

# Knowledge level of dairy farmers about bovine tuberculosis as neglected zoonosis

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**Abstract:** The study entitled “consciousness of dairy farmers about Bovine Tuberculosis as neglected zoonosis” was carried out between the periods of August to October 2020. A total of 180 dairy farmers from 36 villages of 6 talukas of Panchmahals and Mahisagar districts of Gujarat state (India) were randomly selected. Most dairy farmers (95.00%) had high to very high consciousness about bovine tuberculosis. The majority of dairy farmers had a medium to high level of knowledge (71.11%), a very high level of sensitivity (77.78%), and a favorable to most favourable attitude (95.55%) towards the control of bovine tuberculosis. Path analysis shows the maximum positive direct effect exerted by scientific orientation, mass media exposure, and education. Economic motivation, extension participation, and training exerted maximum indirect positive effects. Dairy farmers can enhance their consciousness about bovine tuberculosis through formal education and participation in social-extension activities using mass media, the internet, and other psychological variables. The research findings serve as a guideline for training institutions, researchers, planners, extension agencies, and concerned organizations to form effective & realistic training programmes to impart consciousness amongst dairy farmers about tuberculosis and other zoonoses.

**Keywords:** Attitude, Consciousness, Dairy farmers, Knowledge, Tuberculosis, Sensitivity, Zoonosis

## Introduction

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Tuberculosis (TB) is one of the zoonotic & re-emerging diseases which cause multi-billion-rupees loss and human death annually worldwide. The disease affects humans and animals caused by a group of bacteria called *Mycobacterium tuberculosis* complex of different species, including *Mycobacterium tuberculosis* and *Mycobacterium bovis* (Thoen et al. 2009). Bovine tuberculosis (bTB) is caused by *Mycobacterium bovis*, which is a highly prevalent infectious disease of cattle, buffaloes, and many wild species worldwide (Ameni et al. 2007; Le Roex et al. 2013). Bovine tuberculosis causes a significant economic impact accounting 10 to 25 per cent loss in productive efficiency in dairy cattle due to its chronic and progressive nature, often resulting in high morbidity in animals. The World Health Organization has classified bovine tuberculosis as one of the seven neglected zoonotic diseases having the potential to infect human beings, either by consuming raw milk, meat, and their products (Malama et al. 2013) or by direct contact or inhaling infective droplets of infected animals. There is a higher risk to dairy farmers who live in rural areas and keep animals. A direct correlation between *M. bovis* infection in cattle and the disease in the human population has been well documented. Srinivasan et al. (2018) revealed a pooled prevalence estimate of 7.3 per cent based on a random-effects meta-regression model, indicating that there may be an estimated 21.8 million infected cattle in India. In addition to being a threat to public health, bovine tuberculosis is also a significant economic concern, costing an estimated US \$3 billion worldwide annually due to losses from reduced cattle productivity, culling and movement and trade restrictions (Waters et al. 2012). The annual costs to farmers only from loss in milk production in cows and buffaloes in India are estimated to range between US \$375 and 544 million (Srinivasan et al. 2018). Rahman and Samad (2009) showed a 17% decrease in cow milk yield in Bangladesh. Boland et al. (2010) showed a significant decrease in milk production in BTB reactors in Irish dairy farms ranging from 120 to 573 kg milk loss per lactation. This implies that dairy farmers must be educated to acquire a higher level of consciousness and technical skills to prevent and control tuberculosis to avoid economic losses and animal and human health hazards.

## Materials and Methods

### Study area

The study was conducted in the Panchmahals and Mahisagar districts of Gujarat state (India) from August to October 2020. Panchmahals district has seven talukas (Jambughoda, Shehera, Godhra, Halol, Kalol, Morwa (Hadaf), and Ghoghamba). Mahisagar district consists of six talukas (Kadana, Virpur, Santrampur, Balasinor, Lunawada, and Khanpur). The cattle and buffalo populations are 3,35,220 and 4,34,464 in Panchmahals and 3,08,108 and 4,06,003 in the Mahisagar district, respectively (20<sup>th</sup> Livestock census, 2019).

### Study design

Three talukas were selected from the Panchmahals and Mahisagar districts based on the higher bovine population. Six villages from each taluka were selected randomly. Five dairy farmers were selected from each village randomly.

### Survey instruments

The independent variables of this research study were measured with the help of appropriate scales used by other researchers with due modification. To measure the consciousness of dairy farmers, a standardized scale was developed by Jadav and Patel, (2021), which is used. Consciousness means that the state of being awake, aware of what is around, and able to think. Consciousness is a term used to describe the awareness of one's physical and mental experience (Tononi and Koch, 2015). Knowledge about bTB and attitude towards control of bTB were measured with the help of a scale developed by the researcher, and sensitivity towards bTB was measured by the teacher-made scale.

### Knowledge, attitude and sensitivity score

In the knowledge score aspect, a weightage of 1 was assigned to the correct answer, and a weightage of "0" was given to an incorrect answer. The possibility of getting the knowledge scores ranged between 0 and 15 for an individual. Concerning sensitivity scores, 1 and 0 were assigned for correct and wrong responses attributed by a dairy farmer, respectively. There were a total of ten sensitivity statements for bTB. For the attitude score aspect, out of the 12 selected statements, eleven were positive and had indicators of a favourable attitude, and one was negative and had an unfavourable attitude. Items related to attitude were measured on a Likert scale ranging from 1 to 5 (1 = strongly disagree to 5 = strongly agree), with higher scores indicating the most desired attitude. The possibility of getting the attitude scores ranged from 12 to 60 for an individual.

### Data analysis

The arbitrary method categorizes respondents into very low, low, medium, high and very high categories. The coefficient of correlation ( $r$ ) was calculated to know the relationship between each of independent variables and dependent variable. Path co-

efficient analysis was used to know the direct and indirect effect of independent factors on the consciousness of dairy farmers about bTB (Wright, 1921). The primary data were collected with the help of a pre-tested Gujarati version of the interview schedule by personal interview, and then after it was compiled, tabulated, and analyzed to get a proper answer for the specific objectives of the study with the help of various appropriate statistical tools. SPSS 21 (IBM, USA) processed the collected data.

### Ethics statement

Researchers had verbal consent with respondents for the right of confidentiality of information that they provided us.

### Results and Discussion

Knowledge of dairy farmers about bovine tuberculosis, including the general part of disease, transmission route, symptoms in animals, symptoms in humans, and prevention & control aspects, was studied. The mean percentage score for knowledge was 62.00 (SD: 17.00). It can be observed in Table 1 that more than half (56.67%) of the dairy farmers knew that zebu cattle are relatively more resistant to bovine tuberculosis than exotic cattle. Humped cattle are considered to be more genetically resistant to bTB than non-humped cattle (Murray et al. 2013). The majority of dairy farmers (83.89%) knew that common feeding & drinking troughs are important sources of tuberculosis infection. Almost half of the dairy farmers (47.22%) knew tuberculosis could transmit through infected animals' faeces & urine. The majority of the dairy farmers (78.33%) had knowledge that poor hygiene and poor ventilation can contribute to the entry and establishment of tuberculosis. More than one-third of dairy farmers (40.56%) knew that TB-infected animal milk was unsafe for human consumption. A similar finding was obtained by Bihon et al. (2021), who reported that 42.9 per cent of cattle owners knew that ingesting raw animal products (milk and meat) was the mode of transmission of bovine TB. Many participants (66.9%) disagreed that pasteurization of milk before consumption prevents tuberculosis, as reported by Hailu et al. (2022). The remaining dairy farmers still believed that raw milk from TB-infected animals was safe for human consumption. This shows a need for more information about the transmission of bTB as neglected zoonosis among farmers, especially those who directly or indirectly contact livestock, and to put more emphasis on the consumption of pasteurised milk. They drink the raw milk of animals as they believe in the good taste of milk. There was 71.11 per cent of them knew that TB can be transmitted via the inhalation route. A contrast finding was reported by Bihon et al. (2021), who conducted a study in Ethiopia and revealed that only 7.1 per cent of cattle owners knew that bovine TB could be transmitted through inhalation. Almost half of the dairy farmers did not know that human TB could infect cattle or vice-versa. So, half of the dairy farmers still did not know TB as zoonosis. A similar finding was reported by Hailu et al. (2022) that 75.6 per cent of respondents disagreed

with the idea that tuberculosis can be transmitted from animals to humans and vice versa. More than two-thirds of them (72.22%) had known that bovine tuberculosis could be transmitted to other cattle animals. Addo et al. (2011) reported that only 33 per cent of the herdsmen knew about the mode of transmission of TB. Almost half of the dairy farmers knew about tuberculosis symptoms in animals, like loss of body weight, dry & painful cough, dyspnea,

abortion in late pregnancy, milk secretion gradually diminished, and infertility. Haemoptysis, cough, and loss of body weight are the symptoms of tuberculosis in humans which had knowledge by the majority of dairy farmers (73.33%). Addo et al. (2011) reported that coughing was mentioned by 77 per cent of the herdsmen as a symptom of TB in cattle, while 54 per cent noted it

**Table 1** Knowledge, sensitivity and attitude level of dairy farmers about tuberculosis (n=180)

| Sr.No.  | Knowledge statements   | No. (%) of respondents |
|---------|--|------------------------|
| 1       | Zebu cattle are relatively more resistant to bovine tuberculosis than exotic cattle.                                     | 102 (56.67)            |
|         | Transmission route   |                        |
| 2       | Common feeding and drinking troughs are important sources of tuberculosis infection.                                     | 151 (83.89)            |
| 3       | Tuberculosis can transmit through infected animal's faeces & urine.  | 85 (47.22)             |
| 4       | Poor hygiene and poor ventilation can contribute to the entry and establishment of tuberculosis.                         | 141 (78.33)            |
| 5       | TB infected animal's milk is not safe for human consumption.   | 73 (40.56)             |
| 6       | TB can be transmitted via inhalation route.  | 128 (71.11)            |
| 7       | Human TB is able to infect cattle.   | 90 (50.00)             |
| 8       | Bovine tuberculosis can be transmitted to other cattle animals.  | 130 (72.22)            |
| 9       | Bovine tuberculosis is able to transmit humans.  | 85 (47.22)             |
|         | Symptoms in animal (Suffering from tuberculosis)   |                        |
| 10      | Lose body weight, dry & painful cough and dyspnoea are the symptoms of bovine tuberculosis.                              | 89 (49.44)             |
| 11      | Abortion in late pregnancy, milk secretion gradually diminished and infertility are the symptoms of bovine tuberculosis. | 88 (48.89)             |
|         | Symptoms in human (Suffering from tuberculosis)  |                        |
| 12      | Haemoptysis, cough and lose body weight are the symptoms of tuberculosis in human.                                       | 132 (73.33)            |
|         | Prevention & control aspects   |                        |
| 13      | Tuberculosis can prevent through cleaning of feed and water troughs.   | 163 (90.56)            |
| 14      | Calves can be prevented from tuberculosis through providing pasteurized milk.  | 123 (68.33)            |
| 15      | Human TB is able to prevent by vaccination.  | 94 (52.22)             |
| Sr.No.  | Sensitivity statements   | No. (%) of respondents |
| 1       | Sensitive regarding the effect of tuberculosis on human health.  | 163 (90.56)            |
| 2       | Sensitive to wash your hands with soap before & after handling animals.  | 166 (92.22)            |
| 3       | Sensitive to avoid children handling diseased animals.   | 144 (80.00)            |
| 4       | Sensitive to avoid pregnant women to handle diseased animals.  | 135 (75.00)            |
| 5       | Sensitive to avoid handling the dung of animals with bare hands.   | 171 (95.00)            |
| 6       | Sensitive regarding cleaning and sanitizing the equipment used for handling milk.  | 172 (95.56)            |
| 7       | Sensitive to apply a face mask, hand glove, and use boot while handling animals.   | 166 (92.22)            |
| 8       | Sensitive to keep your animal sheds well ventilated & lighted.   | 168 (93.33)            |
| 9       | Sensitive to prevent overcrowding in animal sheds.   | 165 (91.67)            |
| 10      | Sensitive to keep animals suffering from tuberculosis away from the rest of the herd.                                    | 168 (93.33)            |
| Sr. No. | Attitude statement   | Mean Percent Score     |
| 1.      | I believe that tuberculosis can be eradicated from our country. (+)  | 80.44                  |
| 2.      | I feel that tuberculosis is hazardous to human health. (+)   | 84.44                  |

|     |  |       |
|-----|--|-------|
| 3.  | There is a lot of propaganda about the tuberculosis, but it is not so in a real situation. (+)     | 73.56 |
| 4.  | I would like to purchase tuberculosis -free animals for my farm. (+)                               | 79.89 |
| 5.  | I believe that tuberculosis is the current burning issue to handle seriously in dairy farming. (+) | 73.00 |
| 6.  | I believe that the sale of animals infected with tuberculosis is ethical. (-)                      | 64.22 |
| 7.  | I feel that constant monitoring is needed to control tuberculosis. (+)                             | 79.89 |
| 8.  | Tuberculosis -infected animals affect badly dairy farm income. (+)                                 | 81.78 |
| 9.  | I believe that tuberculosis can be successfully controlled through managerial practices. (+)       | 80.22 |
| 10. | I believe that vaccination is the right way to prevent tuberculosis. (+)                           | 82.33 |
| 11. | I feel that control of tuberculosis should be a prime goal of veterinary public health. (+)        | 80.00 |
| 12. | I believe that public awareness regarding tuberculosis is the need of hours. (+)                   | 81.44 |

(-) indicate the negative question asked to respondents.

**Table 2** Knowledge, Sensitivity & Attitude level of the dairy farmers about tuberculosis (n=180)

| Sr.No. | Knowledge category               | Frequency | Per cent |
|--------|----------------------------------|-----------|----------|
| 1      | Very low (up to 20.00 per cent)  | 1         | 0.56     |
| 2      | Low (20.01 to 40.00 per cent)    | 31        | 17.22    |
| 3      | Medium (40.01 to 60.00 per cent) | 62        | 34.44    |
| 4      | High (60.01 to 80.00 per cent)   | 66        | 36.67    |
| 5      | Very high (above 80.00 per cent) | 20        | 11.11    |
|        | Total                            | 180       | 100.00   |
| Sr.No. | Sensitivity category             | Frequency | Per cent |
| 1      | Very low (up to 20.00 per cent)  | 0         | 0.00     |
| 2      | Low (20.01 to 40.00 per cent)    | 6         | 3.33     |
| 3      | Medium (40.01 to 60.00 per cent) | 6         | 3.33     |
| 4      | High (60.01 to 80.00 per cent)   | 28        | 15.56    |
| 5      | Very high (above 80.00 per cent) | 140       | 77.78    |
|        | Total                            | 180       | 100.00   |

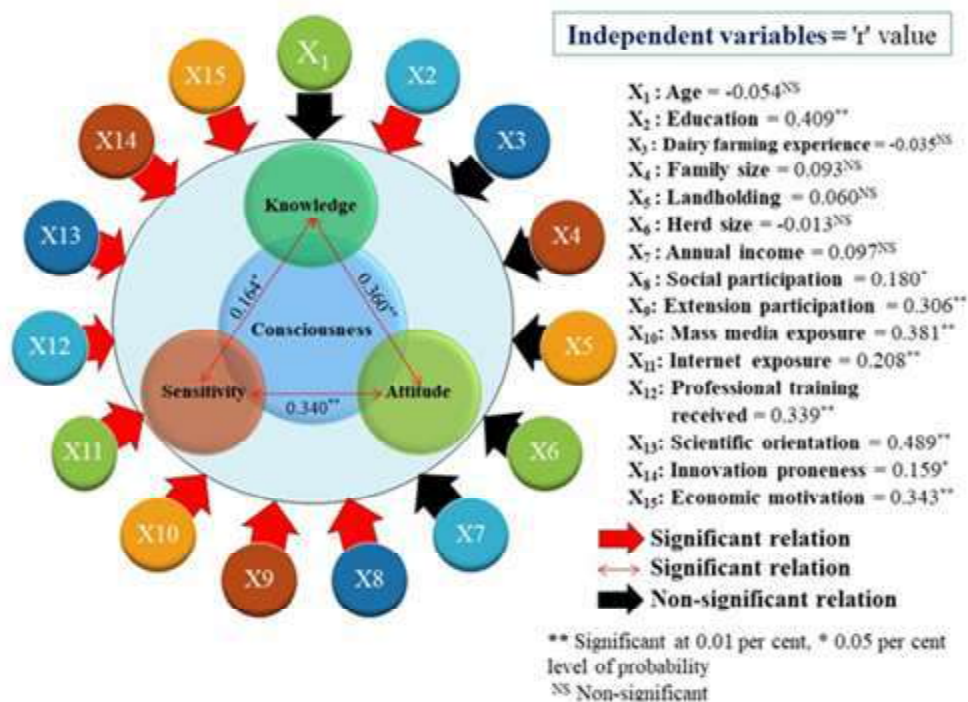
as a symptom of TB in men. They have enough knowledge about the prevention of tuberculosis through cleaning feed and water troughs (90.56%), providing pasteurized milk (68.33%), and vaccination (52.22%). The mean percentage score for sensitivity was 89.89 (SD: 14.22). The majority of dairy farmers (92.22%) were sensitive towards hand washing with soap before & after handling animals and using face masks, hand gloves, and boots while handling animals. Similar findings were reported by Cakmur et al. (2015) study in Kars, Turkey, which stated that 91.4 per cent of the farmers washed their hands. About 92.1 per cent of them thought to use gloves while contacting animals. Regarding using masks, 84.1 per cent of the participants considered it necessary. Regarding wearing water-resistant boots during contact with animals, 89.4 per cent of the farmers felt it essential.

The majority of the dairy farmers had a positive attitude toward the control of tuberculosis, like vaccination (82.33 Mean Percent Score), awareness (81.44 MPS), and constant monitoring (79.89 MPS). These observations were more encouraging than the finding of Bihon et al. (2021); they reported that two-thirds of cattle owners (67.60%) had a positive attitude towards vaccination against TB. Most dairy farmers felt tuberculosis was hazardous to human health (84.44 MPS). Two-thirds of cattle owners

(66.70%) regarded bovine tuberculosis as a significant public health threat reported by Bihon et al. (2021). Most dairy farmers (80.22 MPS) believed tuberculosis could be successfully controlled through managerial practices. Perceived health hazards effect of tuberculosis as a zoonotic disease on animals and human beings by the dairy farmers as well as economic losses caused by such a disease, the primary reasons for the formation of positivism toward control of tuberculosis might be the possible explanation for this result. The mean percentage score for attitude was 78.44 (SD: 9.30). The detailed analysis of knowledge, sensitivity, and attitude of dairy farmers towards control of tuberculosis is described in Table 1.

The data presented in Table 2 revealed that the majority of dairy farmers had a high (36.67%) to medium (34.44%) level of knowledge about tuberculosis. The government of India has run awareness programmes on tuberculosis for a long time, which might be the possible explanation for the high to medium level of knowledge about tuberculosis. Similar findings are reported by Thakkar, (2013). More than a third-fourth (77.78%) of dairy farmers had a very high sensitivity towards tuberculosis disease. A contrast finding is reported by Munisamy et al. (2017). More than half (58.33%) of dairy farmers had a favourable attitude towards

**Fig. 1** An empirical model shows the cause of independent variables on consciousness of dairy farmers about bovine tuberculosis



control of tuberculosis disease, followed by 37.22 and 4.45 per cent of them had the most favorable and neutral attitude towards control of tuberculosis disease. This is because most respondents were literate and understood the seriousness of tuberculosis disease's effect on human and animal health. A similar finding reported by Yadav et al. (2022) that women in India have moderately good knowledge and a correct attitude towards tuberculosis.

The majority (62.78%) of dairy farmers had a high level of consciousness about tuberculosis, followed by 32.22 per cent very high level of consciousness (Table 3). A contrasting finding was reported by Bihon et al. (2021) in Ethiopia, who stated that only 18.6 per cent of cattle owners had a good KAP (Knowledge, Attitude, Practice) score level. The knowledge of dairy farmers about tuberculosis as a component of consciousness is still working to enhance the consciousness level of dairy farmers regarding tuberculosis as zoonosis.

The Pearson correlation analysis was conducted to identify the relationship between factors affecting the consciousness of dairy farmers about tuberculosis and independent variables. In Fig. 1, out of fifteen independent variables, nine had established a positive and significant relationship with the consciousness of dairy farmers about tuberculosis. The result shows that the consciousness of dairy farmers about tuberculosis was significantly increasing with an increase in education, participation in social-extension activities & training programmes, exposure to mass media & internet with scientific orientation, innovation proneness, and economic motivation. This result is

in accordance with the observation of Mesfin et al. 2005; Bati et al. 2013; Bihon et al. 2021; Yadav et al. 2022 who stated that the education status of respondents was significantly associated with the KAP score of TB. The correlation between knowledge level with sensitivity level (0.164) and attitude level (0.360), and sensitivity with attitude (0.340) of dairy farmers regarding tuberculosis was found to be positive and significant. There was a non-significant relationship between age, experience in dairy farming, family size, landholding, herd size, and annual income with the consciousness of dairy farmers about tuberculosis as zoonosis. Cakmur et al. (2015) obtained a similar finding, which reported no statistically significant difference in knowledge-attitude-practice scores about zoonoses according to age.

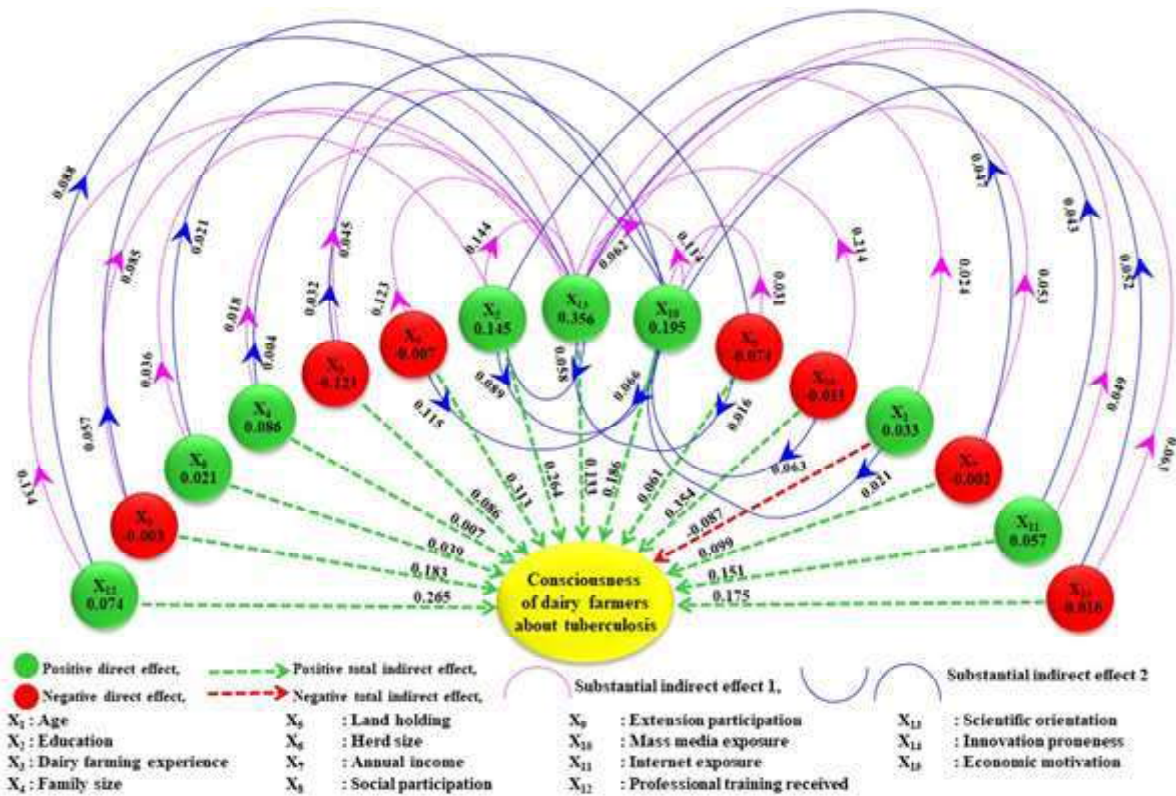
**Fig 2.**

**Path analysis - direct effect**

The data in Fig. 2 revealed that the major variables contributing the maximum direct positive effect on the consciousness of tuberculosis were scientific orientation (0.356), mass media exposure (0.195), education, family size, professional training received, internet exposure, age, and landholding in descending order.

**Path analysis - total indirect effect**

Fourteen variables had a positive total indirect effect out of fifteen on the consciousness of dairy farmers about tuberculosis. Further, it can be observed that economic motivation had a



**Fig. 2** Path diagram of direct and indirect effect of independent variables on consciousness of dairy farmers about bovine tuberculosis

maximum total indirect effect (0.354) through substantial indirect effect-1 [scientific orientation (0.214)] and substantial indirect effect-2 [mass media exposure (0.063)].

**Path analysis - substantial indirect effect**

Data further revealed that out of 30 substantial indirect effects, fourteen routed through scientific orientation, eleven through mass media exposure, four through education, and one through herd size.

To epitomize the result, scientific orientation and mass media exposure of dairy farmers was the critical variables in exerting a considerable direct and substantial effect on the determination of consciousness of tuberculosis. Economic motivation, extension participation, training, and education had exerted a higher indirect effect on dairy farmers’ consciousness about tuberculosis, as seen in Fig. 2. A similar finding was reported by Jadav and Patel, 2022 for the dairy farmers’ consciousness of rabies disease.

**Conclusions**

The majority of dairy farmers had high to very high level of consciousness about bovine tuberculosis. The majority of dairy

farmers had a medium to high level of knowledge and a very high level of sensitivity with favorable to most favorable attitude towards the control of bovine tuberculosis. Veterinary extension wings should organize training programmes to improve the knowledge of bovine tuberculosis, especially on prevention & control aspects to enhance the consciousness of dairy farmers about bovine tuberculosis through education, scientific orientation, mass media exposure, economic motivation, & extension participation.

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**Conflict of interest**

The authors have not any conflict of interest to declare.

**References**

20<sup>th</sup> Livestock Census (2019) All India Report: Ministry of Agriculture, Department of Animal Husbandry, Dairying & Fisheries, Krishi Bhawan, New Delhi, India.  
 Addo KK, Mensah GL, Nartey N, Nipah GK, Mensah D, Aning KG, Smits HL (2011) Knowledge, Attitudes and Practices (KAP) of herdsmen

- in Ghana with respect to milk-borne zoonotic diseases and the safe handling of milk. *J Basic Appl Sci Res* 1: 1556-1562
- Ameni G, Aseffa A, Engers H, Young D, Gordon S, Hewinson G, Vordermeier M (2007) High prevalence and increased severity of pathology of bovine tuberculosis in Holsteins compared to Zebu breeds under field cattle husbandry in central Ethiopia. *Clin Vaccine Immunol* 14: 1356-1361
- Bati J, Legesse M, Medhin G (2013) Community's knowledge, attitudes and practices about tuberculosis in Itang special district, Gambella region, south western Ethiopia. *BMC Publ Health* 13: 734
- Bihon A, Zinabu S, Muktar Y, Assefa A (2021) Human and bovine tuberculosis knowledge, attitude and practice (KAP) among cattle owners in Ethiopia. *Heliyon* 7: e06325
- Boland F, Kelly GE, Good M, More SJ (2010) Bovine tuberculosis and milk production in infected dairy herds in Ireland. *Prev Vet Med* 93:153-161
- Çakmur H, Akođlu L, Kahraman E, Atasever M (2015) Evaluation of Farmers' Knowledge-Attitude-Practice About Zoonotic Diseases in Kars, Turkey. *Kafkas J Med Sci* 5:87-93
- Hailu G, Etefa M, Begna F (2022) Assessment of Knowledge, Attitudes, and Practices (KAP): Public Health and Economic Burden of Tuberculosis in Jarso District of West Wollega Zone, Oromia, Western Ethiopia. *Biomed Res Int* 3314725:1-13
- Jadav SJ, Patel JK (2021) Consciousness of dairy farmers about leptospirosis disease as a zoonosis. *Indian J Dairy Sci* 74: 356-361
- Jadav SJ, Patel JK (2022) Consciousness of Dairy Farmers about Rabies an Oldest Zoonosis *Asian J Dairy and Food Res.* doi:10.18805/ajdfr.DR-1821
- Le Roex N, Koets AP, Van Helden PD, Hoal EG (2013) Gene polymorphisms in African buffalo associated with susceptibility to bovine tuberculosis infection. *PLoS One* 8: e64494
- Malama S, Muma JB, Godfroid J (2013) A review of tuberculosis at the wildlife-livestock-human interface in Zambia. *Infect Dis Poverty* 2:13
- Mesfin M, Tasew T, Tareke I, Mulugeta G, Richard M (2005) Community knowledge, attitudes and practices on pulmonary tuberculosis and their choice of treatment supervisor in Tigray, northern Ethiopia. *J Health Dev* 19: 21-25
- Munisamy B, Prejit, Sivanathan P, Kannan P (2017) Knowledge assessment through surveying on cattle zoonotic diseases in dairy farmers. *Int J Curr Microbiol App Sci* 6: 783-794
- Murray GGR, Woolhouse MEJ, Tapio M, Mbole-Kariuki MN, Sonstegard TS, Thumbi SM, Jennings AE, Van Wyk I, Chase-Topping M, Kiara H, Toye P, Coetzer K, deC Bronsvooort BM, Hanotte O (2013) Genetic susceptibility to infectious disease in East African Shorthorn Zebu: A genome-wide analysis of the effect of heterozygosity and exotic introgression. *BMC Evol Biol* 13: 246
- Rahman MA, Samad A (2009). Prevalence of bovine tuberculosis and its effects on milk production in Red Chittagong cattle. *Bangladesh J Vet Med* 6:175-178
- Srinivasan S, Easterling L, Rimal B, Niu XM, Conlan AJK, Dudas P, Kapur V (2018) Prevalence of Bovine Tuberculosis in India: A systematic review and meta-analysis. *Transbound Emerg Dis* 65: 1627-1640
- Thakkar AP (2013) Study on knowledge of dairy farmers of Anand district about zoonotic diseases. Dissertation (M.V.Sc), Anand Agricultural University, Anand
- Thoen C, LoBue P, Enarson D, Kaneene J, Kantor I (2009) Tuberculosis is a re-emerging disease in animals and humans. *Vet Ital* 45: 35-181
- Tononi G, Koch C (2015) Consciousness: here, there and everywhere? *Phil Trans R Soc B* 370: 20140167
- Waters WR, Palmer MV, Buddle BM, Vordermeier HM (2012) Bovine tuberculosis vaccine research: Historical perspectives and recent advances. *Vaccine* 30: 2611-2622
- Yadav BK, Singh P, Padhi BK (2022) Socio-demographic Determinants of Knowledge towards Tuberculosis Transmission among Women of 15–49 Years of Age in India. *Adv Public Health* 2141777: 1-8