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Analyzing Training Outcomes: An In-depth Study on Understanding, Attitudes, Procedures, Output, and Food Security

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Abstract

The dairy sector is vital to India's financial system since it supports millions of producers and meets the country's growing population's nutritional demands. Problems with milk quality, however, severe obstacles that impact public well-being and competition in the market. This study investigates how customized training courses can address concerns with milk quality for dairy producers in India. The training for this study, which took place between 2014 and 2020, was made to be brief, easy to administer, affordable, and customizable. It also included incentives to encourage changes in understanding, attitude, and Procedures (UAP). The following results were evaluated in 2021: milk production, mastitis prevalence, and altered UAP. A few specific food safety risks were assessed as well, despite the fact that the administrators had to receive any training. While there were no changes in the severity of food safety hazards, we discovered indications of enhanced UAP among educated farmers, 13.8% more milk produced, and an orientation of reduced mastitis. The results of this study demonstrate the potential medium-term effects of training interventions, but food security is an intricate problem that isn't likely to improve even with adequate instruction.

Keywords: Dairy sector, milk quality, understanding, attitude, and Procedures (UAP), food security

INTRODUCTION

The consumption of milk in developing countries is growing due to population expansion, urban expansion, and rising affluence. India, with a Community of over one billion individuals, has been the global producer of milk since 2018.An estimated 70 million Indian domestic units are involved in dairy farming (1). Around 75% of the rural Indian population depends on the dairy sector for a significant source of income, with 38% of them classified as impoverished. However, compared to other regions, the dairy industry in Bihar, located in eastern India, is progressing at a slower pace (2). In Bihar, the amount of milk available per person is comparatively low, with 69 grams per day, in contrast to the national average of 307 grams per day between the years (2018-2021).The informal market holds a dominant position, accounting for approximately 3% percent of the milk that passes by, surpassing the Heat-Treated Milk and dairy industry. Additionally, Milk farming plays a vital role in supporting the livelihoods of other stakeholders, such as dealers and traditional confectioners (3-5).

Milk is a highly perishable food that can become contaminated by bacteria due to its nutritional composition. It has the potential to transmit significant diseases, including tuberculosis and brucellosis. In Bihar, India, there have been documented cases of milk-borne infections (6,7). Residual antibiotics in dairy can promote the emergence of resistance, posing a growing risk to global healthcare. Consuming milk that contains aflatoxins, cancer-causing byproducts Generated by molds, can lead to stunted expansion, cancer, and reduced animal productivity. Mastitis is

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a common health issue that affects dairy production and results in significant production losses (8-10). This paper presents a training program developed to enhance the safety of milk. In Bihar, it includes findings from an assessment study that examines the impact of the training on Understanding, Attitudes, Procedures (UAP), productivity, and food safety.

RELATED WORKS

Study (11) examined the milk production facilities and recommended that they implement more effective cleaning and sanitation protocols to reduce the risk of contamination during pasteurization. They recommended using cutting-edge cleaning and sanitization techniques, including high-efficiency sanitizing agents and automated cleaning systems. As milk was a highly nutritious diet, dairy production facilities had constantly strive to enhance the quality and safety of milk in an ever-changing environment. They emphasized the need to innovate to stay ahead of their biggest rivals, bacteria.

Paper (12) proposed the use of "Wild Fermentations" involving polymicrobial. These methods had the potential to optimize the fermentation procedure to elevate its efficiency and enhance the overall quality of the end products. The investigation examined the market for Non-dairy milk, including its dietary, perceptual, and industrial dimensions. Additionally, it provided a detailed investigation of the innovative process of fermenting botanical matter using both single and mixed microbial populations. The demand for Non-dairy milk substitutes was rapidly increasing.

Article (13) discussed the unique characteristics of the dairy industry chain and examined China's crucial choices for enhancing dairy safety. The dairy industry chain and its accompanying safety assurance structure underwent a transformation. The dairy industry's supply chain moved from a decentralized and loose structure to a centralized and compact one. Additionally, the safety assurance organization structure transitioned from sectional supervision of multiple agencies to centralized monitoring. As a result, the quality and safety of dairy products significantly improved.

Study (14) presented effective strategies to reduce safety risks in the dairy supply chain in Africa. They suggested that official regulation bodies should establish appropriate Country-specific safety regulations, conduct observations, and implement measures to ensure compliance, such as effective enforcement schemes for smallholder dairy chains. Dairy chain participants would benefit from better knowledge and training in preventive measures, including "good agricultural practices (GAP), hazard analysis and critical control points (HACCP) design and implementation, and good hygiene practices (GHPs)". Finally Enhancing students' comprehension of food safety and advocating for safe food handling practices is imperative.

Study (15) provided a detailed investigation of the quality of raw milk affected processed dairy products. According to the study, dairy producers were incentivized with financial bonuses to provide processors with high-quality milk. Dairy farmers could use various techniques to meet and exceed quality standards, thereby aligning themselves with the incentive programs. Processors could allocate resources towards technologies and methods that improved efficiency and product quality. The collective result was a collaborative effort to improve the quality of raw milk, which ultimately had a positive impact on the quality of dairy products available to consumers.

Paper (16) focused on the substances produced when kefir was made, such as lactic acid, ethanol, carbon dioxide, and fragrance molecules like acetoin and acetaldehyde. The suggested examining changes in the microbiological, physicochemical, and sensory properties of kefir during storage to enhance its shelf life. To accomplish these goals, dairy experts could use various methods, including sophisticated data analysis techniques to develop models for comparing products, identifying the most effective additives, and achieving optimal kefir attributes.

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Article (17) explored the potential of supercritical carbon dioxide (SC-CO_2) technology in the domain of milk and dairy processing.The covered various aspects such as historical background, significant advantages, microbial inactivation processes, and the impact on various quality parameters of dairy products. The use of supercritical carbon dioxide (SC-CO_2) was expected to enhance the safety and quality of dairy products by reducing microbial contamination.

Research (18) aimed to the consumption patterns of fresh cow's milk in households that produced dairy products. It examined the consumption habits of such households by analyzing research data and conducting key informant interviews. The goal was to promote sustainable family milk production and enhance milk productivity through the assistance of dairy extension services. The superior resulted in an increased level of milk consumption.

Paper (19) aimed to enhance the quality and safety of dairy products by proposing a potential method for delivering food preservatives. The researchers proposed that the incorporation of nanostructures could enhance the mechanical, barrier, and functional properties of packaging materials. Thus preserving dairy products more effectively. They explored diverse applications and potential benefits of nanostructures in preserving dairy products. Therefore, there was a need to enhance the development of new, practical, and cost-effective techniques for the large-scale production of these materials. They improved the availability of superior and groundbreaking dairy products.

Article (20) investigated the knowledge, attitudes, and implementation of milk quality and food safety measures among small-scale farmers in Kenya, specifically in the counties of Laikipia, Nakuru, and Nyandarua. The study collected qualitative data through ten Focus Group Discussions (FGDs). The research used both qualitative and quantitative methodologies to evaluate the knowledge, attitudes, and practices (KAPs) that led to behavioral modification and ensured that customers received milk and dairy products that were uncontaminated and safe.

Execution of the training process

The study started by investigating the current Unidentified Aerial Phenomenon (UAP) in the informal milk market in Bihar. This was done by conducting 10 focus group discussions (FGD) with a total of 162 participants in four districts: Patna, Gaya, Muzaffarpur, and Bhagalpur. The Non Governmrntal Organization (NGO) FARMER conducted FGDs in Biharese to explore the specific requirements of farmers and traders.

Between 2015 and 2017, a training program was conducted in the Patna region, which included both urban and suburban areas located around the state's capital, Hajipur. The training sessions were scheduled at convenient times and locations, ranging from midnight to 3:30 PM, to accommodate the availability of traders and manufacturers. The venues were selected considering the preferences of the target audience and included local organizations, social centers, educational institutions, and churches.The participants underwent training provided by commercial and agricultural organizations to enhance their knowledge and skills.

In 2018, a customized training session was organized to meet the specific needs and expectations of dairy farmers. The training program focused on essential aspects such as food safety, hygiene, corporate responsibility, dairy production, and customer satisfaction. Despite their diverse backgrounds, all participants actively participated in the five-day program, which was designed specifically for dairy producers. The training covered several topics, including the importance of ensuring the safety of milk, identification, and control of bacterial sources, proper maintenance of cowsheds, methods to maintain cleanliness while milking, and strategies to prevent infections.During the training session, various techniques were utilized to improve the participants' understanding. The methods used in included group discussions, practical exercises, real-life scenarios, and evaluations of milk quality. Public media was also employed to support the training efforts. The involvement of dairy producers' and merchants' associations was crucial as they greatly facilitated active participation among the attendees. To assess the

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effectiveness of the training program, participants were required to fill out assessment forms before and after the training sessions.

Farms selected to participate.

The evaluation covered five of Hajipur's urban and periurban areas. The seasoned "farmers" were chosen at random from a roster of the skilled "farmers" in every area. A local adviser assisted in creating a list of unskilled farmers in each location, after which farmers were chosen at random. A random selection of 55% of the subgroup was selected for further milk samples and mastitis evaluation.

Acquisition of Data

Farmers were requested to provide their Present mean daily milk output as well as their mean milk output previous to instruction or three years before the research visit if they had not been trained.Data regarding farmers' awareness of animal health, milking procedures, and willingness to consume milk from cows receiving antibiotic treatment were gathered. Samples were taken in order to test for mastitis and look for antibodies against Brucella abortus, antimicrobial residues, aflatoxins, and mastitis pathogens. Additionally, cows were examined for any signs of mastitic infection and hidden mastitis using the "California Mastitis Test (CMT)," a "pen-side test." Clinical mastitis was diagnosed based on the presence of aberrant milk composition and a swollen, complex, or warmed udder. Subclinical mastitis was defined as a rise in "CMT (CMT score > 2)" despite any observable symptoms of inflammation. For every cow, a simple clinical form was also filled out. The clinical sheet contained details on udder cleanliness eat lesions, parity number, and lactation stage. The score for urinary hygiene was rated from one to four.

Analytical tests in Laboratories

Using a lateral flow test method, the Charm EZ platform was used to analyse antimicrobial residues and aflatoxin. Each cow's milk sample was examined for aflatoxin. Following the aflatoxin test, every piece taken from a single estate was combined and analyzed for antibacterial residues "tetracycline, β-lactams, quinolones, sulphonamides, gentamicin & macrolides, neomycin & streptomycin, chloramphenicol."Using individual milk samples, the Brucella "Milk Ring Test (MRT)" was utilized to check for the detection of brucellosis antibodies in milk.Samples were kept frozen if testing could not be completed instantly. For every 3 ml of milk sample, three drops of pre-stained abortus Brucella antigen were added, and the samples were then incubated at 38 °C for 46–58 minutes. Following a visual inspection, the samples were scored on a scale between 0 and 3, with 1 denoting a weak positive and 0 being negative.

Data analyses

Statistical analysis was conducted using STATA 14 (StataCorp, Texas, US) for data entry and management. A p-value of 0.06 and 96% confidence intervals (CI) were used to determine statistical significance.Prevalence of subclinical and clinical mastitis was determined at the cow and one-fourth levels for every dairy cow, cattle on farms with trained practices, and cows in untrained farm settings, depending on the CMT result and clinical findings.The CMT ranks were tallied using summary statistics, and a "$\chi 2$-test" was employed to analyse the data to determine whether trained and unskilled farmers differed significantly from one another.

The survey provided information on the projected mean daily milk output yield per cow. Before receiving training, milk producers were questioned about their output, and if they hadn't, they were asked about their circumstances two years prior. Each cow that was investigated did not have its milk output recorded; instead, a median was determined by splitting the entire farm yield by the cow count that was lactating.A two-sample paired t-test was used to evaluate

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the average production of milk per cow between trained & untrained milk producers, each farmer's past and current milk yield.

RESULT

A course of training

The benefits that traders planned to get from training and the ones that mattered them were found during our very first evaluation of their needs.In decreasing order of significance, the outcomes were: increase in social acceptance; more milk consumption; reduced spoilage losses; Greater expense; Career openings; Lowered intimidation and informal payments; learning how to safeguard one's own and one's family's health; obtaining business development services; keeping customers; rectifying the lousy reputation of milk and opening up new business opportunities.Out of an estimated 300 dealers and 600 producers, 270 traders & 485 producers received training in Hajipur of 2016. Up to that point, the intervention had cost approximately INR 31,00,000 in total, which included material development, trainer training, field training, and surveillance INR 16,00,000 for training as well as monitoring, with the remaining amount going towards creating training materials and designing training courses. According to a post-training evaluation, the majority of participants said they were happy with the training programme, giving the training an average score of 9.1 out of 10.

The effect of the intervention on practices and knowledge

In order to evaluate the effectiveness of the intervention, 160 farms in all (78 trained & 82 non-trained) participated in the study. With 96% of the participants being trained (n = 75) and 97% being non-trained (n = 80), males made up the majority of participants. On average, 13 nursing cows were owned by inexperienced and trained farmers. The median number of nursing cows on the taught farms was 14, ranging from 4 to 36. There were from 3 to 45 nursing cows on the unskilled farms, with an average of 13 cows.The most frequent illnesses mentioned by farmers were laminitis (8.4%), mastitis (13.8%), in appetence or emaciation (7.0%), and reproductive issues (9.7%). When asked if they saw a difference in their cows' health status, 88% of the trained farmers (64/78) stated they did, whereas the other nine farmers who responded did not detect any changes in their cows' health. The farms without training, 12 believed that their cows had less healthy than two years prior, while 53 reported no change. Out of the unskilled responders, four believed that the cows had improved in health during the previous two years.In general, trained farmers knew more about the risks associated with milk and the ways in which infections could spread as shown in Tables (1), (2) and Figure (1) and (2).

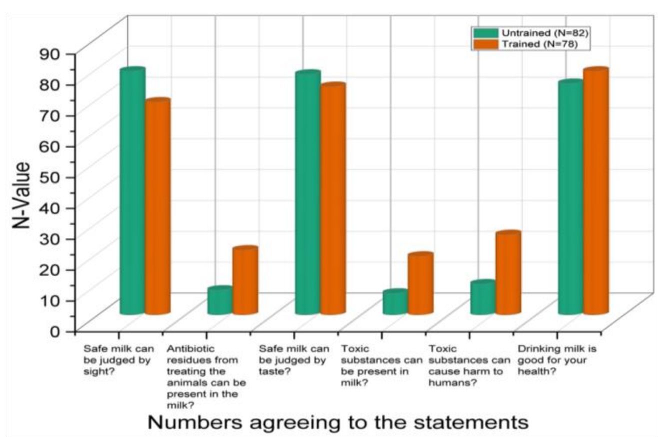

Figure (1). Understanding and attitudes of milk producers in Bihar (Source: Author)

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Table (1). Understanding and attitudes of milk producers in Bihar (Source: Author)

Concurring with the statements	**Untrained (N=82)**		**Trained (N=78)**	
	N-value	**percentage**	**N-value**	**percentage**
Safe milk can be judged by sight?	79	97	69	93.2
Is it possible for the milk to contain antibiotic residues from the treatment of the animals?	8	10.5	21	28.4
Can the safety of milk be determined based on its taste?	78	96	74	99.7
Is it possible for toxic substances to be found in milk?	7	7.9	19	25.7
Toxic substances inflict harm upon humans?	10	14.2	26	36.1
Is the consumption of milk beneficial for your health?	75	99.7	79	99.7

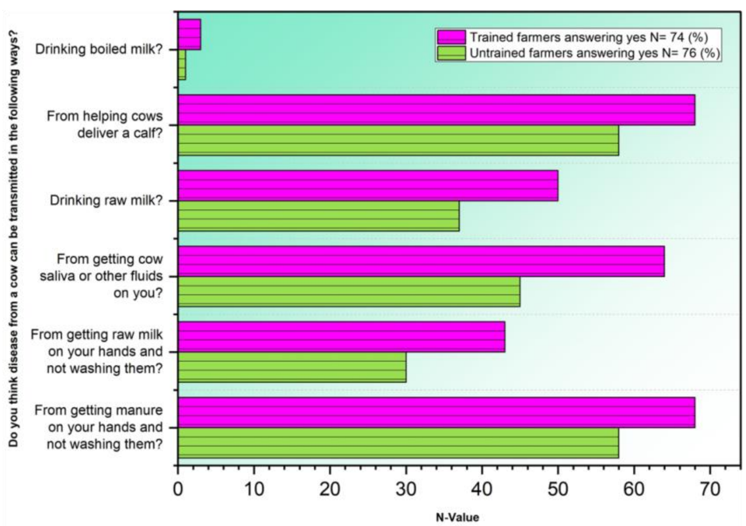

Figure (2). Understanding and attitudes of dairy farmersin Bihar (Source: Author)

Table (2). Understanding and attitudes of milk producers in Bihar (Source: Author)

Can diseases from a cow be conveyed through the following means?	**Untrained "Farmers" responding affirmatively. N= 76**		**Trained Farmers responding affirmatively. yes N= 74**	
	N value	**percentage**	**N value**	**percentage**
Can diseases be transmitted "from getting manure on your hands" and neglecting to wash them?	58	77.4	68	91.6

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Is it possible to contract diseases “from getting raw milk on your hands” and failing to clean them?	30	39.3	43	57.9
Is there a risk of contracting diseases “from getting cow saliva or other fluids on you”?	45	61.2	64	86.2
Drinking raw milk?	37	48.4	50	77.3
From helping cows deliver a calf?	58	77.4	68	91.6
Drinking boiled milk?	1	1.35	3	4.05

According to data gathered from farmer knowledge, the taught farmers had considerably more accurate answers (9.97) than the untrained farmers (8.26) ($p < 0.01$).99.2% of trained farmers and 97.2% of unskilled farmers stated that they cleansed their udders before milking.However, after milking, only 48.4% of untrained farmers and 74.0% of farmers with training indicated cleaning ($p = 0.001$). Every farmer reported use water for cleaning, with no use of disinfectant noted. Every farmer trained or not, cleaned the milking implements after each milking.The majority (96%, n = 74 ;%) for trained & 93.4%, n = 73 non-trained) said they did not use cow's milk when taking antibiotics. A tiny fraction of non-trained (6.6%; n = 6) and trained (2.9%; n = 3) had sold milk from cows that had received antibiotic treatment. Seven additional farmers, two trained and five unskilled, stated that they did not discard the milk from cows that had undergone treatment; rather, they did not sell it. Aflatoxin-related harm to people was more widely known by trained farmers (23%; 16/78) than untrained farmers (8%; 8/78) ($p < 0.001$).

Effect of interventional training on the quality of milk

Milk from the majority of farms contained measurable levels of antibiotic residues; 87.6% of the tested samples were positive for aminoglycosides.The second most prevalent (found in 23.8% of the model) was sulphonamides; the remaining compounds were found in less than 4% of farm milk. There was no discernible difference in the outcomes between the trained and untrained groups.Aflatoxin levels over 502 ng/kg were detected in 20 of the 320 (4.5%) of the cows that were tested. The test's highest amount 760 ng/kg was present in two of the cows. In comparison to the untrained group (8/172, 4.3%), the group with training had a more significant percentage of positive cows (15/140, 8.2%), a statistically significant difference ($p = 0.03$).

Antibodies against Brucella abortus were evaluated in 466 cows at 143 farms in total. One or more of the cows on 127 (89%) of the aforementioned farms tested positive for brucellosis, from 25% to 100% of the animals on positive farms tested positive, out of 460 milk samples, 192 (43.8%) had a negative test score of 0 and 275 (61.2%) had a positive test score of 2-4. Farmers had received the instruction, and the ratio of animals testing positive did not differ among those who had and those who had not

The effect of the training program on milk yield.

The average daily production of milk per cow for untrained farmers was 7.9 L at the point of the 2021 assessment, whereas the mean daily milk yield per cowfor trained farmers was 7.7 L, as shown in Table 3.

Table (3). The average daily production oftrained and untrained farmers (Source: Author)

Metrics	Trained Farmers		Untrained Farmers	
	Value	**Range**	**Value**	**Range**
The current count of cows currently lactating.	14.2	4–35	12.1	3–47
The quantity of cows producing milk two years prior to undergoing ILRI training.	14.8	5–31	12.4	3–50
The current daily average milk yield per cow in liters.	7.7	3–15	7.9	2.5–14
"The mean daily milk output in liters per cow two years ago, prior to receiving ILRI training".	8.1	3.5–13	7.8	2.6–15

Thus, compared to untrained farmers, taught farmers produced more milk (13.8%). The probability value (p) is less than 0.01. Following the training, trained farmers provided information or communicated higher milk output. The average yield of milk per individual cow in farm settings involved in the "training" was 7.9 ± 3.0 L, which was considerably more significant than the mean milk yield For each cow on the farms excluded from the training (7.8 ± 2.3 L) ($p < 0.01$). Following the training, milk output increased by 8.4 liters per cow day from 7.4 liters before, representing a 9.8% increase for the farms that were part of the program. Conversely, inexperienced farmers declared a 12.4% drop in lacteal production during the preceding two years.

180 cows were checked for mastitis in total; 7.2% of them had the disease in the clinical stage, and 51.6% showed sub-clinical illness at least one quarter.45.6% of Cattle in instructed farms and 58% of "cows on untrained farms" had subclinical mastitis. 2.6% of cows at the quarter stage (n = 702, although some did not milk every quarter) had mastitic infections. In comparison, 27.6% had hidden mastitic disorder (CMT score greater than 2)".There was a substantial correlation ($p = 0.08$) between the CMT scores of "trained and untrained farms," with trained farms having a lower CMT score. According to the findings of the bacterial analysis, the most prevalent microorganisms on the quarter levels for hidden mastitic infection (n = 182) were staphylococcal bacteria (absence of coagulase production, n = 57, and Staph aureus bacteria, n = 15), then streptococci (Streptococcus dysgalactiae, n = 11), n = 43.

DISCUSSION

The results of the training program are detailed in this publication, including possible enduring effects on food security and safety.Despite brief pauses in the training sessions, the monitoring and training program has continued, and a sizable fraction of all milk traders and producers in the district that had access to it participated in the intervention. One significant development result is the expansion of the effort, which was started by the Bihar government and funded by the World Bank, to 16 districts in Bihar.

Trained farmers estimated a 12% rise in production two years following training, while untrained farmers reported a 12% drop. This leads to higher milk production, resulting in an extra 9 ltr of milk per day for an average Hajipur farm with 13 lactation cows, or an additional 322 INR per day, or 3.88 USD, in 2018. In addition to enhancing consumer access to milk, a rise in milk output would have a significant effect on farmer economies, as over 92% of farms rely primarily on milk production for revenue. We do not anticipate biased results because there is no explanation to believe that "trained farmers" would exhibit more significant bias than "non-trained" counterparts. However, there is a chance that inquiring farmers to remember past dairy Farming could introduce inaccuracies.One of the main obstacles to the production of dairy products is mastitis. While the hygiene instruction provided by this intervention was beneficial, a greater focus on mastitis prevention should be incorporated into future training.

The results show that farmers should be encouraged to maintain hygienic standards since mastitis prevention is a significant motivator. According to our research, S. aureus was identified in cases of clinical mastitis. We also discovered considerable brucellosis seropositivity. Comparing the current study to other earlier research conducted in India, a greater seroprevalence of brucellosis is found. The training ignored the handling of the risks analyzed; however there was no variation in the amount of zoonotic diseases detected. High amounts of residual antibiotics in the milk were found in this investigation, which may point to antimicrobial overuse. The training did not specifically touch this subject, and no unintended consequences were apparent. The skilled farmers had higher levels of aflatoxins, which would have indicated a .significant reliance on concentrate feeding.

CONCLUSION

The dairy industry was vital to the country's economy as it provided food for millions of farmers and met the country's growing population's nutritional demands. However, problems with milk quality were an essential obstacle to public health and market competitiveness. This study demonstrated that an intervention aimed at enhancing milk production hygiene to promote food safety did indeed enhance behaviors and likely lessened disease linked to improper handling. The gains could improve food security in milk output and revenue. Our analysis revealed that improving hygiene didn't always increase milk safety and that additional instruction and rewards might have been needed to target particular risks. Incentives were essential for behavior change to be sustained. The project aimed to implement a number of incentives, such as increased output, better ties with the administration, and Social expectations from associations. According to the subjective evaluation, trainee engagement required the active support of the dealers' and producers' organizations. Furthermore, the collaborative collaboration between governmental entity representatives and underground economy participants lessened the overall distrust between the two groups of people, which was seen to be one of the main obstacles to the initiative's successful implementation. It was crucial to involve outside groups like ILRI to close the current gap and create a friendly, supportive, and trusting environment.

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