Socio-economic Characteristics and Piscicultural Practices of the Fish Farmers in Imphal-East Manipur, India

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ABSTRACT

The fisheries sector is a cornerstone of global food systems, contributing significantly to nutrition, livelihoods, and economic development. The present study was undertaken to study the socio-economic characteristics and pisciculture practices of fish farmers in Imphal-East, Manipur, India. Data were collected from 50 randomly selected farmers between November 2021-October, 2022. The results showed that most farmers (70 %) were aged (years) 41–60, while the rest were younger. 96% of respondents had formal schooling, while 4% lacked it. For 98% of respondents, pisciculture served as a secondary occupation, and only 2% practiced it as a primary occupation. The farm pond size varied greatly, and on a percentage basis, about 32, 28, 22, 14, and 4% were of small (0.1 to 0.3 acre), medium (0.4 to 0.6 acre), medium large (0.7 to 1 acre), large (1.1 to 1.5 acre), and extra-large (>1.6 acre) categories, respectively. The results showed the prevalence of a semi-extensive pisciculture system, involving the use of cow dung and the preferential supplementation of urea, triple superphosphate, and muriate of potash. As for the finance, about 64% of the farmers were self-financed, while the rest relied on taking loans from private banks, non-governmental organizations, and local money lenders. The annual revenue generation ranged between1 to 4 lakhs. The results suggested an increased fish production at a higher fertilizer use, with farm management time and secondary occupation, also exerting some influence.

Keywords: *Fish farm profile; fish production and economy; livelihoods; northeast India; socio-economics*

INTRODUCTION

The fishery sector is a cornerstone of global food systems and contributes significantly to nutrition, livelihoods, and economic development. More than 59 million people worldwide are directly engaged in fisheries and aquaculture, with a considerable majority operating in Asia (FAO, 2020). The sector is vital not only for employment generation, but also for addressing global food security, particularly in regions where fish are a primary protein source (FAO, 2020). Beyond its direct contributions, fisheries bolster ancillary industries, such as feed production, equipment manufacturing, and logistics, fostering broad-based economic growth.

In developing countries, fisheries represent a critical lifeline for millions of people. For example, Asia alone accounts for nearly 70% of global aquaculture production, driven by countries such as China, Indonesia, and India (FAO 2022). These nations have leveraged aquaculture to meet rising domestic demand, while positioning themselves as global leaders in seafood exports. However, rapid population growth has introduced challenges including environmental concerns, resource conflicts, and the need for sustainable management practices.

India, a prominent player in global aquaculture, is the second largest producer of fish and contributes significantly to both domestic food security and global seafood trade. The fisheries sector constitutes a vital component of the Indian economy, accounting for approximately 1.24% of the country's gross value-added (GVA) and over 7.28% of the agricultural GVA (Anonymous 2021). Over 16 million individuals are directly employed in fisheries and aquaculture, with millions more engaged in allied industries, such as fish processing, marketing, and transportation (Kumar, 2020b). Aquaculture in India has also played a transformative role in enhancing rural livelihoods, improving nutritional standards, and empowering marginalized communities, particularly in coastal and inland regions (Little *et al.,* 2012).

Despite the national success story, the northeastern region of India has remained underrepresented in discussions about fishery development. States such as Assam, Meghalaya, and Manipur possess unique ecosystems conducive to aquaculture but have yet to realize their full potential due to various socioeconomic and infrastructural constraints, including limited adoption of scientific fish farming practices, inadequate infrastructure, and insufficient market linkages. These states are characterized by high fish consumption, underscoring the cultural and dietary importance of fisheries within local communities. However, gaps in production, market accessibility, and capacity building hinder the growth of this sector (Yadav *et al.,* 2019).

Manipur, an important fish consuming state in India has a a consumption rate (kg per capita per year) of 14.1, which is lower than Tripura (29.29) and Kerela (19.41) but higher as compared to Odisha (13.79) and Assam (11.72). (Anonymous, 2020 a). However, Manipur's fish production has stagnated over recent years, remaining at 0.32 lakh tonnes between 2015 and 2016 and 2019–2020. This stagnation highlights underlying issues, such as limited infrastructure, inadequate technical support, and socioeconomic barriers faced by fish farmers (Haobijam & Ghosh, 2020). Moreover, the absence of comprehensive data on the trade practices and socioeconomic conditions of fish farmers complicates the formulation and implementation of effective development programs (Dorothy *et al.,* 2018). Against this backdrop, the current study was undertaken in the Imphal-East, Manipur, to study the socioeconomic conditions and pisciculture practices of fish farmers. The findings hold relevance not only for policymakers and development practitioners in Manipur but also for other regions facing similar challenges.

MATERIALS AND METHODS

Study Area

Manipur, located in northeastern India surrounded by Assam, Mizoram, and Nagaland, shares international borders with Myanmar (Fig. 1), spans an area of 22,327 km², and is characterized by its lush green hills, diverse ecosystems, and rich cultural heritage. The study was conducted in the Imphal-East district (24°48′N, 93°57′E), comprising the subdivisions Poropat, Keirao-Bitra, and Sawombung, which covers 497 km² and is home to approximately 412,275 residents across 172 revenue villages (Census of India, 2011). This district, because of its favourable climatic conditions, homogeneous physiography, is a hub for pond-based fish farming.

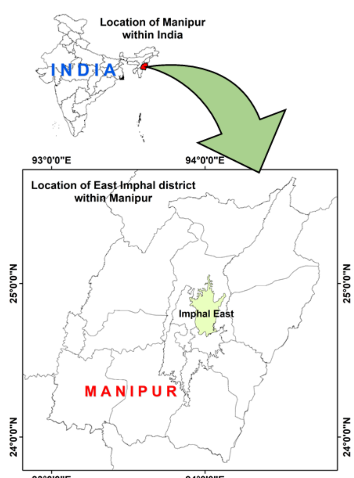

Fig. 1: Map showing the study site, Imphal East District, Manipur, India.

Data Collection

The study evaluated the livelihood and socioeconomics of fish farmers in the Imphal-East district, Manipur. Data were collected over 12 months, from November 2021 to October 2022, using a structured questionnaire with a random sample of 50 fish farmers. The sample size was determined to balance the statistical reliability and constraints of time and resources, as suggested by previous fisheries studies (Devi *et al.,* 2014). The questionnaire was systematically refined for clarity and alignment with research objectives, and thus captured information on fish farm size, farming practices, production output, farmers 'socioeconomic status, and challenges.

Data analysis

The collected data were verified for consistency and categorized systematically for analysis. Quantitative data were subjected to statistical tests, including descriptive statistics, to evaluate the relationships between the variables.

Results and discussion

Socio-economic profile of fish farmers

The majority of the fish farmers (70%) were aged between 41 and 60 years, while the remaining 30% were aged between 30-40-year. (Fig. 2). These findings are in line with Sen and Roy (2015), who reported that about 52.3% of the fish farmers were aged between 40 and 60 years, followed by 25.8% of those aged >60 years, while farmers aged <40 years constituted only 21.9% in North Tripura District and West Tripura District, India. This suggests that age plays a significant role in shaping individuals' participation in the pisciculture sector.

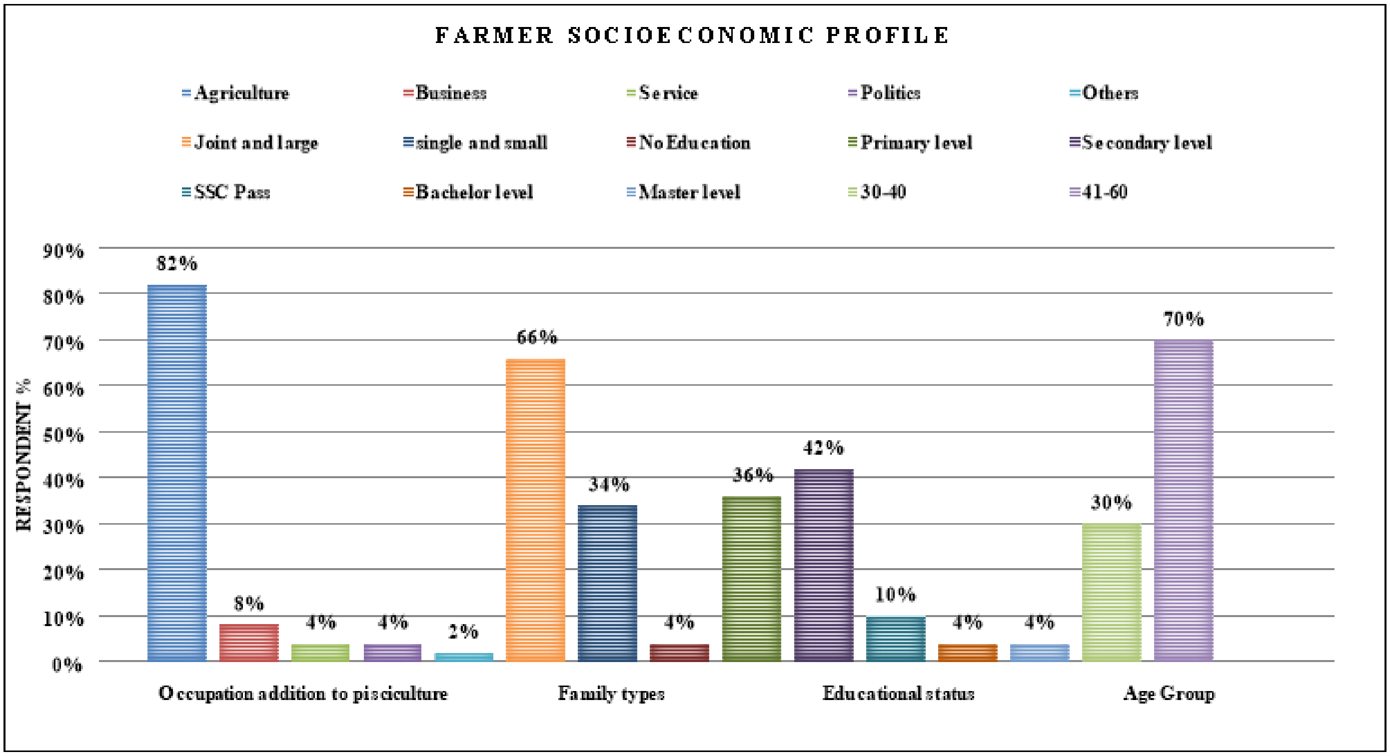

Fig. 2. Socio-Economic Profile of Fish Farmers in the Study Area

As for the type of family, the study recorded that 66% of farmers lived in joint families, while 34% resided in nuclear families. Family structure can influence pisciculture practices, particularly in terms of labour utilization and cost inputs, as joint families may offer more hands for farm management, affecting cultivation. These results contradict Lakshmi *et al.* (2012), who reported that only 11.3% of fish farmers in Manipur lived in joint families, while the rest lived in nuclear families. The difference may be attributed to variations in sample size and target population, as the present study focused on a more localized sample.

The results showed that only 4% had no formal education, 36% had primary education, 42% had secondary education, and 10% completed a Secondary School Certificate (S.S.C.), and 4% held bachelor's and master's degrees, respectively. The predominance of secondary or lower education may limit access to advanced aquaculture techniques and innovation.

Our results suggest that fish farming is predominantly a secondary occupation among farmers, with only 2% relying solely on pisciculture. Sen and Roy (2015) also found that only 18.8 % of the sampled farmers in Tripura have aquaculture as the primary occupation. This raises important questions regarding the viability of pisciculture as a primary livelihood, and thus, we hypothesize that the revenue generated from pisciculture may not be sufficient to cover expenditures, which pushes g farmers to diversify their income sources. Therefore, policy interventions, improved market access, and technological advancements may be required to enhance profitability and encourage full-time engagement in aquaculture.

Table 1. Time spent on pisciculture pond management Vs other occupations in respondent

Minimum Time spent in pisciculture	Secondary Occupation				
	Agriculture	**Business**	**Service**	**Politics**	**Others**
One hour	0.98				
Two hours	0.28	0.19			
Three hours	0.99	0.97	0.22		
Four hours	0.52	0.39	0.13	0.61	
Five hours	0.52	0.39	0.13	0.61	1.00

Effective monitoring and management of fishponds is crucial for optimizing production outcomes (Table 1). In this study, a positive relationship was observed between other occupations and time allocated to fish farm management. Farmers engaged in different occupations, such as agriculture, business, private service, and politics (Fig. 2), demonstrated varying levels of involvement in pisciculture, which underscores the influence of livelihood diversification on farm management practices (Sen and Roy 2015). Those relying on agriculture alongside fish farming may be more engaged in daily pond maintenance owing to the seasonal nature of crop cultivation, allowing for flexible time allocation. Conversely, individuals in the business or service sectors might have limited availability, potentially leading to less frequent monitoring and suboptimal production efficiency.

The extent of engagement in fish farming directly impacts key factors, such as water quality management, feeding schedules, and disease control, all of which are essential for maximizing yield (Kumar 2020b). When pisciculture is a secondary occupation, farmers might prioritize their primary income source, reducing the attention given to fish farming operations (Sen and Roy 2015). This can result in lower productivity, higher mortality rates, and inefficient resource utilization. These insights suggest that promoting fish farming as a viable primary occupation through targeted training, financial incentives, and technological support could enhance time investment and overall production outcomes (Kumar 2020b). Furthermore, encouraging part-time fish farmers to adopt improved management strategies, such as automated monitoring systems and scheduled farm visits, may help bridge the gap between occupational commitment and effective farm management.

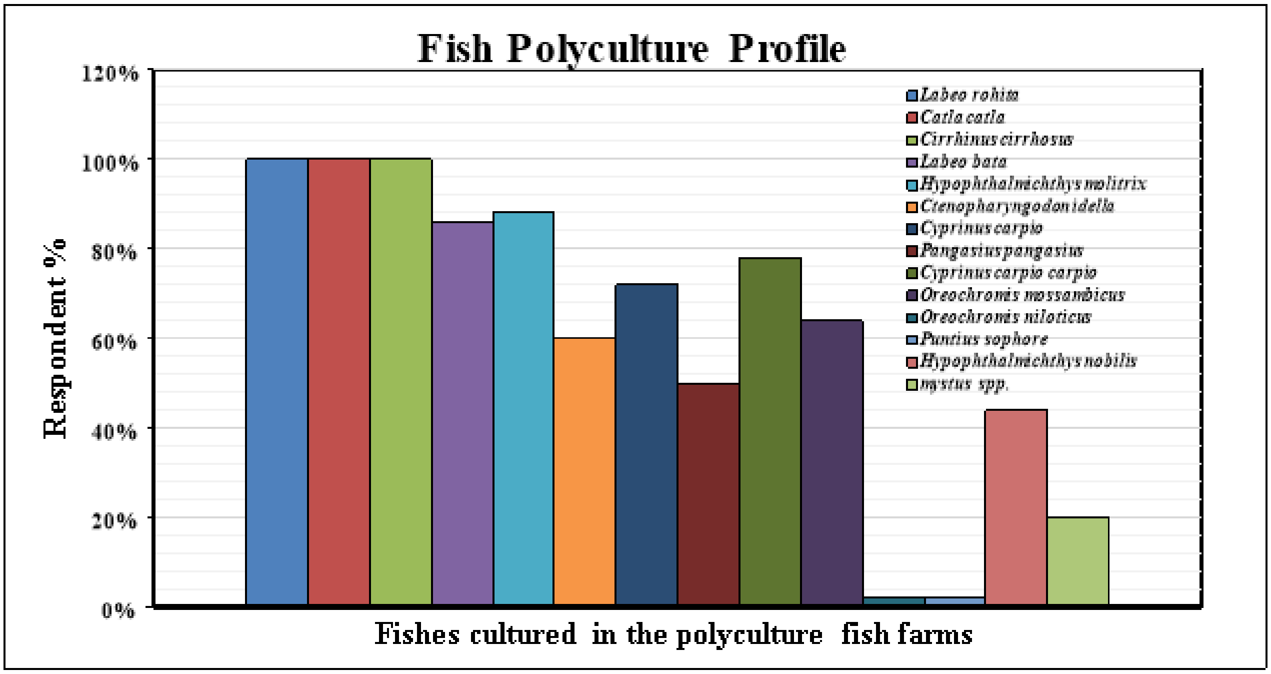

Fig. 3. Fish Polyculture Profile in Fish Farms

Fish stocking and pisciculture practices

The analyzed farms followed a semi-extensive polyculture system. The fish farms showed greater variations in preferences to fish species stocking, with preferential difference recorded being 100% for Indian major carps—Rohu (*Labeo rohita*), Catla (*Catla catla*), and Mrigal (*Cirrhinus cirrhosus*), 86% for *Labeo bata*,88% for Silver carp (*Hypophthalmichthys molitrix*), 60% for Grass carp (*Ctenopharyngodon idella*) 72% for Common carp (*Cyprinus carpio*) , 78% for Mirror carp (*Cyprinus carpio carpio*),64% for Tilapia (*Oreochromis mossambicus*) , 44% for Bighead carp (*Hypophthalmichthys nobilis*), 50% for Pangasius (*Pangasius pangasius*), 20% for Tengra (*Mystus spp.*) and 2% each for Monosex Tilapia (*Oreochromis niloticus*), and Pool barb (*Puntius sophore*). This multi-species approach is in agreement with Singh and Basudha (2020), who documented high stocking preferences for Indian major carp in Manipur. These species are highly preferred among farmers because of their adaptability and market demand. While species like Oreochromis *mossambicus* are preferred because of their fast growth rates and resilience, which aligns with efforts to optimize pond productivity in semi-intensive systems (FAO, 2020).

The analysis of pond sizes also revealed variations, with approximately 32% of the ponds (Total sampled ponds 138) being relatively small (0.1 to 0.3 acres), 28% medium (0.4 and 0.6 acres), 22% medium large (0.7 to 1 acre), 14% large (1.1 to 1.5 acres), and only 4% extra-large (1.6 acres) (Fig. 4). This underscores the predominance of small-to medium-sized ponds in fish-rearing systems, reflecting the adaptability of pisciculture to various land and water resource constraints. Previous studies suggest that smaller ponds may require higher input intensity for effective resource utilization, while larger ponds often require extensive monitoring and sustainable practices to prevent overexploitation (Boyd & Tucker, 2012).

Fish production variability among farmers

Influenced by factors such as pond size, species diversity, fish stock density, and management practices, the fish production showed greater variability, ranging on an annual basis between 650- 30000 kg (Fig. 4). The highest production recorded was 3000 kg/year in large-scale farmers, while the lowest was 650 kg/year in small-scale farming. This is in agreement with Bista *et al.* (2019), who examined fish production across small, medium, and large-scale farms and showed that the average fish production in one cycle was 504 kg for small-scale farmers, 2239 kg for medium-scale farmers and 4203 kg for large-scale farmers.

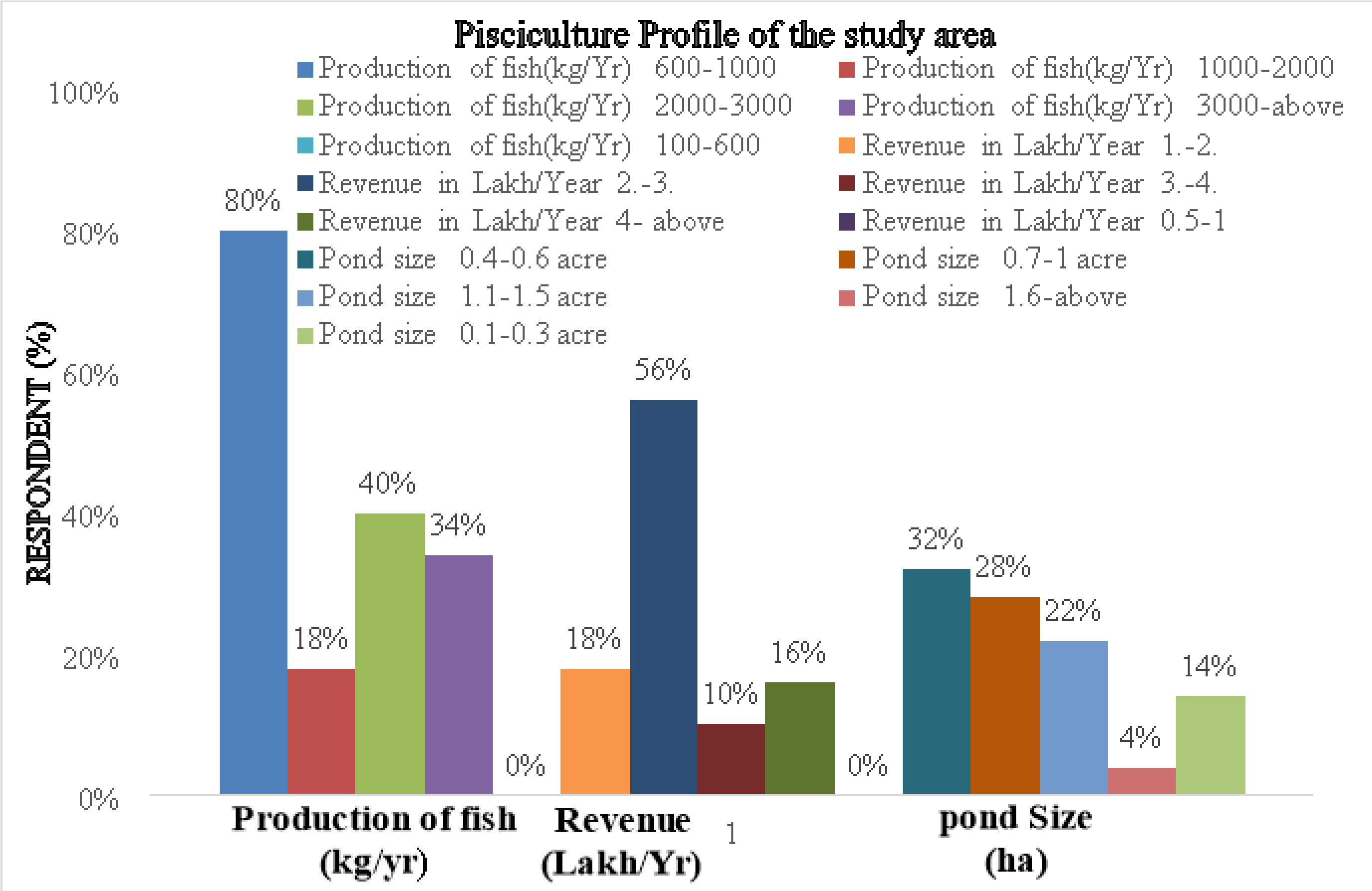

Fig. 4. Pisciculture profile of the study area

Revenue levels of fish farmers

The farmers reported a higher variability in their annual revenues, with 8% reporting between ₹1 lakh and ₹2 lakh, 56% between ₹2 lakh and ₹3 lakh, 10% between ₹3 lakh and ₹4 lakh, and 16% earning over ₹4 lakh (Fig. 4). This concentration of farmers within the mid-range income bracket of ₹2–₹3 lakh annually, aligns with Dhenuvakonda *et al.* (2019), who reported that a significant proportion of fish farmers in Telangana had an average annual income of ₹2.5 lakhs.

Factors Affecting Pisciculture Growth and Production

The extent of supplementary feeding, feeding frequency, use of biofertilizers, use of inorganic fertilizers, and time spent in farm management indicate that most fish farms operate under semi-extensive systems, where management practices vary significantly (Fig. 5). Kumar (2020a) also reported similar pisciculture practices (semi-extensive) in Bihar. Semi-extensive aquaculture combines elements of both extensive and intensive systems, relying on natural productivity while also incorporating some level of external inputs such as supplementary feeding and occasional water quality management. Notable disparities in daily time commitment to fish farming were observed (Fig. 5), and 82% of fish farmers were engaged in only minimal to moderate daily management, with about 38% farmers allocating just one hour per day to farm activities, while 44% allocated two hours. Such time allocation is a characteristic of semi-extensive systems, where routine tasks such as feeding, water quality checks, and fish health monitoring require limited direct supervision. The relatively lower labour demand in such systems allows farmers to balance fish farming with other livelihood activities, such as agriculture or secondary employment, as observed in the current study. Our results showed that about 6% farmers spent four hours and just 4% spent five hours daily (Fig.5). These varying engagement levels in farm management likely translate into differences in productivity, efficiency, and economic returns, and thus farmers who invest more time in their farms report better control over factors, such as water quality, disease prevention, and feed optimization, leading to improved fish health and growth rates. Conversely, those who spend minimal time may rely more on natural productivity and passive management, potentially resulting in lower yields (Fig. 5).

The management of feed and feeding frequency varies according to pond size, with approximately 70% of farmers involved in both weeding and fertilizing their ponds, while 30% focus exclusively on fertilization. As most farmers have small and medium ponds, and they primarily use household waste, rice bran, and mustard oil residue as fish feed. Commercial feed use is more common among farmers with larger-scale operations (≥1 acre), who typically feed on fish three to four times per week. In contrast, farmers in smaller ponds feed their fish less frequently, usually 1–2 times per week.

The variation in feed management practices reflects the different levels of investment, resources, and goals of farmers, based on pond size (Fig. 5). Singh and Basudha (2021) highlighted a similar pattern of pisciculture management in Bishempur, Imphal West, and Thoubal districts in Manipur. Smaller-scale farmers focus on more economical and less labour-intensive feeding strategies, whereas larger-scale farmers invest in more structured, frequent feeding regimes to ensure higher productivity. The frequency and type of feed used are important factors that influence fish health, growth, and overall farm output.

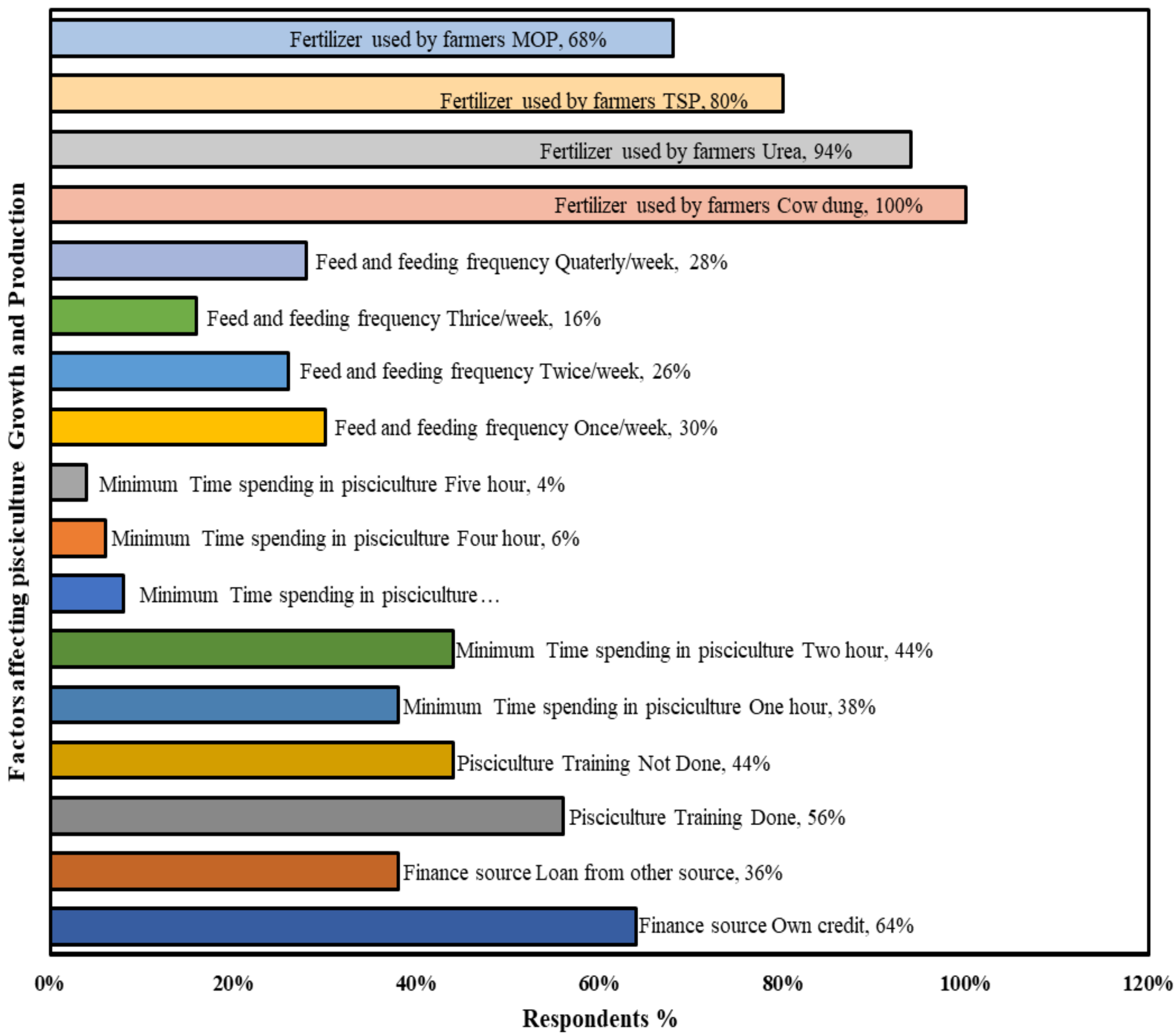

Fig. 5. Factors Affecting Pisciculture Growth and Production

The feeding frequency survey showed that 30% of farmers fed their fish once a week, 26% twice a week, 16% three times a week, and 28% four times a week (Fig. 5). These feeding habits are in agreement with Ndome *et al.* (2011), who while investigating the effect of feeding frequency on growth, feed consumption, and feed conversion of *Clarias gariepinus* x *Heterobranchus longifilis* hybrids also reported similar results

Pond management

Fertilizer use varied greatly, with nearly 100% of respondents applying bio-manure, such as cow dung, for pond fertilization, 94% of respondents applying inorganic manure, 80% using triple superphosphate (TSP), and 68% using muriate of potash (MoP) (Fig. 5). These differences emphasize the significance of using both organic and inorganic fertilizers in ponds, and reflect the importance of ensuring optimal nutrient levels for fish growth and overall health of pond ecosystems (Boyd *et al.,* 2022).

Farmer training and capacity building

Our findings showed that 44% of farmers lacked fish farming training, whereas 56% had obtained it through government or non-governmental organization (NGO) programs. These numbers point to a weakness in attempts to increase capacity, highlighting the necessity of more extensive outreach and training program accessibility. Supporting data from earlier studies emphasizes how crucial farmer education is to enhancing pisciculture methods. According to Salam *et al.* (2022), for example, training initiatives in a few Manipur districts saw notable participation rates.

Financial sources for fish farmers

Around 36% of the farmers depended on loans from banks, NGOs, village money lenders, and broker agencies, whereas 64% of farmers funded their pisciculture operations on their own. Interest rates on these loans were frequently substantial, typically surpassing 18% (Fig. 5). Sen and Roy (2015) reported that about 93.4% of Tripura farmers faced serious financial difficulties. The region's widespread financial hardship was highlighted by these problems, which were mostly ascribed to their reliance on funding from NGOs, self-help groups (SHGs), cooperative societies, and other social or political organizations. The difficulties farmers encounter in obtaining reasonably priced funding and the significant financial load were also highlighted by Sharif *et al.* (2015), who noted similar patterns among fish farmers in Pitamborpur.

CONCLUSION

The majority of ponds in the study area are small to medium-sized, and using semi-extensive polyculture methods, the majority of farmers stock Indian big carps like Mrigal, Catla, and Rohu. Although the quantity of fish produced fluctuates, a proportion of farmers produce between 2000 and 3000 kg annually. Fish farms with greater production levels typically employ a variety of fertilizers, which emphasizes the importance of urea and triple superphosphate in enhancing fish productivity. Development of farm management techniques, improved financial access and training initiatives can greatly help farmers to maximize their production and ensure its r long-term success.

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Authors Contribution

The First Author made substantial contributions to the conception design, and acquisition of data for the article; whereas the Second Author contributed analysis and interpretation of data, involved in drafting the manuscript or revising it critically for important intellectual content.

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