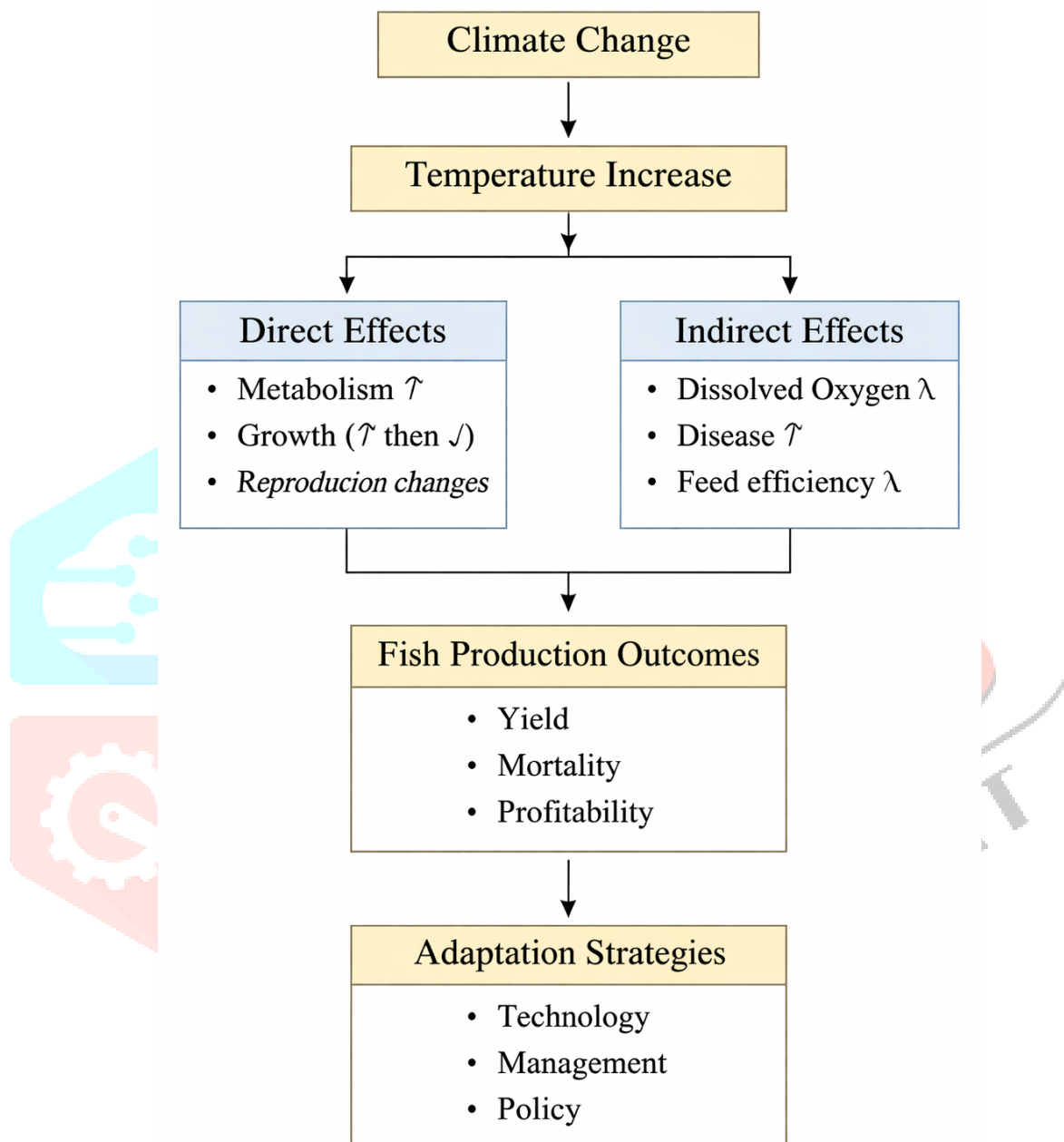
For ectotherm like fish temperature works as food. Temperature regulates the fish physiology, metabolism and growth. The reproduction process also influenced by the temperature. But in very low and high temperature, the normal physiological process of fishes is hindered. The high temperature produce stress for fishes that eventually causes death. On the other hand, low temperature slows down the metabolic rate of fishes consequently, the fish production hampered. The literatures from India, Pakistan and Bangladesh are the evidence of those cases (Table 3.3)

Table 3.3: Temperature and fish mortality

Study	Country	Event	Outcome
Ahmed & Diana (2015)	Bangladesh	Heatwave	Significant pond fish mortality
Ali et al. (2020)	Pakistan	High temperature	Increased physiological stress and fish death
Maniselvam et al.(2026)	India, Bangladesh	Minimum temperature	Reduced production

#### IV. CONCEPTUAL FRAMEWORK OF TEMPERATURE IMPACT ON FISH PRODUCTION

The temperature is the vital climate change variable. In the fish production system temperature plays both direct and indirect roles. These direct and indirect functions affect the outcomes. The profitability subsequently relies on temperature changes. If the environment friendly policy is made specifically for this sector and imply properly, may be soon, the adaptive technology overcome the consequences of temperature variation.



#### V. RESEARCH GAPS

The literature shows a non-linear relationship between temperature and fish production. Positive effects within the optimal range and Negative effects beyond the threshold. In South Asia faces higher exposure to extreme heat and Limited adaptive capacity. This creates vulnerability for smallholder farmers. The main problem in south Asia is lack of micro-level empirical data and gap between research and implementation in field. Due to limited econometric modeling, there is no perfect economic analysis about the losses of temperature changes. Weak integration of climate and economic data also contributes to maximize the gap.

## VI. RECOMMENDATION FOR MINIMIZING RESEARCH GAP

The temperature issue with fish production system in south Asia is now a hot cake. Though south Asia is globally important for aquaculture and fisheries, it is high time to make intervention through policy. Specific aquaculture related policy and their proper implementation can avoid the risk of temperature variation consequences.

The modern technology should be adopted for better future. At the same time the technology must be eco-friendly.

The management procedure should be taken to consider improving the culture practice and make it sustainable and

Climate-resilient aquaculture systems should be introduced.

## VII. CONCLUSION

Temperature plays a decisive role in shaping fish production in South Asia. While moderate warming may enhance productivity, extreme temperatures pose serious risks. Sustainable adaptation strategies are essential to ensure long-term resilience of aquaculture systems.

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