**Supplementary table 5:** Results of Framework Analysis: Identified categories with selected examples

|  |  |
| --- | --- |
| **I. INNOVATION DOMAIN** | |
| **CFIR constructs** | **Categories and examples based on interviews and literature [identifier]** |
|
| **A. Innovation Source** | **Trusted innovation sources:** The interventions for animal source food safety that were reported in this study were primarily undertaken by government and government-affiliated institutions, such as the Ministry of Agriculture (MoA), Ministry of Health (MoH), Ethiopian Institute of Agricultural Research (EIAR), and Ethiopian Food and Drug Administration (EFDA). Additionally, development partners, academic institutions, and city administrations were involved, as determined by the type of data provided during interviews to support the claims made.[ID02, ID03,ID04, ID04, ID05, ID06, ID07, ID 09, ID10, ID12, ID13, ID14]  **Lack of supporting data:** Two of the sources were unable to substantiate claims and hence only data that could be triangulated through at least one other trusted source was considered. [ID01,ID11] |
| **B. Innovation Evidence-Base** | **Robust locally relevant global data:** The ENSHURE project was initiated in response to data from the global Food-borne Epidemiology Research group (FERG), which is based at the World Health Organization (WHO). This data identified 31 pathogens as potential food safety risks. The ENSHURE project specifically targeted the milk value chain and identified high-risk areas for specific pathogens, including Salmonella, Campylobacter, Listeria, and E. Coli. The project also included training for value-chain actors. An independent group evaluated the impact of the intervention by comparing the results before and after the training. They found a statistically significant reduction in total coliform counts, from 71% to 62%, and improvements in the raw milk's bacteriological quality.[ID13, GL018, GL019].  **Pre-assessment data for the specific interventions:** The AAU-ILRI intervention on milk handling and safety training was implemented in selected areas due to high consumption of raw milk and traditional storage practices which were assessed as a food safety risk and the team conducted pre-training assessment as baseline to study intervention effect. The pre-assessment revealed high knowledge, poor attitudes and incorrect practices among pastoralist women regarding milk hygiene and milk-borne diseases. Post-training assessments found significantly improved knowledge, attitudes, and practices although they found no significant difference between container type or wood type used for smoking on the impact of smoking on microbial load in fermented milk. Hence, the intervention was discontinued and did not contribute to an innovation. Moreover, budget limitations prevented a follow-up of the continued impact on knowledge and attitudes.[ID12, GL02, SL02].  **Proven effectiveness in another context:** A single study on export abattoir found that spraying goat carcasses with 2.5% acetic acid significantly reduced total E. coli count by 1.18 log10 CFU/ cm2 compared with carcasses before spray with acid. This is not yet an innovation but is being tested further by other research groups.[SL03]. |
| **C. Innovation Relative Advantage** | **More effective and standardized practices:** Current standard practice in all abattoirs in the country include the use of detailed meat inspection protocols developed by World Organization for Animal Health (WOAH). Detailed meat inspection is a better procedure for detecting tuberculosis lesions than routine meat inspection, as a significant proportion of infected carcasses passed undetected during routine inspections. A study at Debre Birhan municipality abattoir revealed an overall prevalence of bovine tuberculosis (bTB) in slaughtered cattle of 4.7% based on detailed meat inspection, as compared to only 0.5% identified through routine meat inspection (which was usual practice prior to the implementation of the detailed inspection). The sensitivity of routine meat inspection was notably low at 11%, indicating an 89% probability of missing animals with suspected TB lesions. In contrast, detailed meat inspection demonstrated high specificity, enhancing lesion detection efficiency. [SL01 ]  **Demonstrating difference between perception and reality:** In routine milk handling practice and cleaning of milk containers, the use of Glo Germ was found to be particularly useful in teaching proper handwashing techniques during food safety training sessions. The participants were able to differentiate between their perception of cleanliness and the reality of unclean spots highlighted by Glo Germ. However, Glo Germ is not easily accessible, hence its utility in training programs has been limited.[ID13, GL108] |
| **D. Innovation Adaptability** | **Adaptation of demonstrated good practice:** SNV supported the Oromia regional bureau in the development and enforcement of directives for milk quality and market regulation, which saw an improvement in milk safety, adulteration and marketing practices. SNV is currently supporting the Amhara region to adapt the directives to their context.[ID08, GL017, GL015,GL016] |
| **E. Innovation Trialability** | **Testing on small scale:** The AAU-ILRI training on milk and technology transfer is only for research purposes and not for development, hence it was tested on a small scale and subsequently discontinued when no effect was found.[ID12, GL02]  **Resource sharing for future scale-up:** The ENSHURE project based on their work (described above) submitted all relevant documents and training materials to the government for scaling up the intervention on food-borne pathogens and hygienic handling of milk.[ID13,GL018] |
| **F. Innovation Complexity** | **Multi-component interventions to address whole value chains:** The complexity of the ENSHURE project included training for regulators, farmers and processors who represented a range of actors sampled across Addis Ababa in the milk value chain for whom the training program (intervention) was adapted and implemented in order to improve milk safety. The training manuals for each value chain actor, Standard Operating Procedures for laboratory diagnostics and communication material for milk handling and safety were made available to the research team.[ID13, GL018] |
| **G. Innovation Design (Type)** | **1. System capacity innovations:** Focuses on institutional capacity building through training, equipment or financial support. Establishment of a dedicated institute (Ethiopian Agriculture Authority) for food safety; Standards for domestic abattoirs. Capacity building for human and infrastructure, including material provision and training, adopting a value chain approach for meat and milk by USAID and ENSHURE. [ID01, ID02, ID03,ID06, ID08, ID09, ID13, GL07, GL08, GL09, GL10, GLO12, GL013, GL014, GL015, GL016,GL017, GL018, GL20, GL21, GL022, SL04]  **2. Workforce and value chain capacity innovations:** This isdifferentiated from system capacity as innovations that focus is on individual capacity building through training programs or protocols. Curriculum development for an MSc degree in Meat Processing Technology by LDI in collaboration with Mekelle university; Training of trainers (ToT) programs on meat handling and hygiene to disseminate knowledge and skills by University of Florida and ILRI; Training manual on milk safety, handling practice and lab diagnosis in different languages by ENSHURE; Training on certified meat inspection by MoA in collaboration with AAU-CVMA; Pilot training program focused on milk hygiene, including the development of a training manual and questionnaires by a multi-country East Africa consortium including the Holeta research institute in Holeta, Ethiopia.[ ID01,ID02, ID04, ID05, ID06, ID08, ID09, ID10, ID11,ID12,ID13, ID14, SL02, SL04, GL03, GL04, GL05, GL06, GL010, GL014, G015, GL016, GL017,GL018, GL019, GL022]  **3. Hygiene and safety practice innovations:** Implementation of a 10-year plan to improve milk and milk product safety and accessibility for consumers by MoA; Awareness creation on quality and safe milk production, handling, and promotion of milk consumption by MoA and GAIN; Meat and milk safely handling and production inspection by EFDA and Addis Ababa Urban Agriculture. [ID02,ID07, ID08, ID09,ID11, ID13, ID14, GL07, GL20, GL21, GL022, GL018]  **4. Technology and technique innovations:** Evaluation of the best practice identifying TB case comparing routine and detailed meat inspection in abattoir; and the use of application of 2.5% acetic acid on meat to reduce bacterial load by AAU (College of Veterinary Medicine). [ ID08, ID012,ID13, SL01,SL03,GL017, GL018, GL019, GL020, GL021 ]  **5. Financial and technical innovations:** Support from SNV to Oromia regional bureaus and FDA through technical and equipment support for the implementation of directives on milk safety; USAID provided bank loans to support milk value chain activities for dairy value chain actors.[ID04, ID08, ID09,ID11, ID012, SL01,SL03,GL017, GL019, GL020, GL021]  **6. Policy and strategy innovations:** Collaboration with other relevant stakeholders for development of Food safety strategy for primary agricultural products by MoA; Development and enforcement of directive for milk marketing proclamation by SNV; Policy briefs on public-private partnerships (PPP) to facilitate collaboration in the food safety sector by Tuft University in collaboration with MoA; Draft policies and regulations on livestock trade, meat inspection and safety and animal welfare by MoA.[ID01, ID03, ID08, GL07, GL08, GL10, GL011, GLO12, GL013] |
| **H. Innovation Cost** | **Source of funding:** For the implementation of innovation, the sources were predominantly the government, externally-funded projects and development partners like FAO. All [ID01- ID14,SL01-SL04, GL01-GL-023]  **Funding-related challenges:** include insufficient Government Finance for sustainability of the innovation; research and laboratories having no independent budgets for food safety; and resource deficiency in domestic abattoirs for standards compliance. All [ID01- ID14,SL01-SL04, GL01-GL-023]] |

|  |  |
| --- | --- |
| **II. OUTER SETTING DOMAIN** | |
| **CFIR constructs** | **Categories and examples based on interviews and literature [identifier]** |
| **A. Critical Incidents** | **Civil war and Covid-19**: Travel security was affected by both civil war and COVID-19. COVID-19 has had an impact on the ENSHURE project, and on the certified meat inspectors training programs. [ ID.08, ID09, ID.13, GL021, GL22, GL08, GL016, GL017].  **Lack of or unintentional use of appropriate equipment:** The ENSHURE project faced a challenge in importing laboratory consumables and material; and field equipment, which hinder on-time delivery of project activities; SNV provided food grade material to dairy farmers for milking, but there was unintentional use of non-food grade equipment for milking. [ID.08, ID.13, GL021]  **Lack of clarity about food safety among stakeholders:** There is a lack of clarity among stakeholders regarding the significance of food safety. It is often misunderstood that food security is more important than food safety which is prioritized, hindering government intervention; Men participated during training for hygienic handling of milk provided by SNV, instead of women who typically handle milking or dairy processing. This has budget implications as it costs double to train the right participants and also leads to implementation delay. [ID01, ID.05, ID.04, ID.06, ID07, ID.08, ID.10, ID.12, ID.13, ID14,]  **Lack of follow through:** Participants in TARTAR Project on meat safety training did not follow through on their commitment to attend training, despite scheduling them as per previously agreed-on times and dates, leading to delays. Moreover, most butchers were unwilling to participate in the training program, as they believed that they already had sufficient knowledge of meat safety and handling.[ID10] |
| **B. Local Attitudes** | **Traditional equipment as symbols:** The local community in Borana values their traditional milk container, known as Gorfa, which they do not wash but clean by smoking it with wood. This practice is seen as a symbol of dignity to them.[ID14]  **Profits change local attitudes, however slowly:** The AAU-ILRI intervention identified that for the Borena pastoralist, selling milk was once taboo, but it has since become a profitable business due to recent developments. However, the locals prioritize production over safety and quality of the milk; MoA dairy development encourages dairy farmers to have a higher quality in milk production, but the traditional methods are more popular, and few farmers are willing to undergo training.[ID14, ID02, GL03, ]  **Traditional practices are seen as reliable and preferable:** Due to the lack of temperature regulation or refrigeration, the consumers in general preserve meat by drying with added salt and pepper. Milk is typically preserved by making cultural yogurts or refining it into butter or ghee. [ID04]  **Risky consumption practices:** Some people prefer consuming raw meat, while others consume raw milk as they believe that heated dairy products change their flavor and goes against their cultural norms. Camel milk is mostly consumed raw, while goat milk is mixed with boiled tea.[ID14, ID04, ID12, GL02,SL02 ] |
| **C. Local Conditions** | **Enabling environment for implementation:** The AAU-CVMA curriculum was specifically designed with 70% practical and 30% theory sessions to conduct meat inspection training for regional and export abattoirs workers, with close follow-up of the trainings by MoA. They are also conveniently located near all export and local domestic abattoirs, providing easy access to practical training sessions, and their location is accessible to most participants. The AAU-ILRI intervention in contrast was challenged by the scattered living arrangements of the pastoralist making home visits difficult. However, a common strategy used by AAU-ILRI, SNV and ENSHURE projects, was the use of government structures like the agricultural bureau and health extension system that go from federal to local level and local religious leaders to improve access to the communities. Moreover, complexities in food safety management, particularly in low-income traditional markets, mean that addressing one aspect may impact others like water shortages; difficulties in regulating the markets; the need for improved coordination; limitations in quantifying the monetary impact of public health actions; barriers to sustainable meat hygiene, including infrastructure and human resource management issues. [ID01, ID,08, ID13, ID12,ID14, ID04, ID02, ID011]  **Challenges in use of equipment and technology:** The USAID Feed the Future project, and MoA in collaboration with GAIN project introduced and provided a vehicle with a chiller for milk transportation for commercial dairy farms. However, there were different challenges in adapting different technologies such as insufficient capacity for equipment calibration, inadequate infrastructure and technical expertise, especially for refrigeration. SNV for example, identified that most small-scale milk processors did not have the knowledge or experience on how to regulate and (or) operate a refrigerator at home.[ID02, ID08, GL020, GL021, GL022]  **Lack of political will:** The lack of government support, poor political commitment to food safety, and political resistance are major challenges facing food safety in Ethiopia. Difficulties in obtaining land for animal quarantine in Addis Ababa, lack of awareness, and minimal facilities in traditional markets for food safety practices further exacerbate the issue. In addition, insufficient land, credit, financial resources, and foreign exchange incentives for legal transactions pose significant limitations to the expansion of large-scale farming. Although legal frameworks exist, their implementation and enforcement are often lacking. [ID01, ID02, ID03, ID04, ID05, ID06, ID07, ID08, ID09, ID10, ID11, ID12, ID13, ID14, GL010, GL018] |
| **D. Partnerships & Connections** | **International and national collaboration:** Projects and institutions engage in international collaboration, strengthening relationships with foreign universities and organizations for knowledge exchange and support. E.g. AAU- ENSHURE project networked with different national and international organization like Penn state University, GOHI, ILRI, MOH, MOA, and FDA; SNV working with federal and regional agriculture bureaus and public health bureaus; LDI works with Mekelle University; Ministry of Agriculture has established collaboration with AAU-CVMA,[ID13, GL018, ID07, ID08, GL0017, ID04]  **Lack of multi-actor inclusion and or connections at system-level:** The above-described collaborations are however not inclusive of all relevant sectors such as communities, regulatory bodies, private sectors, research institutes, standard agency and government structures at different levels for strategy development and agenda settings. Additionally, the location and planning of facilities, such as abattoirs, are crucial, emphasizing the need for coordination not only in terms of facilities but also in residential planning to bring about positive changes.[ID01, ID02, ID03, ID04, ID05, ID06, ID07, ID08, ID09, ID10, ID11, ID12, ID13, ID14] |
| **E. Policies & Laws** | **Local regulatory support for intervention:** Adulteration issues are primarily considered regulatory challenges. Moreover, the effectiveness of interventions is also dependent on strong regulatory support, emphasizing the need for clear rules and regulations. For example, the presence of regulation in Oromia region on milk marketing supported the development of directives which when enforced improved the safety of milk at local level. [ID08, GL015, GL016, ]  **Gaps at national level in Legal Framework:** There are gaps in the legal framework for food safety, particularly in the milk value chain. There are different draft proclamations, regulations and policy briefs, which remain at draft level without proceeding to finalization and implementation. For example, the policies and proclamation related to animal health and welfare, including the control of informal livestock trade across borders, are recommended but not endorsed or implemented.[ID02, ID09, ID08, ID01,ID03, ID05ID14, GL012, GL013, GL014, GL06, GL08]  **Enforcement Challenges:** Enforcement challenges, such as unclear identification of sellers or processors of milk, pose hurdles in maintaining quality throughout the value chain. The absence of a comprehensive food safety strategy and challenges in law enforcement were identified by the ENSHURE project. In addition, traditional food markets pose unique challenges due to their informal nature. Coordination, improvement in food safety management structures, which require investments in infrastructure. The formal market is seen as a better option for ensuring quality and safety compared to the informal market though, challenges in regulation and quality control persist.[ID13,ID09, ID01, ID07, ID03, ID12, ID10, ID02, GL010, Glo02, GL018] |
| **G. External Pressure** | **Societal pressure:** The role of social media, other media in general and advocacy were identified as strategies to assist implementation. Platforms like Facebook and video-sharing sites were highlighted as effective channels for disseminating project outcomes and building awareness. Advocacy for food safety and promotion of new agricultural technologies, especially among women, was considered valuable. The media was recognized as a powerful tool for disseminating information on food safety and nutrition education, though challenges exist in understanding consumer perceptions. Additionally, focus days such as the World Food Safety Day served as opportunities to raise awareness at a national level or disseminate project results.[ID06, ID13, ID08, GL018, GL017]  **Market pressure:** LDI noted a shortage of skilled meat technology workers and high turnover in slaughterhouses due to labor competition and low wages. Core support strategies included business-to-business linkages, milk price information, and on-site training. Mobile apps were highlighted as tools to share product details, discounts, and incentives for traditional markets. A USAID project found that essential livestock inputs (feeds, drugs, vaccines) were mainly available in larger towns, limiting access for most producers. In response, special events were organized to connect producers with these inputs.[ID04, GL020, GL021] |

|  |  |
| --- | --- |
| **III. INNER SETTING DOMAIN** | |
| **CFIR constructs:** | **Categories and examples based on interviews and literature [identifier]** |
| **Structural Characteristics** | **Physical infrastructures support functional performance**: Institutions and facilities that have better infrastructure are able to support the required functions better. Mekelle University and Addis Ababa University for example, have diverse facilities that can be used to support food safety training and research. In terms of slaughter facilities, export abattoirs have the required infrastructure capacity such as electricity, drainage system, abattoir equipment and clean water as compared to domestic abattoirs. Similarly, small scale dairy productions also lack such basic infrastructure in addition milk transportation facilities.[ID01, ID04, ID13, ID08, ID09, ID07, ID10, ID05, ID11,ID12, ID14, ID02, GL015,GL016, GL01, GL022 ]  **Institutional capacity, structure and ownership impact functional performance:** Institutional capacity and structure are equally important as physical infrastructure. LDI for example, has a better Institutional structure and workflow at federal level thereby making it better at federal level. However, there seems to be limited institutional capacity for food safety and quality control in both public and private sectors in terms of laboratory, workforce in number and food safety surveillance at all levels (federal to kebele level). Moreover, according to the current mandate of the Ethiopian Agriculture authority, they lack the authority to control domestic slaughter facilities as they don't have control over facility design, operation, and inspection, which makes it challenging to introduce new regulations and capacity building, especially as many independent butchers provide slaughter services. Ownership is another key factor as most domestic abattoirs are owned by municipalities, which has challenge in standardization the facilities and controlling of hygienic production of meat. [ID04, ID01, GL01]  **Human resource issues and functional performance:** Factors hindering hygiene improvement in the domestic abattoir, including a lack of skilled personnel, inadequate training and education for domestic slaughter facility workers, high worker turnover due to competition from higher-paying jobs (like construction sector), and financial constraints. The labor-intensive nature of the work, coupled with low wages, also affects temporary workers during peak slaughter times (like holidays). Regulated human resources on other hand, support required functions such as in export abattoirs where employees are required to adhere to strict rules for working conditions and abattoir, and personal hygiene. [ID01, ID04, ID05] |
|
| **Communications and Relational Connections** | **Formal connections and information sharing:** There are different methods for formal information sharing at different levels, such as, one-day milk stakeholders round table meetings or ministerial level consultative meetings. In addition, there are specific focus days or campaigns such as world milk day where workshops and campaign could be used for awareness and dissemination. Information sharing may also be done formally through extension services. The ENSHURE project for example, used stakeholder communication to improve food safety through severalstakeholder engagement activities focused on a range of issues, including quality milk production and productivity, milk consumption, and the development of mandatory milk and dairy product standards, awareness creation, policy agenda setting, and challenges faced in regulating milk products.[ID13, ID08]  **Informal relations and information sharing:** Through informal communication mainly through personal calls with local research centers, Holeta Research center managed to obtain a reference culture for laboratory diagnosis from a private lab and Ethiopian Public Research Institute. [ID06] |
| **Culture** | **Recipient-Centeredness:** The communication and training materials developed by the ENSHURE project and AAU-ILRI are community-oriented (recipient), engaging, comprehensible, and culturally relevant. In the training intervention given by AAU-ILRI for pastoral women (recipient), the training was delivered by a local employee of Agriculture Bureau, in order to connect better with the local participants and minimize communication and cultural gaps.[ID12, ID13, GL03, GL018, SL02] |
|
|
| **Tension for Change** | **Fear-based tension:** In one of the private sector commercial farms, there was a constant fear of AMR and disease transmission from surrounding small-scale farms. In order to address this, he provided training and deworming drugs to the small-scale farmers at personal cost. [ID11]  **Prioritization within available resources:** Lack of funding and technical capacity is a major constraint on efforts to improve food safety. When MoA for example, conducted an assessment of municipality abattoirs, a host of problems were identified which were beyond the scope of available resources. Hence, the MoA prioritized the standardization of abattoir design and training of meat inspectors.[ID01, GL010]  **Weak enforcement:** SNV identified high milk adulteration practices in Oromia region which they assessed as being caused by low enforcement of quality control by regulatory bodies. SNV therefore changed track and supported the region to develop directives to enforce existing regulations. [ID08, GL016, GL017] |
|
|
| **Incentive Systems** | **Branding signage:** The installation of branding signage in dairy product processing is a positive step, but it is not directly related to the improvement of food safety.[ID08]  **Auditing and certification program:** The Ministry of Agriculture implemented an auditing and certification program to leverage the training improvements and drive ongoing progress. [ID01]  **Reward system for slaughter workers:** The current reward system is inconsistent and not directly tied to the hygienic handling of carcasses. Instead, it focuses on general work performance related to customer service and proper skinning of animals.[ID12] |
|
| **Mission Alignment and Compatibility** | **Activities aligned to or compatible with institutional mission:** The Institute of Livestock Development was explicitly created by decree to resolve issues along the animal resources value chain, with a key role of supporting and collaborating with industries. In general, most of participants reported activities as aligned to their respective institutional missions such as providing training, awareness creation, inspection, legal framework development (MoA, LDI, FDA, ). The AAU-ENSHURE project however reported training of milk value chain actors which were not within their regular duties and responsibilities, but rather conducted through external grants; and hence unlikely to be continued after the project period.[ID04, ID13, ID07, ID1, ID02, ID05, GL05] |
|
|
| **Available Resources** | **External funding through a grant-based approach:** Activities related to specific projects have funding allocated for those particular activities through a grant-based approach, whereas the government budgets are constrained, necessitating collaboration with projects and NGOs for implementation. [ID09, ID01, ID02, ID 04, ID05, ID07, ID08, ID12, ID14, Glo20, GL021, GL022, ]  **Material and Equipment in relation to government’s purchasing system****:** Various materials and equipment were supplied to the beneficiaries with the aim of improving milk and meat safety and hygiene standards. This included provisions for a milk quality and safety laboratory testing consumables and supplies and transportation equipment and cold tracks necessary for its operation. Additionally, a range of translated training and communication materials, guides, and standardized operating procedures for laboratory diagnostics. These materials and equipment’s were given to the beneficiaries both during and after the projects period and filled a gap exposed by the inefficiency of the government’s purchasing system. In another example, USAID designed, fabricated, and installed a clean-in-place tank-washing system, upgraded access and connection to water and electrical supply, and tested the standby-generator electric power supply as complementary support to dairy processing commercial farms.[ID013, ID08, ID04, GL018, GL020, GL021, GL022, GL003] |
|
|
| **Access to Knowledge & Information** | **Awareness creation:** Awareness creation focused mainly on animal welfare, animal food safety, milk production and productivity, quality and safety issues and promotion of milk consumption, while capacity building focused on different technologies and practices including food grading material. [ID01, ID02, ID04, ID05, ID07, ID08, ID09, ID10, ID11, ID12, ID13, ID14, GL01, GL02, GL04, GL05, GL021, GL021, GL022, GL018, GL023]  **Formal and informal technical training:** Technical training included regulation and directives, milk quality testing and sampling procedure, hygienic milk handling, laboratory testing, hygienic handling of meat. The ENSHURE project, for example trained university staff and regulatory laboratory experts on different laboratory diagnostic techniques for milk. Additionally, MoA in collaboration with CVMA provided certified meat inspection training for regional meat inspectors.[ID13, ID01, GL018]  **Experience sharing:** The SNV supported the regulatory experts and some other value chain actors to get experience from Netherland dairy production system through an international visit. [ID08, GL017,] |
|
|

|  |  |
| --- | --- |
| **IV. INDIVIDUALS DOMAIN** | |
| **CFIR constructs** | **Categories and examples based on interviews and literature [identifier] & CFIR role characterization** |
| **A-G** | Information included in text |
| **H.** **Innovation Deliverers** | The primary entities implementing interventions include government sectors, externally funded projects, collaborative efforts between government and externally-funded projects, academia, research institutes, and private sector institutions. All [ID01- ID14,SL01-SL04, GL01-GL-023]] |
| **I. Innovation Recipients** | The recipients were the participants in the different interventions described in the interviews and document, such as women in pastoral Borena for milk hygienic training; the milk value chain actor and abattoir workers in urban and peri urban area of Addis Ababa, Oromia, Amhara, South, and Tigray; livestock-rearing owners and traders; relevant regional offices and government bodies; actors in milk and meat value chain; and associations, cooperatives, and regulatory bodies. All [ID01- ID14,SL01-SL04, GL01-GL-023]] |

|  |  |
| --- | --- |
| **V. IMPLMENTATION PROCESS DOMAIN** | |
| **CFIR constructs** | **Categories and examples based on interviews and literature [identifier]** |
| 1. **Teaming** | **Multi-stakeholder collaborations for different purposes:**  Teaming for capacity building: The implementation team (LDI Meat) collaborated with the ministry of industry, Ministry of Health, and regional and national agriculture offices, and NGOs to address meat safety. A national milk quality and safety task force consisting of four relevant ministries was established to give directions for a short-, medium- and long-term action plan preparation by technical professional committee.[ ID04, ID05, ID08, ID14, GL017, GL04]  **Teaming for policy document development:** The live animal livestock trade policy document was developed by teams from the Ministry of Trade, Ministry of Agriculture, and a Policy and Research Institute. [ID01, ID03, ID08, ID13, ID12, GL05, GL012, GL018 ]  **Teaming for research:** The team from the University of Florida, collaborated with Ethiopian partners, including the Ethiopian Meat and Dairy Industry Development Institute and the Feed the Future Ethiopia Value Chain Activity project assessed meat handling and hygiene practices and implemented an intervention to train butchers to improve hygiene.[SL01, SL02, SL03, SL04, ID13, ID04,GL01, GL02, GL019, ] |
| **B. Assessing Needs** | **Needs identified by innovation deliverers:** This includes: 1) Risk based approach where the focus is on public health considerations by prioritizing issues and interventions for identified high-risk groups. 2) Funding call-based needs, where the interventions are developed in response to specific funding calls such as the one from the Bill and Melinda Gates Foundation and UKAID to address foodborne pathogens, particularly bacterial ones, in response to the high burden identified in the Foodborne Disease Burden Epidemiology Reference Group (FERG) report. 3) Based on previous studies and assessments such as interventions on milk safety and drug residue which were based on recommendations from previous dairy studies and community requests. 4) As part of institutional core activity such as LDI trainings on animal source food safety issues which are provided as per their activity plan in accordance with their core activities of training, research and community development; or the Addis Ababa Urban Agriculture Bureaus which played a role in inspecting daily activities of abattoirs and butcher houses and providing training based on assessment, in order to align with annual plans.[ID12, ID14, ID08, ID14, ID04,ID05, GL018, GL016, GL015, ]  **Needs identified by innovation recipients:** This includes mainly request or market driven activities such as the LDI institute for example, receiving requests from private sector abattoirs as well as companies, FAO, SNV, and the association of the slaughterhouse for market-driven training programs. [ID04, ID05, ID13, ID14] |
| **D. Planning** | **Sharing of responsibilities:** A big forum on safety and quality of milk production was co-organized by the Ministry of trade and regional relations, Ministry of Agriculture and Ministry of Health with shared responsibilities among them. This led to the implementation of mandatory regulations enforced by various governing bodies, including the Ministry of Trade and Regional Relations, and led to halting production of dairy products by some manufacturers.[]ID07, ID12, ID08, Gl018]  **Sharing of information and expertise:** The ENSHURE project filled an information gap by providing data on source of aflatoxin and the burden of microbial load on pasteurized milk to the government in order to improve milk hygiene and safety.[ID13, GL018] |
| **E. Tailoring Strategies** | **Tailoring to meet local needs:** Two examples of training programs that were altered to meet local needs included: 1) The training program developed by Addis Ababa University in collaboration with Penn State University was expanded from 30 to 120 women in the Oromia region to accommodate the felt need of the area. 2) The curriculum for Meat Inspector training was amended by the MoA, in collaboration with College of Veterinary Medicine and Agriculture (CVMA) and reduced to three months with increased intake of trainees to manage resource constraints while allowing for training the required number of experts in all the regions. An example of tailoring of recruitment strategy to meet local needs: Dairy cooperatives identified issues of management and resistance to change, and therefore supported recruitment of better qualified personnel through grants. [ID01, ID13, ID08, GL018, GL017] |
| **G. Doing** | **Piloting with intention of handover:** The ENSHURE project began by training a small number of participants with the intention of government takeover for sustainability. It was initiated as a pilot, and plans are in place for continued extension. All guidelines, material and tools have now been handed over to the government to continue the intervention based on developed implementation guidelines. However, challenges in aligning the Ministry of Agriculture's priorities with a shift towards emphasizing safety rather than solely focusing on production. [ID13,] |
| **H. Reflecting & Evaluating** | **Monitoring the Implementation:** The Ministry of agriculture supported a training program on certified meat inspection training which was provided by CVMA for regional meat inspectors using standard material and monitored for effective implementation. Government training programs, including Training of Trainers (TOT), use standardized materials and are monitored for effective implementation.[ID01]  Evaluation of the impact of the innovation: The training provided for butchers’ meat hygiene and safety and the intervention implemented by ENSHURE project is being assessed by the TARTAR project to evaluate its impact. The emphasis remains on ensuring proper cascading and implementation of the initiatives. In addition, the ENSHURE projects consistently inform stakeholders about their progress, that everyone is well-informed at each step focused on updating dairy stakeholders on research findings related to milk and Environmental and Social Impact regulatory assessments. [ID13,GL019] |
| **I. Adapting** | **Adapting to community needs:** The ENSHURE project intervention did not directly implement the intervention that was developed elsewhere but rather adapted it to the context, based on the needs of the community. [ID13, GL018] |