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An evaluation of the effectiveness of training programs for fish and livestock farmers in West Bengal

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Abstract
A study was conducted among 3,546 farmers in West Bengal to evaluate the effectiveness of training programs aimed at enhancing their livelihoods. Out of these, a total of 3,533 farmers from aspirational districts, namely Birbhum (783), South Dinajpur (518), Malda (933), Murshidabad (684), and Nadia (628), received training. Among the trained participants, 2,623 were women, 623 belonged to tribal communities, and 783 were marginal farmers. The study focused on assessing capacity-building outcomes for these farmers, using structured questionnaires to measure shifts in knowledge and attitudes. The findings indicated a significant positive impact on the adoption of scientific methods in fish culture, poultry farming, and sheep and goat rearing practices. This training initiative extended beyond the aspirational districts to also benefit farmers in North and South 24 Parganas of the Sundarbans and additional regions across West Bengal.

Keywords: Livestock farmers, aspirational districts, training programme, West Bengal

Introduction

Training programs for fish and livestock farmers play a pivotal role in enhancing agricultural productivity, improving livelihoods, and fostering sustainable development in rural areas. West Bengal, characterized by its diverse agro-climatic zones, is a critical hub for aquaculture and livestock farming in India. However, effective training programs remain a key determinant of success in these sectors. Studies reveal significant improvements in farmer productivity following well-structured training initiatives. For instance, a study conducted in North 24 Parganas demonstrated that formal training and experience significantly increased the productivity of fish farmers, with training being a critical factor for yields exceeding five tons per hectare annually (Biswas x., 2018) [11]. Similarly, an evaluation of fish farmer producer organizations in Dakshin Dinajpur highlighted the need for targeted training in areas like fish seed production, disease management, and farm business operations to address skill gaps effectively (Saha *et al*., 2021) [12].

In the livestock sector, a comprehensive assessment in West Bengal's aspirational districts identified a strong correlation between farmers' knowledge levels and their adoption of improved animal husbandry practices. Notably, training emerged as a vital tool for overcoming constraints such as inadequate technical know-how and poor access to resources (Bhattacharjee *et al*., 2022) [13].

Moreover, training programs have broader socio-economic implications. Initiatives in South 24 Parganas showcased how capacity-building efforts through farmer field schools empowered rural communities, enhancing entrepreneurship and fostering knowledge sharing (Paul *et al*., 2023) [14]. However, challenges like inadequate training facilities and inconsistent support from governmental and non-governmental agencies remain barriers to achieving the full potential of such programs (Chattoraj *et al*., 2015) [15]. Effective training programs require careful planning, incorporating local needs, and addressing specific constraints faced by farmers. By leveraging structured and targeted training, fish and livestock farmers in West Bengal can achieve enhanced productivity, resilience, and socio-economic well-being.

Agriculture is the backbone of India's economy, contributing significantly to the nation's GDP and employing a substantial portion of the population. In West Bengal, a state known for its fertile lands and diverse agricultural output, farming is the primary livelihood for many rural communities. However, the sector faces multiple challenges, including fluctuating market prices, climate variability, and limited access to modern farming techniques. To address these issues, training programs for farmers have been introduced across the state, focusing on skill development, sustainable practices, and efficient resource management. These training initiatives, implemented by government agencies, non-governmental organizations (NGOs), and private entities, aim to enhance farmers' knowledge and equip them with the skills to improve productivity and income. However, the effectiveness of these programs remains under evaluation, as factors like resource availability, program reach, and participant engagement vary widely. This study assesses the impact of these training programs on farmers in West Bengal, examining their ability to adapt to new techniques, manage resources sustainably, and increase crop yields. Through this analysis, we aim to highlight areas where training initiatives are effective and identify challenges limiting their success, providing insights into optimizing agricultural support systems for West Bengal's farming community. Livestock and poultry have been key sub-sectors of agriculture in the country, accounting for 4.9

percent of total gross value added (Rs. 758,417 crores in 2017-2018) [National Accounts Statistics-2019]. Providing a source of income and employment for around 8.8% of the country's population. With a population of 536.76 million cattle and 851.81 million poultry, the livestock and poultry sector has long been the primary source of animal protein for both non-vegetarians and vegetarians in the country, contributing considerably to nutritional security for people of all ages [Livestock Census-2019].

It is also expected that the impact will be long-lasting and have a significant impact on the sector's livelihood, employment, and overall economy. While all related concerns are being tackled with vigour these days, a comprehensive understanding of the total impact will aid in the development of appropriate policies and revival measures. The purpose of this study was to represent the impact of the epidemic and the ensuing lockdown on the country's cattle and poultry sectors, fishery and animal sectors which have been among the fastest growing in recent years. The lack of adequate country-wide data has been a key impediment to gaining a comprehensive understanding of the impact of the lengthy lockdown on various livestock and poultry sub-sectors. In this example, an in-depth examination of the subject was conducted using a combination of publicly available documents and information gathered through public contacts. The pandemic and its accompanying lockdown have not only caused enormous distress to millions of poor and marginal farmers who are trying to save their crops and/or livestock to ensure their livelihoods, but it has also had an impact on the overall poultry, dairy, and other livestock production systems and value chains, nutrition and health care, and labour availability. The study discusses a variety of repercussions, including decreased demand for various commodities, wasting of produce owing to the closure of transportation and market networks, distress sales of produce, and government and affiliated enterprise labour shortages and revival plans. Although the current impact research provides an overview of the current situation, a systematic study based on the gathering of primary data from across the country is recommended to provide a comprehensive picture of the impact on each of the sub-sectors and their associated value chains. The lack of adequate country-wide information on pertinent issues has been a key impediment to gaining a better understanding of the pandemic's impact and the protracted lockdown on various livestock and poultry sub-sectors. As a result, an attempt has been made to conduct an in-depth investigation of the subject by compiling training as well as information gathered from public interactions, published materials, the results of which are summarised below.

Materials and methods

The present study was conducted among 3,546 farmers in West Bengal who participated in a training program spanning fisheries, animal science, poultry, sheep and goat production, and other agricultural sectors from January, 2023 to December, 2023. The program’s impact on farmers' adoption of scientific practices in fish culture, poultry farming, and sheep and goat rearing was found to be substantial. The training extended beyond the scope of the Aspirational Districts Program in West Bengal (including Malda, Nadia, Birbhum, Murshidabad, and South Dinajpur) to cover two Sundarbans districts (North 24 Parganas and South 24 Parganas) and other districts within the state. Farmers were provided with a structured curriculum on fish culture, poultry, and small ruminant farming, among other areas, using lectures, presentations, and demonstrations. The assessment of knowledge gains was conducted following a standardized procedure (Goswami, 2010). Data analysis employed several statistical methods, including percentage analysis, chi-square testing, and t-tests (Snedecor and Cochran, 1994).

Results and discussion

Socio demographic parameters: The analysis of knowledge scores pre- and post-training across various demographic and socio-economic categories reveals significant knowledge gains in most areas, with an overall average knowledge gain of 17.63 points, equating to a 42.86% improvement.

1. **Overall-knowledge-gain:** The pre-training knowledge score averaged at 26.87, which increased to 43.52 post-training, indicating a substantial gain. This suggests the training program's effectiveness in enhancing knowledge across a broad audience.

2. **District-wise comparison:** All districts exhibited substantial knowledge gains, with Nadia achieving the highest post-training score of 46.36 and a gain of 19.70 points (41.60% increase). South Dinajpur showed the lowest pre- and post-training scores (22.32 and 38.87, respectively) but still achieved a gain of 16.55 points (42.58%). These variations may reflect initial disparities in knowledge levels across districts.

3. **Age groups:** The “Most Active Group” (ages 30-60) showed the highest average knowledge gain of 18.93 points (43.04%), slightly higher than other age groups.

4. **Religion and marital status:** Across religious groups, Hindus and Muslims had similar knowledge gains, showing that training effectiveness was consistent regardless of religious background.

Among marital statuses, widows/widowers had a slightly higher post-training score and gain (18.55), while married and unmarried individuals also showed comparable gains.

5. **Occupation:** Participants from cultivation occupations displayed the highest post-training score (44.94) and a gain of 19.05 points (42.36%). Business owners had the lowest pre- and post-training scores, suggesting potentially lower engagement or a mismatch between training content and business activities.

6. **Caste:** The Other Backward Caste (OBC) group showed the highest knowledge gain (18.74 points) post-training, while Scheduled Castes and Tribes had slightly lower scores but still showed significant improvements.

7. **Education level:** As expected, education positively correlated with knowledge gains, with graduates showing the highest post-training score (46.76) and gain (19.97 points). Even illiterate participants experienced a substantial improvement, highlighting the program's accessibility and effectiveness across educational backgrounds.

8. **Family type and family size:** Joint families had a slightly higher knowledge gain than nuclear families, possibly reflecting collaborative learning environments. Larger families showed a higher average knowledge gain than smaller ones, potentially due to broader support and reinforcement of training information within the family setting.

9. **House type and land holding:** Participants living in pucca houses and mansions demonstrated higher post-training scores and gains, indicating that better living standards might contribute to learning engagement. Landholding size was also positively correlated with knowledge gain, with individuals owning up to 2 hectares showing the highest knowledge gains (20.19), likely reflecting the relevance of training content to those with larger landholdings.

Table 1: Knowledge Score (Mean ± SEM) of the farmers of Aspirational districts of West Bengal after training (N =3546)

Category	Different factors	Knowledge-score (Mean ± SEM)		Average-knowledge gain	
		Pre-Training (Mean ± SEM)	Post training (Mean ± SEM)	Gain	Percentage
Overall (3546)		26.87	43.52	17.63	42.86
Districts	Birbhum	24.95	43.67	17.72	40.89
	Nadia	25.63	46.36	19.70	41.60
	Maldah	25.29	43.54	18.25	41.91
	South Dinajpur	22.32	38.87	16.55	42.58
	Murshidabad	24.80	42.66	17.86	41.87
Age	Young Group (Up To 30 Years)	25.21	43.87	18.65	42.51
	Most Active Group (30-60 years.)	25.04	43.97	18.93	43.04
	Elder Group (Above 60 Years.)	25.35	43.95	18.55	42.29
Religion	Hindu	25.74	44.29	18.55	41.89
	Muslim	24.75	42.57	17.82	41.85
Marital Status	Married	24.33	41.84	17.51	41.84
	Unmarried	24.74	42.58	17.81	41.86
	Widow/ Widower	25.72	44.26	18.55	41.92
Occupation	Labour	25.15	43.26	18.12	41.89
	Caste Occupation	25.89	44.57	18.66	41.87
	Migrants Labour	24.86	42.86	17.98	41.94
	Business	23.83	40.63	16.81	41.36
	Cultivation	25.92	44.94	19.05	42.36
Caste	General	25.73	44.33	18.56	41.85
	Schedule Caste	24.69	42.46	17.77	41.86
	Schedule Tribe	24.41	41.99	17.58	41.88
	Other Backward Caste	26.04	44.78	18.74	41.85
Education of the farmers	Illiterate	23.33	40.13	16.79	41.83
	Can Read Only	24.85	42.69	17.89	41.76
	Can Read & Write	24.89	42.81	17.91	41.83
	Primary	24.47	42.91	18.44	42.93
	Middle School	24.95	43.01	18.01	41.91
	High School	25.16	43.81	18.64	42.55
	Graduate	26.79	46.76	19.97	42.71
Family type	Nuclear Family	24.98	42.90	17.93	41.78
	Joint Family	25.97	44.67	18.70	41.85
Family Size	Small	24.99	42.99	18.00	41.87
	Medium	26.23	45.13	18.92	41.91
	Large	27.04	46.41	19.43	41.85
House Type	No house	24.61	42.05	17.43	41.46
	Hut	24.86	42.24	17.34	41.11
	Kutcha House	25.25	43.65	18.45	42.29
	Mixed House	25.73	44.55	18.81	42.25
	Pucca House	27.03	46.71	19.69	42.15
	Mansion	27.43	47.81	20.45	42.64
Land Holding	No land/Land less	24.64	42.45	17.75	41.85
	Up to 1 hectare	25.53	44.92	19.37	43.14
	Up to 2 hectares	26.63	46.84	20.19	43.11
	Above 2 hectares	26.81	46.71	19.89	42.59

Impact of training

The impact of farmer training on scientific fish culture, poultry, sheep, and goat farming practices among farmers of West Bengal was evaluated, and the effectiveness of capacity building with modern curriculum was found to be satisfactory (Table 2), with an increase in mean knowledge score pertaining to various aspects of fish culture, poultry, sheep, and goat rearing practices.

The training program significantly improved the participants' knowledge across various livestock management parameters, as demonstrated by the increase in mean knowledge scores before and after the training. This section will discuss the results parameter-wise and interpret the overall impact of the training program.

1. **Housing management**: The mean knowledge score for housing management increased from 30.64 to 46.62, with a mean knowledge gain of 15.97 and a percentage knowledge gain of 34.26%. This significant improvement reflects the training's effectiveness in enhancing participants' understanding of optimal housing practices, which are crucial for maintaining animal welfare and productivity.

2. **Breeds and breeding practices:** Knowledge in breeds and breeding practices saw a mean score rise from 36.13 to 49.73, with a mean knowledge gain of 13.59, translating to a 27.33% increase. This suggests that training effectively bridged knowledge gaps in this area, likely leading to more informed breeding decisions among participants.

3. **Feeding practices:** The participants' knowledge in feeding practices improved notably, with mean scores increasing from 22.22 to 42.16, yielding a mean knowledge gain of 19.93 and a substantial percentage gain of 47.27%. This considerable enhancement indicates the training's strong impact on educating participants about balanced and nutritious feeding, essential for animal growth and health.

4. **Fodder production:** Knowledge in fodder production improved modestly, with scores increasing from 26.93 to 34.45, resulting in a mean knowledge gain of 7.51 and a percentage gain of 21.81%. Though less pronounced than other areas, this improvement highlights a growing awareness of fodder cultivation as a sustainable practice for livestock feed.

5. **General care and management:** The highest gain was observed in general care and management, where mean scores rose from 14.85 to 47.03, with an impressive mean knowledge gain of 32.17 and a percentage gain of 68.41%. This substantial increase emphasizes the success of the training in educating participants about basic yet crucial aspects of animal care, which form the foundation of good livestock management practices.

6. **Health care management:** Participants' knowledge in health care management improved significantly from 24.50 to 47.11, yielding a mean gain of 22.59 and a percentage gain of 47.97%. This demonstrates the training's effectiveness in imparting knowledge about disease prevention and treatment practices, vital for minimizing livestock morbidity and mortality.

7. **Overall knowledge:** The overall mean knowledge score increased from 25.88 before training to 44.51 after training, with a mean gain of 18.61 and an overall percentage gain of 41.85%. This broad improvement across all parameters reflects the comprehensive success of the training program in improving knowledge and equipping participants with essential skills in livestock management.

Table 2: Farmers' Knowledge scores at pre and post training programme. (N=3546)

SL. No.	Parameters	Mean knowledge score	Mean knowledge gain score	Mean knowledge gain score	Percent of knowledge gain
		Before training	After training		
1.	Housing management	30.64	46.62**	15.97	34.26
2.	Breeds & breeding practices	36.13	49.73**	13.59	27.33
3.	Feeding practices	22.22	42.16**	19.93	47.27
4.	Fodder production	26.93	34.45**	7.51	21.81
5.	General care & management	14.85	47.03**	32.17	68.41
6.	Health care management	24.50	47.11**	22.59	47.97
7.	Overall	25.88	44.51**	18.61	41.85

** Highly Significant at P<0.001

Standard Error:

Parameters	Mean knowledge score	
	Before training	After training
Housing management	1.32	4.19
Breeds & breeding practices	1.51	4.75
Feeding practices	1.04	3.31
Fodder production	1.35	4.32
General care & management	0.84	2.55
Health care management	1.11	3.48
Overall	0.92	2.93

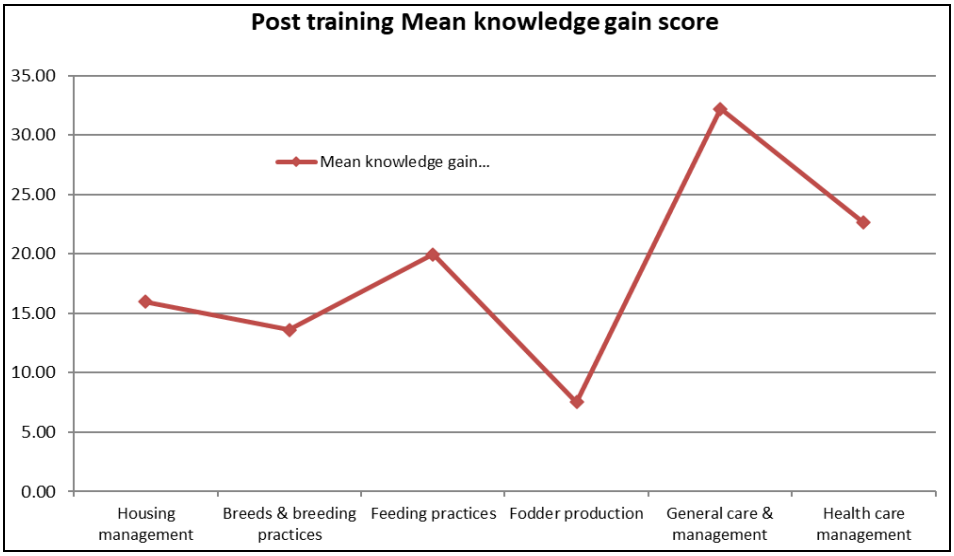

Fig 1

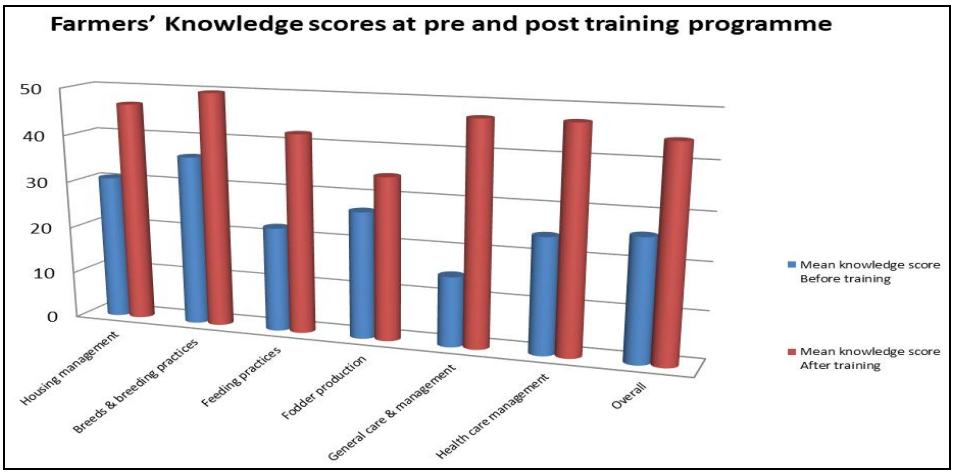

Fig 2

Adoption of different technology: The analysis of adoption levels for various livestock management practices indicates significant variation in uptake, which can inform future strategies for improving animal husbandry practices.

Vaccination against Contagious Disease: Vaccination for contagious diseases was adopted by 63.51% of respondents, a moderately high level that reflects awareness of disease prevention but suggests there is room for improvement. Increasing this rate could further safeguard herd health and reduce the incidence of outbreaks.

Deworming for parasitic control: With a 72.35% adoption rate, deworming for parasitic control showed one of the highest levels of uptake, suggesting a widespread recognition of its importance in maintaining animal health and productivity. This high rate indicates strong compliance, possibly due to visible benefits like improved growth rates and general animal wellbeing.

Cultivation and feeding of green fodder: Adoption of green fodder cultivation (36.09%) and feeding (38.53%) was notably low. This may be due to limited access to resources for fodder cultivation or lack of awareness about its benefits. Improved adoption of green fodder cultivation and feeding could enhance animal nutrition and reduce dependence on purchased feeds.

Feeding of concentrate mixture: Nearly half (49.72%) of respondents reported feeding concentrate mixtures, indicating a moderate level of adoption. This may be due to partial knowledge of its nutritional benefits or financial constraints in accessing concentrate feeds. Efforts to increase awareness of its benefits for higher milk and meat yields could encourage broader adoption.

Breeds of sheep and goat: Awareness and adoption regarding breeds of sheep and goats reached 69.12%, a high level that suggests farmers are increasingly conscious of breed selection and its impact on productivity. This indicates an openness to improving livestock quality, though continued education on breed-specific advantages could push this figure higher.

Housing and management: Housing and management practices were adopted at a very high rate (81.73%), suggesting farmers recognize the importance of proper animal housing for health and productivity.

Value addition of milk and meat: Value addition for milk and meat was adopted by 25.04% of respondents, indicating

low engagement in value-adding practices. This could reflect limited access to processing facilities or markets for value-added products. Training on processing techniques and potential market advantages could encourage higher adoption and improve income opportunities for farmers.

Table 3: Farmers' adoption of different technology in the training programme. (N =3546)

Category	Adoption level	
	Freq	(%)
Vaccination against contagious disease	2242	63.51
Deworming for parasitic control	2554	72.35
Cultivation of Green fodder	1274	36.09
Feeding of green fodder	1360	38.53
Feeding of Concentrate Mixture	1755	49.72
Breeds of sheep and Goat	2440	69.12
Housing and management	2885	81.73
Azolla feeding	668	18.92
Value addition of Milk & Meat	884	25.04

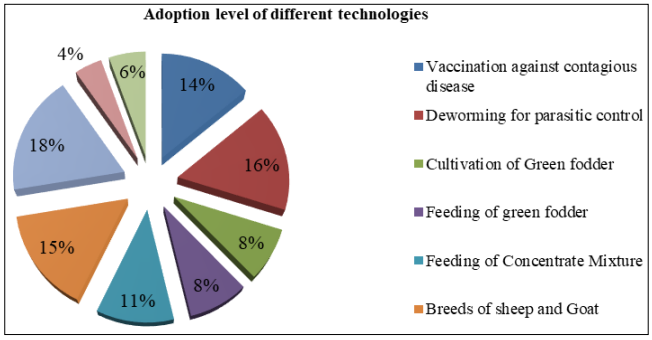

Fig 3

Impact on knowledge level: The study assesses the impact of various socio-demographic factors on the knowledge level of individuals after training, categorized into three knowledge levels: Low (<30%), Medium (>30<35%), and High (>35%). The overall chi-square analysis indicates that there are statistically significant differences in knowledge levels across different socio-demographic categories.

1. **Overall Knowledge Level**: After training, 51.71% of participants reached a high level of knowledge, while 34.42% were at a medium level, and 13.73% remained at a low level. The chi-square value of 64.12** ($p < 0.01$) indicates a significant difference in the distribution of knowledge levels across all factors combined.

2. **District-Wise comparison:** Knowledge levels varied across districts, with South Dinajpur showing a lower high-level knowledge proportion (45.81%) than Birbhum (54.80%) and Nadia (53.94%). The chi-square value (62.81**) for Birbhum shows a significant difference, indicating that geographic location impacts knowledge gain.

3. **Age group:** The young group (up to 30 years) and the elder group (above 60 years) had similar high knowledge levels (approximately 49.5%), with the "most active group" (30-60 years) reaching a slightly higher high-level knowledge score (49.92%). However, a chi-square value of 103.31** suggests a significant relationship between age and knowledge level, indicating that age impacts the capacity for knowledge retention after training.

4. **Religion:** Hindu participants had a slightly higher medium knowledge level (38.59%) than Muslim participants (37.14%). A chi-square value of 73.25** implies a statistically significant difference, suggesting that cultural or religious context may influence knowledge acquisition.

5. **Marital status:** Married individuals showed a higher percentage at the high knowledge level (50.66%) compared to unmarried (50.21%) and widowed (49.19%) participants, with a significant chi-square value of 57.54**, indicating a potential link between marital status and knowledge gain.

6. **Occupation:** Migrant laborers achieved the highest high-level knowledge score (57.01%), indicating that occupation type affects learning outcomes. The chi-square analysis (57.64**) supports this, suggesting that certain occupations may enhance or limit knowledge acquisition.

7. **Caste:** The Other Backward Caste (OBC) group had a slightly higher proportion of individuals at the high knowledge level (48.83%), with the chi-square value (62.63**) indicating significant variations in knowledge level distribution across caste groups, highlighting social factors that may influence learning.

8. **Education level:** Individuals with a higher educational background (graduate) achieved a higher medium-level knowledge (40.22%), and fewer remained in the low knowledge category. This result, supported by a chi-square value of 57.36**, underscores the influence of formal education on knowledge retention.

9. **Family type and size:** Joint families showed a higher percentage of individuals at the medium knowledge level (37.88%) compared to nuclear families (37.49%). Family size also impacted knowledge levels, with large families showing more variability across knowledge categories. The chi-square values (97.25** for family type and 56.21** for family size) suggest that family dynamics and size are associated with knowledge levels.

10. **House type:** Participants living in pucca houses and mansions demonstrated higher medium knowledge levels (40.53% and 41.21%, respectively), suggesting that housing quality is correlated with better knowledge acquisition. A chi-square value of 41.21** supports this finding, indicating that household stability may influence learning outcomes.

11. **Land holding:** Those with larger landholdings (above 2 hectares) had higher medium knowledge levels (40.25%), which implies that economic stability, represented by landholding size, is associated with improved knowledge acquisition. The chi-square value of 45.63** confirms a statistically significant relationship between landholding and knowledge level.

Impact on agriculture and supply chains: According to preliminary reports, the lack of migrant labour is causing certain harvesting efforts to be disrupted, notably in northwest India, where wheat and pulses are being picked. Supply chains are being disrupted because of transportation issues and other issues. Wheat, vegetables, and other crops have seen lower prices, but consumers are still paying more. According to accounts in the media, the lockdown has already slowed milk sales by closing hotels, restaurants, confectionery shops, and tea shops. The government published lockdown guidelines that exempt agriculture activities and supply networks, which is correct.

Impact on poultry

In terms of volume, India is currently the fourth-largest poultry producer. It is predicted that over 3.8 million tonnes of poultry meat were consumed in the country during the calendar year of 2019, with a retail value of around Rs. 85,000 crores [3-5]. Unlike most other economic sectors, the impact on India's poultry sector was much more obvious even before the country-wide lockdown was imposed. The recent clarifications made by several organisations that eating chickens is perfectly safe, however, may be able to persuade people to a large extent [9].

Impact on dairy

India has maintained its top position in the world, with milk output of 187.7 million tonnes in 2018-2019[6]. Sweet shops, which had been regular customers for numerous dairy farmers, are no longer able to obtain milk or cheese because their stores have been closed for the previous 112 months, and they are unsure how long they will have to wait to reopen. Due to a lack of other options, these farmers have been spotted milking their animals only once a day, resulting in significant financial losses. As a start toward controlling the spread of the COVID-19, numerous governments sealed their borders to prohibit automobile and migrant mobility. This further hampered the transfer of milk to customers, at least in border regions.

Impact on fisheries

Fish sales daily have been severely cut (85 percent -90 percent in Hyderabad). Fishing activities in marine fisheries have decreased by 6.33 percent, potentially resulting in a financial loss of Rs 9,378 crores (for 21 days). For local food security, integrated coastal agriculture should be supported through capacity building and research and development. The focus of research should be on non-fishery-dependent alternative diets that can be used to partially replace fish meal. Fresh fish should be stored in low-cost storage facilities. The focus in the future should be on the development and improvement of indigenous species (Source: Based on the information compiled by ICAR). Mental health disbalanced by COVID19 with special reference of fisheries community [10].

Conclusion

The findings suggest that socio-demographic factors, such as district, age, religion, marital status, occupation, caste, education, family type and size, housing, and landholding, significantly influence knowledge retention after training. The high chi-square values in multiple categories emphasize the importance of considering these factors when designing educational programs for diverse populations. Tailoring training to address these socio-demographic variations could enhance knowledge transfer and retention across communities.

Overall, the training proved effective in significantly improving livestock management knowledge, with potential for improved livestock productivity and animal welfare outcomes. It had a significant negative impact on the availability of livestock and poultry products for daily consumption by the public and all those who rely on the sector for their livelihood and/or income. The threat of an epidemic, which necessitated social isolation and the implementation of many preventive measures, as well as the lockdown situation, have taught each of us several lessons to be better equipped to deal with such situations in the next days and years. In this scenario, it is expected that the government will take all necessary steps to alleviate the distressing situations through effective governance, essential financial support, and the creation of a conducive atmosphere for the sector's revival and the livelihood of the connected stakeholders. The commercial sector, NGOs, and even ordinary citizens would all play important roles in this initiative.

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