Original Research Article **Open Access**

Growth trend in production of inland fish in Haryana and India

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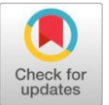
ABSTRACT

Background: *Fish is a vital nutrient-rich food in developing nations like India and significantly contributes to nutritional security, socio-economic development, and poverty alleviation etc. It serves as a cost-effective source of high-quality protein, essential fatty acids, and micronutrients, particularly for vulnerable populations. With over 75 per cent of total fish production now originating from inland sources, this sector plays a pivotal role in achieving Sustainable Development Goals (SDGs) related to zero hunger, decent work, and climate action.*

Objective: *This study analyses the growth trends in inland fish production in India and Haryana from 2010-11 to 2023-24 using secondary data from various sources. It specifically evaluates the impact of policy frameworks, technological interventions and regional disparities on production dynamics. The research also compares national and state-level performance to identify scalable models for sustainable aquaculture development.*

Methods: *The statistical parameters like linear regression (R^2) and Compound Annual Growth Rate (CAGR) were used to find out the production dynamics which were mainly influenced by technological advancements, policy interventions and market demand etc. Time-series data were sourced from the different official sources, ensuring reliability and comparability. Exponential regression models were applied to capture non-linear growth patterns, while R^2 values assessed the goodness-of-fit of the trends.*

Results: *The results revealed that India's inland fish production increased from 4.9 to 139 lakh tons with a CAGR of 8.21 per cent (R^2=0.9813), which shows that huge growth driven by improved practices, extension services and farmers' adoption level. The production in Haryana increased from 9.62 to 21.5 thousand tons with a CAGR of 6.38 per cent (R^2=0.9251), which indicates steady expansion with some fluctuations. These trends align with prior studies, underscoring the sector's responsiveness to infrastructure investments, research dissemination and climate adaptations.*

Conclusions: *The findings of the study highlight the potential of fish sector to address food security and economic growth through sustainable practices, value-added processing, and global market integration. However, the challenges like resource management and policy consistency necessitate a multi-pronged approach involving government support, farmer education, and technological innovation. Strategic interventions in post-harvest infrastructure, eco-friendly aquaculture, and market linkages are crucial for sustaining growth and ensuring long-term viability. This study underscores the critical role of inland fisheries in India's agrarian economy, advocating for targeted policies to enhance productivity while addressing emerging environmental and socio-economic challenges.*

Keywords: *CAGR, Fish, Linear regression, Management, Production.*

INTRODUCTION

Fish holds importance in developing countries such as India and often dubbed as "nutrient-rich food for the economically disadvantaged" sector of society. It serves as a vital source of essential nourishment, supplying crucial macronutrients like quality proteins and fats, as well as micronutrients in the form of vitamins and minerals to a person who consume it. Fish is globally recognized as the third major contributor to dietary protein following cereals and milk [2] and plays a pivotal role in

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addressing worldwide hunger, ensuring food security, and improving overall nutrition [1]. Consequently, the fisheries sector actively contributes to diverse socio-economic development initiatives, fostering self-employment, income generation, and playing a crucial role in ensuring nutritional security across all segments of the population [7].

Inland fish production witnessed substantial stake in fish sector with considerable growth in India. The fish output climbed from 4.9 lakh Tons to 139 lakh Tons in a period from 2010-11 to 2023-24 in India with annual growth of 8.21 per cent [3]. Haryana, with a production of 2.15 lakh Tons, was ranked 14th in inland fish production of India [4]. There is a huge demand for high quality protein products and fish farmers can fetch reasonable prices for their produce. Factors such as a shift in farmer's interest in growing high value enterprise due to their higher returns over short period, increased per capita income and shift

in health awareness directed rise in both area and production of fish. There is a large growth in fish products over a couple of years throughout the world. Fish is equipped with the significant demand among in India, consumed by all levels of people, whether they are poor or rich, urban or rural. In recent decades, India has witnessed considerable growth in the production of inland fish. This growing trend has been influenced by various factors such as technological advancements, improved fish farming practices, changing market dynamics, climate change, government policies and increasing demand globally. The study was carried out for analysing the trend to show growth trend in production of inland fish farming in India and Haryana.

METHODOLOGY

The study was conducted with the objective to analyse the growth trends in the production of inland fish in state of India and Haryana from 2010-11 to 2023-24. The methodology employed a combination of statistical tools and quantitative analyses to derive insights from the time series secondary data collected from various sources. The data for production under inland fish in India was collected from Indiastat.com, whereas data for Haryana was collected from handbook on fisheries statistics issued by the government of India. The first step involved collecting comprehensive data on inland fish production spanning the thirteen year period. The data included for analysis for inland fish production was annual figures, leading for a detailed analysis of trend and fluctuations over time. To analyse the trend of inland fish production, the data was plotted against independent variable as time (years) and the dependent variable as production to compute R^2 from regression trend line using linear regression. The graphical representation of regression charts was used to visualize growth pattern with individual data points for each year, representing the actual values for the production of inland fish in India and Haryana. R^2 values also measure how well it fits the data. The value of R^2 ranges from 0-1, with higher values indicating a better fit. Production trend indicates overall trend in inland fish production over time, which can be influenced by factors such as area, yield, climate and better management practices. To analyse the growth rates of inland fish production, the Compound Annual Growth Rate (CAGR) was calculated using linear regression statistics in excel. CAGR provides a measure of the average annual growth rate, assuming compounding over the specified period. By employing these methodologies, this study aimed to offer an all-inclusive and comprehensive analysis of the trends and growth rates in inland fish production in India and Haryana over the period of thirteen years from 2010-11 to 2023-24, thus contributing a profound understanding of the dynamics determining the fish industry.

RESULTS AND DISCUSSION
Growth in production of inland fish in India

The growth trend in inland fish production in India from 2010-11 to 2023-24 was analysed and is presented in Table 1 with the trend analysis and R^2 value illustrated in Fig. 1.

The production of inland fish increased significantly from 4.9 lakh tons in 2010-11 to 139 lakh tons in 2023-24, although fluctuations were observed during the intervening years. The annual compound growth rate (CAGR) for inland fish production during this period was calculated to be 8.21 per cent indicating a robust and consistent upward trend.

The R^2 value of 0.9813, which is close to 1 demonstrates that the production trend over the study period is statistically significant and represents a strong fit. This high R^2 value underscores the reliability of the growth model applied to the data.

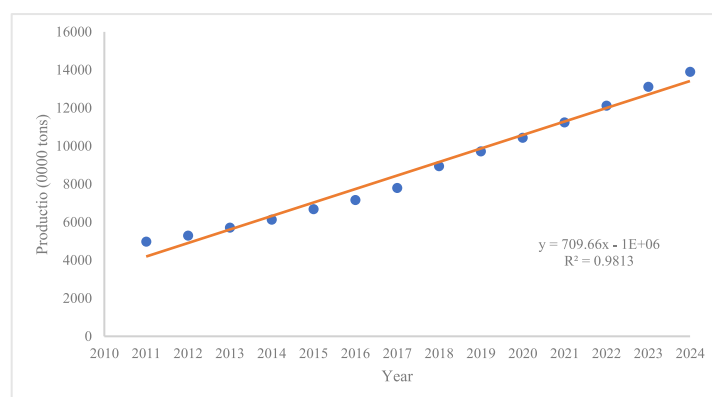$$y = 709.66x - 1E+06$$
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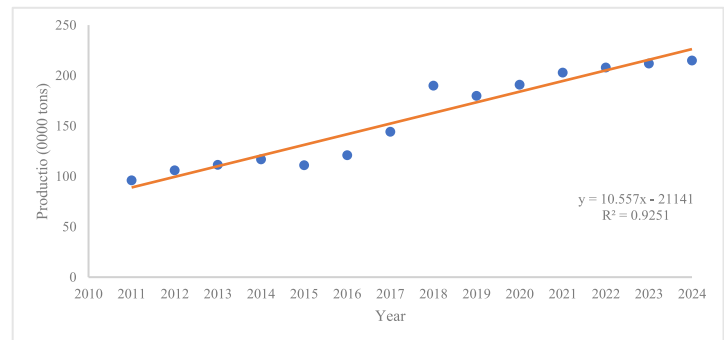
Fig 1: Growth in production of inland fish in India

The substantial growth in inland fish production can be attributed to the concerted efforts of extension agencies, educators, and service providers. Their interventions, including research initiatives, technology dissemination, training programs, capacity building, farmer mobilization, and market linkages, have played a pivotal role in enhancing production levels. The adoption of improved practices by farmers has been particularly critical, as theoretical knowledge alone is insufficient without practical implementation. The successful adoption of these practices has significantly contributed to the observed increase in inland fish production. These findings are consistent with previous studies conducted by Sharma [5] reported positive and significant compound growth rates in inland fish production in India during 1995-2014 with a CAGR of 5.77 per cent and an R^2 value of 0.960, indicating a statistically significant and well-fitted production trend. Similarly, the over a 25-year period (1981-2006), inland fish production grew at an annual rate of 6.20 per cent, supported by an R^2 value of 0.996 further validating the statistical significance and strong fit of the production trend [6]. The results of the current study align with these earlier findings, reinforcing the conclusion that inland fish production in India has experienced sustained and significant growth over the years, driven by effective interventions and the adoption of improved practices. The analysis highlights the remarkable growth in inland fish production in India, supported by a high R^2 value and a substantial CAGR. The role of extension services, research, and farmer adoption of advanced practices has been instrumental in achieving this growth. These findings contribute to the existing body of knowledge and emphasize the importance of continued efforts in research, technology dissemination, and capacity building to sustain and further enhance inland fish production in India.

Table 1: Growth in production of inland fish in India and Haryana

Year	India (0000 ton)	Haryana (0000 ton)
2010-11	4981.3	96.2
2011-12	5294.7	106
2012-13	5719.6	111.5
2013-14	6135.9	116.9
2014-15	6690.8	111.2
2015-16	7162.1	121
2016-17	7805.8	144.2
2017-18	8948	190
2018-19	9720	180
2019-20	10437	191
2020-21	11249	203
2021-22	12121	208
2022-23	13113	212
2023-24	13900	215
Average	8805	157
CAGR	8.21%	6.38%
R^2	0.9813	0.9251

Growth in production of inland fish in Haryana

The growth trend in inland fish production in Haryana from 2010-11 to 2023-24 was analyzed and is presented in Table 1 with the trend analysis and R^2 value illustrated in Fig. 2. The production of inland fish increased from 9.62 thousand tons in 2010-11 to 21.5 thousand tons in 2023-24, although fluctuations were observed during the intervening years. The annual compound growth rate (CAGR) for inland fish production during this period was calculated to be 6.38 per cent indicating a steady and positive growth trend. The R^2 value of 0.9251, which is close to 1 demonstrates that the production trend over the study period is statistically significant and represents a good fit. This suggests that Haryana has experienced an overall positive and increasing trend in inland fish production from 2010 to 2024 despite minor fluctuations in certain years. The growth in inland fish production in Haryana can be attributed to various factors, including advancements in aquaculture practices, improved technology adoption, and effective interventions by extension agencies and policymakers. The steady increase in production, despite periodic fluctuations, highlights the resilience and potential of the inland fisheries sector in the state. The high R^2 value further reinforces the reliability of the growth model and the statistical significance of the observed trend. These findings are consistent with previous studies that reported positive and significant compound growth rates in inland fish production in India during 1980-2006, with a CAGR of 4.46 per cent which was statistically significant and a good fit at the 1 per cent level of significance [6]. The results of the current study align with these earlier findings, further validating the positive growth trend in inland fish production over time. The analysis reveals a significant and positive growth trend in inland fish production in Haryana supported by a high R^2 value and a steady CAGR. Despite fluctuations in certain years, the overall trend indicates progress in the sector, likely driven by improved practices and effective interventions. These findings contribute to the understanding of inland fisheries development in Haryana and underscore the importance of continued efforts to sustain and enhance production through technological advancements, capacity building, and policy support.

Fig 2: Growth in production of inland fish in Haryana

CONCLUSION

The trend analysis of production of inland fish in India and Haryana provides valuable insights into the understanding growth patterns and challenges in inland fish production. The fish industry witnessed a remarkable growth and holds significant potential for further growth in future through adoption of sustainable fish farming practices, value added processing and export opportunities. The significant growth in inland fish production attributed to many factors such as technological advancements, improved infrastructure, government support, changing market dynamics, and consumer demand locally as well globally. Multi-pronged approach involving government policies, research and development, education, and awareness to farmers is required as knowledge with proper adoption will ultimately help in the blooming fish industry. Implementation of sustainable fish farming practices, investing in research, improving postharvest infrastructure and market support are crucial towards reversing this declining trend and ensuring long-term sustainability of fish production in India and Haryana.

REFERENCES

1. Bennett, A.; X. Basurto; J. Virdin; X. Lin; S.J. Betances; M.D. Smith and S. Zoubek. 2021. Recognize fish as food in policy discourse and development funding. *Ambio, 50*(1), 981-989.

2. FAO. 2020. Tracking progress on food and agriculture related SDG indicators 2020. A report on the indicators under FAO custodianship. Available at http://www.fao.org/sdg-progress-report/en/

3. GOI (2023). Handbook on Fisheries Statistics, 2023. Retrieved from:https://dof.gov.in/sites/default/files/2024-03/handbook_sp.pdf

4. GOI (2024). Retrieved from: https://www.indiastatagri.com/ table/agriculture/production-fish-india-1950-1951-1955-1956-1960-196/101820

5. Hemant Sharma (2017). Growth and Instability of Inland Fish Production in India. *Fishery Technology, 54*(1), 155-161.

6. Kumar, B. G., Datta, K. K. & Joshi, P. K. (2010). Growth of fisheries and aquaculture sector in India: Needed policy directions for future. *World Aquaculture, 41*(3), 45-51.

7. Langeh, S.; P. Kumar; P. Choudhary and D.S. Rawat. 2023. Health Status of Golden Mahseer, *Tor putitora* in Anji Hatchery of District Reasi of Jammu Region. *Journal of Community Mobilization and Sustainable Development, 18*(4), 1294-1297.

8. Maurya, A. K., Upadhyay, A. D., Prasad L. & Khan, S. (2018).Trend analysis of fish production in Uttar Pradesh, India. *Journal of Entomology and Zoology Studies, 6*(4), 180-184.

9. Sonvanee, O. P., Devi, B. N., & Mohale, H. P. (2021). Trend analysis and forecasting of fish and fish seed production in Chhattisgarh, India. *Indian Journal of Economics and Development, 9*(1), 1-12.

10. Yadav, A. K. & (2020). Growth trends and forecasting of fish production in Assam, India using ARIMA model. *Journal of Applied and Natural Science, 12*(3), 415-421.