Journal of Agriculture and Natural Resources (2024) 7(1):25-36
ISSN: 2661-6270 (Print), ISSN: 2661-6289 (Online)
DOI: https://doi.org/10.3126/janr.v7i1.73122

Research Article

Economics of fish production demand and trade in terai region of Nepal

Sudha Sapkota[1*], Asha Raimajhi[2], Umita Sah[2], Hareram Devkota[3] and Shreeya Tripathi[1]

[1]Nepal Agricultural Policy Research Centre, Nepal Agricultural Research Council, Lalitpur, Nepal
[2]National Fishery Research Centre, Nepal Agricultural Research Council, Lalitpur, Nepal
[3]Nepal Agricultural Research Council, Lalitpur, Nepal
[*]Correspondence: sudhanepal@gmail.com
[*]ORCID: https://orcid.org/0000-0002-0610-0956

Received: August 15, 2024; Revised: October 30, 2024;
Accepted: December 05, 2024; Published: December 30, 2024

ABSTRACT

Aquaculture is gradually establishing itself as a significant agricultural activity in Nepal, a country endowed with abundant water resources and diverse topography. Despite its potential, aquaculture in Nepal, faces significant challenges that hinders optimal fish production and economic returns. This study was conducted in 2022 to 2023 and aims to analyze the current status of fish farming, examining production trends, socio-economic profiles of fish farming households, cost structures, and profitability. The research highlights the achievements of the Game Changer program, which has significantly boosted fish yield through fry production. It also examines the growth and economic feasibility of fish farming in Siraha, Nepal. Over the past decade, fish production has grown significantly, driven by enhanced aquaculture practices and supportive policies, the sector's profitability is reflected by a Benefit-Cost Ratio (BCR) of 1.28, despite challenges such as high feed costs and reliance on imported seeds. Fingerling production in Siraha experienced remarkable growth, rising from 5.5 million in 2019/2020 to 13.65 million in, 2021/2022 with a Compound Annual Growth Rate (CAGR) of 57.54%. Based on this growth trajectory, fingerling production is expected to reach 37.11 billion by 2034, showcasing the sector's significant potential for expansion. Despite notable progress, several constraints such as limited technical knowledge, inadequate access and knowledge to quality inputs, and insufficient market infrastructure persist. This study underscores the need for targeted interventions to address these challenges. Recommendations include enhancing technical training, improving low-cost high-quality inputs, strengthening market facilities, promoting gender balance, and advocating for supportive policies. By leveraging these strategies, Nepal can significantly increase its aquaculture production, contributing to national food security, economic growth, and employment generation.

Keywords: Fish, Economy, Trade

Correct citation: Sapkota, S., Raimajhi, A., Sah, U., Devkota H., & Tripathi, S. (2024). Economics of fish production demand and trade in terai region of Nepal. J*ournal of Agriculture and Natural Resources*,7(1), 25-36.
DOI: https://doi.org/10.3126/janr.v7i1.73122

Journal of Agriculture and Natural Resources (2024) 7(1):25-36
ISSN: 2661-6270 (Print), ISSN: 2661-6289 (Online)
DOI: https://doi.org/10.3126/janr.v7i1.73122

INTRODUCTION

Nepal being a landlocked nation, is blessed in water resources, offering significant potential for fisheries and aquaculture. However, only a small fraction of these resources has been effectively utilized. Over the past 15 years, pond fish production has shown notable progress, reaching 73,693 metric tons in the fiscal year 2020/21 (Dhakal *et al.*, 2022). Despite Nepal's relatively low production ranking, aquaculture significantly contributes to the national Gross Domestic Product (GDP), accounting for 2.47% of the agricultural GDP (MoALD, 2022). However, literature shows among different system of fish culture only 2% of the Nepal's total water resources have been used for aquaculture production and still the opportunities can be created by fish job is still unaddressed but addressed on many other countries (Simbo, 2023; CFPCC, 2020).

Pond fish culture is the most prevalent and favored aquaculture practice in Nepal. In 2020/21, the Terai region led with the highest number of ponds (45,169), covering a vast area (13,404 ha). This was followed by the Hilly region with 4,491 ponds covering 430 ha, and the Mountain region with 462 ponds spanning 20 ha (Mahaseth & karki, 2021). Particularly, fish farming in the Terai region has become a major part of Nepal's agricultural economy. Fish has tremendous source of both macronutrients and micronutrients and bear capacity to strengthen bone formation, metabolism, and calcium absorption (Das *et al.*, 2024). However, the districts like Siraha, where the cChildren and the women are highly malnutrition despite having the land of favorable climatic conditions and abundant water resources, demonstrate considerable potential for aquaculture are still lagging the potentiality of fish production. In 2016 Nepal Demographic and Health Survey revealed that only 51% of households in the Terai region were food secure. This issue is likely exacerbated by increasing migration to the Terai in search of socio-political and economic opportunities, creating competition among local residents for resources needed for daily livelihoods and food security. To combat hunger, poverty, and malnutrition among the rural population, there is an urgent need to boost the production of protein-rich foods. Fisheries have significant potential to address this need, with an average annual growth rate of about 6.7% and contributing 4.18% to the agricultural gross domestic product.

Current fish production in Nepal stands at 91,832 metric tons, with a per capita availability of 3.39%. Despite this, the country still imports 10,756 metric tons of fish annually (Budhathoki, 2018). Carp aquaculture is well-established in the Terai region, while Pangas aquaculture and Tilapia farming are emerging as promising cash crops with niche market potential. An ample supply of fish seed and improved technology is crucial for promoting these species and enhancing the value chain. Despite this promise, the aquaculture sector in Nepal faces numerous challenges that hinder optimal fish production and economic returns. In 2020/21, pond fish production amounted to 73,693 Mt. The sector confronts several challenges, including limited technical knowledge, insufficient capital, low-quality fingerlings and feed, disease issues, and inadequate market infrastructure. Government intervention is suggested to boost the sector's contribution to nutrition and employment (Dhakal *et al.*, 2022).

Journal of Agriculture and Natural Resources (2024) 7(1):25-36
ISSN: 2661-6270 (Print), ISSN: 2661-6289 (Online)
DOI: https://doi.org/10.3126/janr.v7i1.73122

The Nepal Agricultural Research Council (NARC) has expressed its commitment to the private aquaculture sector and improving infrastructure, following the successful introduction of trout aquaculture in remote hill areas. Documents in NFRC shows that by 2016, there were 85 private farms across 16 hill and mountain regions, with a total raceway area of 13,161 square meters. Production reached a peak of 400 metric tons of fish. This development was supported by ongoing research from institutions like NARC's Fisheries Research Division, Tribhuvan University (TU), and RONAST (Royal Nepal Academy of Science and Technology). Over the past five decades, significant strides in aquaculture have been bolstered by the Ministry of Agriculture and key international agencies including FAO/UNDP, ADB, JICA, USAID, IDRC, and DFID's Hill Agriculture Research Program (HARP). These efforts emphasized the need for increased investment and the establishment of an autonomous decision-making body for optimal sector development (Gurung, 2016; FAO, 2020). Likewise, among various development projects to enhance fisheries sector in Nepal, Game Changer Project was introduced with the aim to reduce poverty particularly in Terai focused leading fisheries and aquaculture development. The major objective of the project is to facilitate private hatchery men on brood fish management and breeding, the project also helps to assure availability of quality fish seed of carp, all male tilapia and pangas supply, thus the primary objective of this study is to analyze the current scenario of fish farming and its economic impact in the Siraha district of Nepal. Specifically, the study aims to:

1. Examine the socio-economic characteristics of fish farming households.
2. Evaluate the resource allocation, input-output relationships, and profitability of fish production.
3. Assess the impact of the Game Changer program on fingerling production and aquaculture development in Siraha.
4. Forecast future fingerling production and propose strategies to address challenges in fish farming, such as input availability, market infrastructure, and technological adoption.

METHODOLOGY

Sample Size and Sampling Method

Among the prioritized districts in the Terai area, Siraha was purposively selected for this study. Data were collected from a representative sample of fish farming households through surveys. A multidisciplinary team, including socio-economists, was involved in launching and monitoring the project, as well as conducting household surveys.

Data Collection Method

Structured questionnaires were administered to fish farmers across various districts in the Terai. Key variables collected included types and quantities of inputs such as feed, fingerlings, fuel, electricity, lime, manures, fertilizers, labor, drag nets, hormones, and medicines. Both primary and secondary data were collected. Additionally, an extensive review of academic journals, government reports, and publications from international organizations was conducted to understand the historical context, growth, production trends, and economic contributions of fisheries in Nepal. Data from various online governmental portals were analyzed to establish baseline metrics for food security and fish production.

Journal of Agriculture and Natural Resources (2024) 7(1):25-36
ISSN: 2661-6270 (Print), ISSN: 2661-6289 (Online)
DOI: https://doi.org/10.3126/janr.v7i1.73122

Statistical Analysis

Quantitative data from surveys were analyzed using statistical software to determine the relationship between input variables and fish production. Excel was utilized to calculate the Annual Compound Growth Rate, assess production trends, and determine the significance of various input variables. Derivative analysis was conducted to evaluate the contribution of different factors to overall production. Profitability was assessed using Benefit-Cost (B:C) analysis, with comparisons made specifically to fish farming in Siraha district. Qualitative data from interviews were transcribed and thematically analyzed.
ming in Siraha district. Qualitative data from interviews were transcribed and thematically analyzed.

Compound Annual Growth Rate (CAGR) Calculation

The Compound Annual Growth Rate (CAGR) was from FY 2076/77 to FY 2078/79. The CAGR which was calculated to project future fingerlings production shows a smoothed annual growth rate over a specified period, reflecting the year-over-year growth rate as if it had grown at a steady rate.

The formula for CAGR is:
CAGR = (Ending Value/Beginning Value) ^(1/n) – 1 ……(1)

Where:
Ending Value = 136.5 lakhs (for FY 2078/79)
Beginning Value = 55 lakhs (for FY 2076/77)
n = Number of years (2 years between FY 2076/77 and FY 2078/79)
Using this formula, we calculated the CAGR to be approximately 57.54%.

Impact of the Game Changer Program

The Game Changer program was introduced to improve various aspects of fish farming, including brood management and fry production. Given its success in boosting production in the short term, we estimate that this initiative contributes an additional 2% growth.

Thus, the total growth rate considered for our projection is:
Total Growth Rate =CAGR + Impact of Game Changer Program= 57.54% + 2%=59.54%.....(2)

Projection of Fingerling Production for 2034

To predict fingerling production by 2034, we use the Future Value (FV) formula:
Future Value= Present Value × (1 +Growth Rate) ^{n} ……..(3)

Where:
Present Value = 136.5 lakhs (for FY 2078/79)
Growth Rate = 59.54% (combined growth rate)
n = Number of years from 2022 to 2034 (12 years)

Plugging in these values, we calculate the projected fingerling production for 2034 to be

Journal of Agriculture and Natural Resources (2024) 7(1):25-36
ISSN: 2661-6270 (Print), ISSN: 2661-6289 (Online)
DOI: https://doi.org/10.3126/janr.v7i1.73122

approximately 37,110.62 lakhs. The projected increase to 37,110.62 lakhs by 2034 represents a substantial rise in fingerling production. This growth reflects not only the sector's historical performance but also the anticipated long-term impact of ongoing initiatives like the Game Changer program to the specific site and more. The projection underscores the potential for aquaculture to significantly contribute to the region's economy, food security, and employment opportunities. However, to sustain this growth, continuous investment in technical knowledge, quality inputs, and market infrastructure will be essential. Additionally, addressing challenges such as the cost of feed and labor dependency on imported seeds will be critical to achieving this projected growth.

Year-by-Year Projection of Fingerling Production up to 2034

Initial Data:

Base Year (FY 2078/79 or 2021/22): 136.5 lakhs (starting value)

Annual Growth Rate: 59.54%

Projection Formula: Fingerling Production in Year X= Fingerling Production in Previous Year × (1+Growth Rate) ……..(4)

Where the Growth Rate = 0.5954 (or 59.54%).

Table 1: Year-by-Year Breakdown

Calendar Year	Fingerling Production (lakhs)	Growth Rate (%)
2021/22	136.5	Base Year
2022/23	217.73	59.54
2023/24	347.39	59.54
2024/25	554.31	59.54
2025/26	884.11	59.54
2026/27	1,410.85	59.54
2027/28	2,252.85	59.54
2028/29	3,597.01	59.54
2029/30	5,742.89	59.54
2030/31	9,170.15	59.54
2031/32	14,657.31	59.54
2032/33	23,335.34	59.54
2033/34	37,110.62	59.54

By following the annual growth rate of 59.54%, the fingerling production in Siraha is projected to increase from 136.5 lakhs in FY 2078/79 (2021/22) to approximately 37,110.62 lakhs by FY 2090/91 (2033/34). The dramatic rise highlights the significant potential for growth in aquaculture in this region, driven by effective initiatives like the Game Changer program and continued investment in the sector. The analysis projects that by 2034, the fingerling production in the Siraha district of Nepal could increase to approximately 37,110.62 lakhs. This projection highlights the importance of sustained efforts in enhancing aquaculture practices, which could position Siraha as a significant contributor to Nepal's aquaculture sector.

RESULTS

This section summarizes the socio-economic profile of fish farming households, resource allocations, economics of fish farming and trade, introduction of game changer project its

Journal of Agriculture and Natural Resources (2024) 7(1):25-36
ISSN: 2661-6270 (Print), ISSN: 2661-6289 (Online)
DOI: https://doi.org/10.3126/janr.v7i1.73122

impact and forecast of fish and the recommendations for further improvement.

Socio-Economic Profile of Fish Farming Households and Resource Allocation

The socio-economic data of fish farming households provide insights into the demographic engaged in this sector. The average age of fish farmers was 43.66 years, and the gender distribution is heavily skewed towards males (98%). Educational levels vary, with 6% having higher education, 52% primary education, 32% lower secondary education, and 10% illiterate. The average family size was 5.6 members, and the ethnic composition was predominantly Madheshi (98%). The average total land owned by households was 35 Katha, with fish ponds covering 20.22 Katha on average. The number of ponds per household averages 3.46, and the cost of pond construction averages NPR 20,850. Fish farming experience ranges between 1-2 years, and the quantity of fingerlings per Katha was 10,410 (Table 2).

Table 2: Socio-economic information of farm households.

S.N.	Household Information	Average Mean Value	Standard deviation	Maximum value	Minimum value
1	Age	43.66	8.644	60	26
2	Gender Male :98% Female: 2 %				
3	Education Higher Studies: 6% Primary: 52% Lower Secondary: 32% Illiterate:10%				
4	Family Size	6.66	3.639	28	2
5	Ethnicity Brahmin/Chettri: 0% Janajati/ Dalit: 2% Madheshi:98%				
6	Total Land Owned (Kattha)	35	26.537	160	8
7	Fish Pond Coverage (Kattha)	20.22	19.916	120	5
8	Number of Ponds	3.46	3.660	18	1
9	Pond Construction cost (NRs)	20850	19988.84	120000	5000
10	Fish Farming Experience (Years)	1.64	0.662	3	1
11	Quantity of Fingerlings/ Kattha	10,410	10026.85	60000	2500

(Source: Survey, 2023)

Fish Production in Siraha

Fish farming in Siraha primarily involves species such as Common Carp, Pangas and Tilapia. Recent data from annual reports shows a significant increase in fry production over the years. For instance, in the year 2019, 55 lakhs fry were produced. This number increased to 139.1 lakhs in 2020 and slightly decreased to 136.5 lakhs in 2021.This upward trend indicates a growing capacity and potential for fish production in Siraha.

Cost of Fish Production

Analyzing the cost structure of fish production in Siraha reveals significant insights. Fixed costs constitute 18.47% of the total cost, including land rent (NPR 161,097.9), pond

Journal of Agriculture and Natural Resources (2024) 7(1):25-36
ISSN: 2661-6270 (Print), ISSN: 2661-6289 (Online)
DOI: https://doi.org/10.3126/janr.v7i1.73122

construction (depreciated amount of NPR 30,934.5), and machinery (depreciated amount of NPR 25,741.5). Variable costs account for 81.53% of the total cost, with the primary expenses being feed (NPR 375,038.4 or 31.83% of the total cost) and labor (NPR 323,345.1 or 27.44%). Other significant variable costs include fingerlings (NPR 137,047.2), fuel and electricity (NPR 32,303.4), lime (NPR13,778.7), manure and fertilizers (NPR 38,102.7), and medicine (NPR 21,335.1) (Table 3).

Table 3: Cost associated with the fish production.

S. N	Cost items	Cost (NPR/ha)	Cost items (%)
1.	Fixed cost		18.47
2.	Land rent	161097.9	13.67
3.	Pond construction (depreciated amount)	30934.5	2.62
4.	Machineries (depreciated amount)	25741.5	2.18
	Total Fixed cost	217773.9	18.47
5.	Variable cost		
6.	Feed	375038.4	31.83
7.	Fingerlings	137047.2	11.63
8.	Fuel and electricity	32303.4	2.75
9.	Lime	13778.7	1.17
10.	Manure and fertilizers	38102.7	3.23
11.	Labor	323345.1	27.44
12.	Medicine	21335.1	1.82
13.	Others	19620.6	1.66
	Total Variable Cost	960571.2	81.53
	Total cost	11,78,345.1	100

(Source: Survey, 2023)

Profitability of Fish Farming

The productivity of fish farming in Siraha was quantified at 60.62 Qt/ha, with an average market price of NPR 250 per kilogram. This translates to a total revenue of NPR 15,15,525 per hectare. With total costs amounting to NPR 11,78,345 per hectare, the resulting profit was NPR 3,37,179 per hectare. The Benefit-Cost Ratio (BCR) calculated is 1.28, indicating that fish farming is a profitable venture in Siraha.

Table 4: Benefit Cost Ratio.

S.N.	Indicators	Unit	Value
1.	Productivity	Qt/ha	60.62
2.	Average price of fish	NPR/Kg	250
3.	Total revenue	NPR/ha	1515525
4.	Total cost	NPR/ha	1178345
5.	Profit	NPR/ha	337179
6.	Benefit Cost Ratio		1.28

(Source: Survey 2023)

Journal of Agriculture and Natural Resources (2024) 7(1):25-36
ISSN: 2661-6270 (Print), ISSN: 2661-6289 (Online)
DOI: https://doi.org/10.3126/janr.v7i1.73122

Trends in Fish Production

Fish production in Nepal has shown consistent growth over the past decade. From 37,427 metric tons (Mt.) in 2013/14, production increased to 82,161 Mt. by 2022/23. The growth has been driven by enhanced aquaculture practices and supportive policies, with significant annual increases observed particularly in the years 2016/17 to 2020/21 (Figure1).

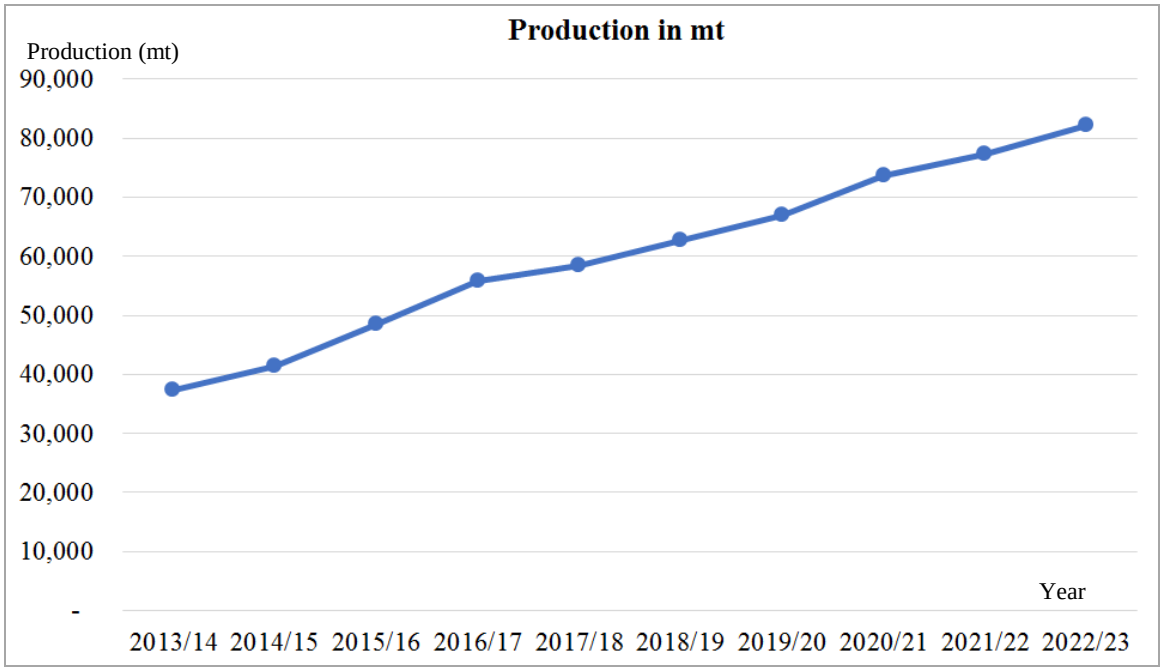

Figure 1: Trend of fish production.

Trends in Fish Yield

Fish farming yield has also shown a positive trend, reflecting improvements in production efficiency. Yields increased from around 3.60 mt/ha in the early years (2013/14 - 2015/16) to approximately 5.57 mt/ha in 2022/23. This growth indicates significant advancements in fish farming techniques and resource management (Figure 2).

Journal of Agriculture and Natural Resources (2024) 7(1):25-36
ISSN: 2661-6270 (Print), ISSN: 2661-6289 (Online)
DOI: https://doi.org/10.3126/janr.v7i1.73122

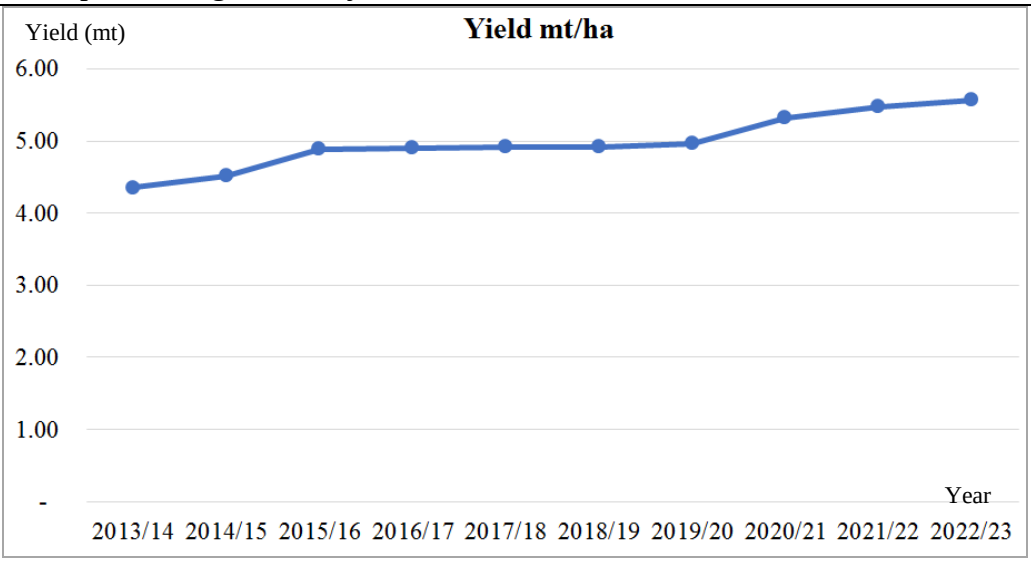

Figure 2: Fish yield scenario.

Imports

Fish and fish product imports into Nepal have shown a fluctuating trend from 2013/14 to 2022/23. There was a general increase in import values from 2013/14 to 2016/17, peaking in 2017/18 at approximately 1,853,570 thousand NPR. Post-2017/18, a decline in import values was observed, dropping to 1,030,417 thousand NPR by 2022/23 (Figure 3). This decline suggests improved domestic production and potential shifts in consumer preferences.

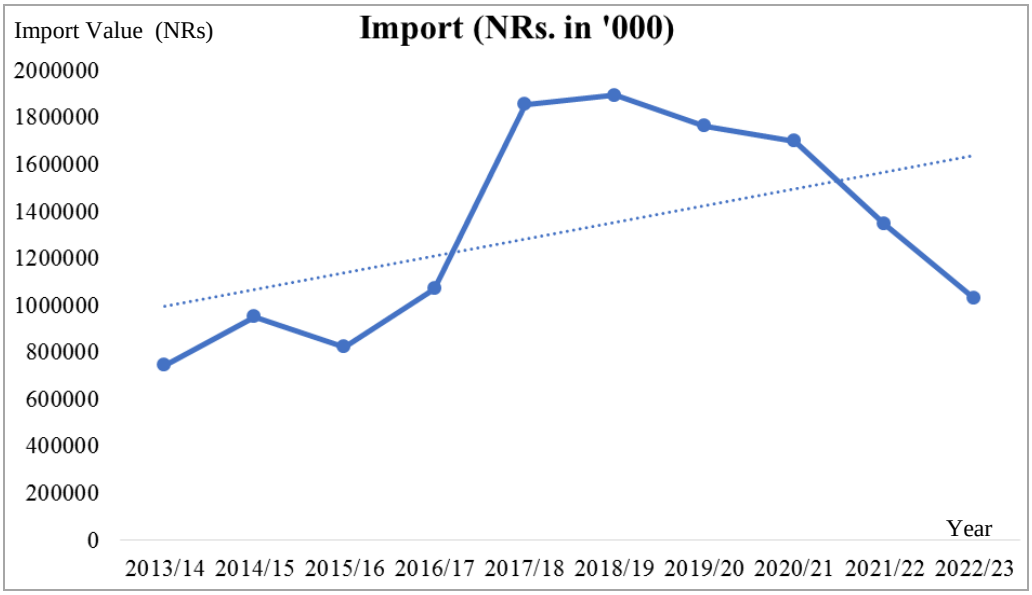

Figure 3: Trend of fish import.

Government interventions for fish production

The Game Changer program was implemented to revolutionize fish farming practices in Siraha. The program's objectives include enhancing brood management, increasing fry production, and developing efficient seed distribution networks. The annual targets set by the

Journal of Agriculture and Natural Resources (2024) 7(1):25-36
ISSN: 2661-6270 (Print), ISSN: 2661-6289 (Online)
DOI: https://doi.org/10.3126/janr.v7i1.73122

program were consistently met and surpassed. For example, the target for 2076/77 was 10 lakhs fry, and the actual production was 5.5 lakhs. In 2077/78, the target was 10 lakhs, and the actual production was 13.91 lakhs, demonstrating the program's effectiveness in boosting production (Figure 4).

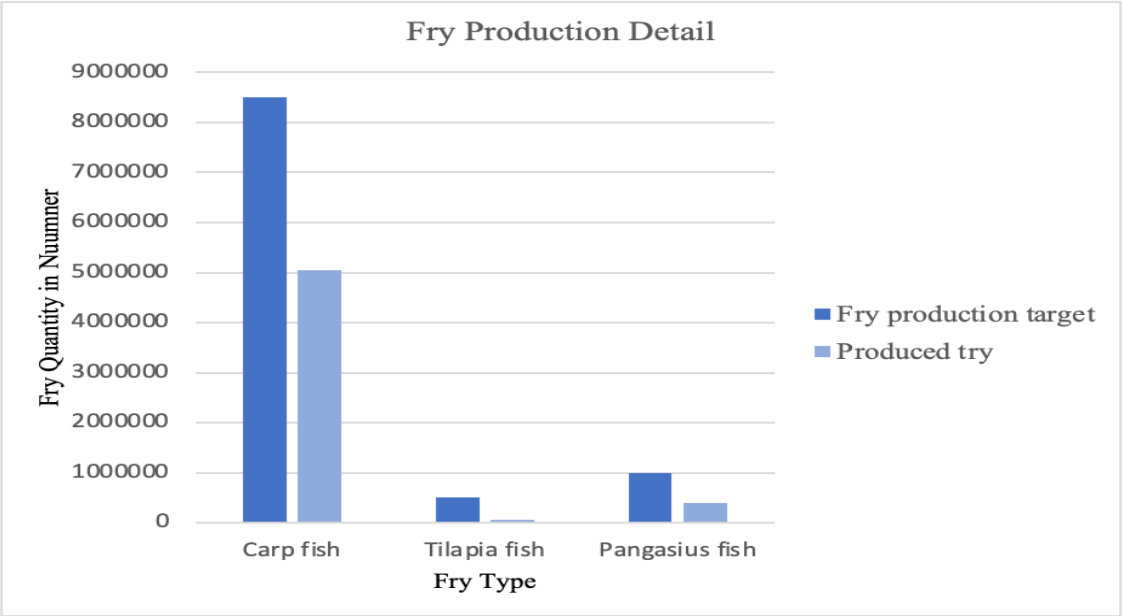

Figure 4: Status of fry production targets and the production.

Technology Innovations and Dissemination through NARC

Pangas seed production and its rearing are the huge challenges in Nepal due to newly introduced technology in fish breeding sector. The above figure shows (Figure 4) the significant production of pangas fry was 386000 for Nepalese condition which is significance achievement in Nepal even in farmer's field. There was the role of package on pangas seed production and rearing technology. Combine effect of technical expertise, farmers experience and input support system were noted. Farmers need to regular technical support, technology related inputs and farmers own commitments and continue in the adaption of new technology. There are several types of fish related technologies like fish feed production, fingerlings transportation, brood selection and development of monosex tilapia. This success should be widely extended in farmers level with package of practice; so the game changer project was implemented.

Discussion

The results indicate that fish farming in Siraha is economically viable and profitable. The socio-economic profile of fish farmers shows a potential for targeted interventions to enhance inclusivity and education. The cost analysis highlights feed and labor as major expenses that is 31.83% and 27.44% respectively, suggesting areas for cost management improvements. The profitability analysis, with a B: C ratio of 1.28, confirms the economic potential of fish farming in the region. Despite the economically viable enterprise; fishery sector could be more capacitate through low cost for feed and labour interventions The socioeconomic status of fish farmers is important because, on the one hand, it influences the farming practices that

ISSN: 2661-6270 (Print), ISSN: 2661-6289 (Online)
DOI: https://doi.org/10.3126/janr.v7i1.73122

the farmers use, and on the other hand, it is the result of farming performance (Sen & Roy, 2015).The size and nature of pond ownership, family size, variation in age, education, social participation, income, and aquaculture experience are socioeconomic factors that affect fish production (Altaf, 2019).

The Game Changer program has significantly contributed to increasing fry production of particularly pangas and improving local economies. However, challenges such as the high cost of feed and dependency on imported seeds need to be addressed. The trends in fish production and yield over the past decade indicate substantial growth, driven by improved practices. Future prospects for fish farming in Siraha are promising, with opportunities for expansion, value chain enhancement, and improved market access. Continued investment in awareness and common camps training and support for farmers will be crucial in sustaining this growth and addressing existing challenges.

In the Siraha district, fingerling production has shown significant growth that is 55 lakh, 139.1 lakh and 136.5 lakh in 2018/19, 2019/20 and 2019/20 respectively. It shows significant growth. Despite a slight decrease in FY 2019/20, the overall trend indicates robust growth in fingerling production. This trend suggests that the aquaculture sector in Siraha has been expanding, partly due to favorable initiatives such as the Game Changer program.

CONCLUSION

This study has provided a comprehensive analysis of fish farming practices, production trends, socio-economic profiles, cost structures, and profitability. Despite facing numerous challenges such as limited technical knowledge, insufficient capital, low-quality inputs, and inadequate market infrastructure, the sector has shown promising growth.

The Game Changer program has played a pivotal role in increasing fry production and improving brood management, showcasing the potential for further advancements in aquaculture practices. The socio-economic analysis reveals that fish farming households primarily consist of small-scale farmers with limited resources, highlighting the need for targeted interventions to support these communities. To fully realize the potential of aquaculture in Nepal, several key recommendations are proposed.

Enhance farm-based training programs for fish farmers to improve technical skills and knowledge. Ensure the availability of high-quality fingerlings, feed and gender friendly equipment to reduce the cost of labor. Develop better market facilities to ensure fair prices and reduce post-harvest losses. Implement initiatives to encourage greater participation of women in fish farming. Advocate for supportive policies that provide financial incentives and infrastructure development for the small holder farmers in aquaculture sector.

ACKNOWLEDGMENT

The author would like to acknowledge the farmers for their valuable time and the NARC for financial support.

Journal of Agriculture and Natural Resources (2024) 7(1):25-36
ISSN: 2661-6270 (Print), ISSN: 2661-6289 (Online)
DOI: https://doi.org/10.3126/janr.v7i1.73122

Authors' Contributions

Conceptualization and methodology: Sudha Sapkota
Formal analysis and investigation: Sudha Sapkota, Asha Raimajhi and Umita Sah
Resources: Asha Raimajhi, Hareram Devkota
Data curation: Sudha Sapkota, Asha Raimajhi, Umita Sah,
Writing-original draft preparation: Shreeya Tripathi
Writing revised draft and editing: Sudha Sapkota, Hareram Devkota and Shreeya Tripathi
Supervision: Sudha Sapkota

All authors have read and agreed to the publication version of the manuscript.

Conflicts of interest

The authors declare no conflict of interest.

REFERENCES

Sen, A., & Roy, M. (2015). Socio-economic status of fish farmers in Tripura, India. *Int. J. Cur. Res*, 7, 17090-17096.

Altaf, M. (2019). Socio economic status of fishermen community, South Punjab, Pakistan. *Punjab University Journal of Zoology, 34*(2), 115-118.

Budhathoki, R., & Sapkota, B. (2018). Fish farming in Nepal: Trend and consumption level. *Acta Scientific Agriculture, 2*(9), 109–115.

CFPCC. (2020). *Annual progress report (fiscal year 2075/76).* Retrieved from https://cfpcc.gov.np/downloadfile/annualbookoffish_FY207576_1612509786_1613375364.pdf

Das, A., Singh, K. M., Ahmad, N., Kumari, T., & Sinha, D. K. (2024). Economics of fresh water cultured fish production in Odisha and Bihar, India: A comparative analysis. *Journal of Scientific Research and Reports, 30*(9), 119–130.

Dhakal, A., Pandey, M., Kayastha, P., Suwal, G., & Suwal, B. (2022). An overview of status and development trend of aquaculture and fisheries in Nepal. *Advances in Agriculture, 2022*(1), 4206401.

FAO. (2020). *State of World Fisheries and Aquaculture 2020: Sustainability in Action.* Food and Agriculture Organization of the United Nations, Rome, Italy.

Gurung, T. (2003). Fisheries and aquaculture activities in Nepal. *Aquaculture Asia, 8*(1), 14–22.

Mahaseth, H., & Karki, C. (2021). Rainbow trout aquaculture in Nepal: Promise amid shocks. Retrieved from https://thediplomat.com/2021/02/rainbow-trout-aquaculture-in-nepal-promise-amidshocks/

MoALD. (2022). *Statistical information on Nepalese agriculture 2077/78 (2020/21).* Ministry of Agriculture & Livestock Development, Vol. 78.

Simbo, A. R. N. (2023). Modeling optimal income and job increase on fishing in the current economic scenario in Angola until 2050. *American Journal of Theoretical and Applied Statistics, 12*(5), 129–149. https://doi.org/10.11648/j.ajtas.20231205.15