

Improving On-Farm Milk Quality Bacterial Load Through Dairy Community Empowerment in The Framework of Dairy Development Partnership

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INFORMASI ARTIKEL	ABSTRAK
Kata Kunci: Pengembangan Produk Susu; Peningkatan Kualitas Susu; Pelatihan Praktek On-Farm .	<i>Kualitas susu merupakan aspek penting dalam produksi peternakan sapi perah. Titik awal untuk membuat produk susu berkualitas tinggi dan berbagai turunannya untuk konsumsi manusia yang sehat memerlukan tingkat kualitas susu tertentu yang dapat diterima. Namun, kualitas susu juga mencerminkan perilaku dan pengetahuan peternak sapi perah. Penelitian baseline awal di Kota Padang Panjang, Sumatera Barat pada Juni 2018 menunjukkan bahwa muatan bakteri susu segar dari tiga belas peternakan Koperasi Susu Marapi Singgalang sebagian besar di atas satu juta unit pembentuk koloni per mililiter. Itu lebih tinggi dari standar susu segar yang dapat diterima berdasarkan Standar Nasional Indonesia. Rencana intervensi pengembangan susu dalam bentuk kemitraan susu dengan pemangku kepentingan utama dirancang untuk meningkatkan kualitas susu peternakan dalam empat bulan. Ini terdiri dari kegiatan peternakan penuh intensif penyegaran dan pendidikan kualitas susu, pelatihan praktis dan bantuan pada kebersihan pribadi, peralatan dan lingkungan juga diikuti dengan pengambilan sampel susu dan air secara acak. Intervensi on-farm menghasilkan peningkatan beban bakteri susu segar menjadi rata-rata di bawah 400 unit pembentuk koloni per mililiter. Pencapaian rata-rata yang sebanding dengan standar susu Selandia Baru untuk tujuan ekspor. Perilaku dan keterampilan peternak terhadap kualitas susu meningkat. Konsistensi pada pengetahuan dan keterampilan praktis sederhana yang dapat dicapai memberdayakan kemampuan dan kapasitas peternak sapi perah yang mendorong peningkatan signifikan muatan bakteri kualitas susu di peternakan.</i>
Keywords: Dairy Development; Milk Quality Improvement; On-Farm Practical Training	ABSTRACT <i>Milk quality is an essential aspect in dairy farm production. Starting point for making high quality milk products and its various derivatives for healthy human consumption shall require certain acceptable degree of milk quality. However, milk quality also reflects the behaviour and knowledge of the dairy farmers. Initial baseline research in Padang Panjang City, West Sumatera in June 2018 exhibited that the fresh milk bacterial load from thirteen farms of Marapi Singgalang Dairy Co-operative was mostly above one million colony forming units per millilitre. It was higher than the acceptable fresh milk standard based on Standar Nasional Indonesia. Dairy development intervention plan in the form of a dairy partnership with key stakeholders was designed to improve on farm milk quality in four months. It consisted of intensive full-on farm activities of milk quality refreshment and education, practical training and assistance on personal, equipment and environmental hygiene also followed up with random milk and water samplings. On-farm intervention resulted the improvement of fresh milk bacterial load to average below 400 colony forming units per millilitre. The average achievement which is comparable to New Zealand milk standard for export purpose. Farmers' behaviour towards milk quality perception and skill were improved. Consistency on simple practical achievable knowledge and skills empowered the capability and capacity of dairy farmers which drove the significant improvement of on-farm milk quality bacterial load.</i>

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I. INTRODUCTION

West Sumatra contributes 0.14% of dairy cow population (793 heads) and 1,081.85 tonnes (0.11%) of national fresh milk production. While Padang Panjang as one of dairy area in West Sumatera contribute 3.28 tonnes (0.30%) of regional production, 200 heads (25%) of dairy population with average 7-11 litres/day/head (BPS, 2021; Dinas Pangan dan Pertanian Padang Panjang, 2022). Despite its minor figure, it gives a high potential source for accessible and affordable nutritional protein intake from dairy products for improving health status of local society beside other various sources such as eggs and meats out of local agricultural livestock outputs.

Marapi Singgalang Dairy Co-operative (Mersi Dairy), the only dairy co-operative in the region which is comprised of nine groups with 15 active farmers households are the main player of local fresh milk production. Historical government policy background on rural poverty alleviation by developing local dairy sector in 1980s culminated in the establishment of Mersi Dairy Co-op as the grass roots' initiative by the local dairy farmers in 2010. Having the lengthways up and down of the Mersi Dairy's existence, apparently the availability of baseline data from the local livestock authority was insufficient to gather the preliminary status of milk quality. The sampling activities were executed infrequently by various local authorities, the farmers remained less enlightened about the results. Subsequently, farmers were uncertain and reflected the incapability to determine the assurance of their milk quality production. Plausibly by safety and quality regime, within dairy value chain periodical milk sampling practice at farm level is an essential behaviour to determine the milk quality (Tegegne and Tesfaye, 2017; Ndahetuye et al. 2020).

The aim of the research is to define suitable and meaningful output and outcome through on-farm practical intervention. It is to improve on-farm level milk quality bacterial load as the significant first-time milk quality doorstep onward of dairy value chain. By means of the hands-on practical trainings and participatory engagement at farm level, the end point objective is to shape the behaviour of the dairy farmers continuously for being self-driven and capable in assuring their milk quality responsibly. Ultimately, the local communities will obtain the nutritional and healthy benefits on consuming the accessible and affordable high quality locally sourced milk products.

II. METHODS

Partnership amongst stakeholders, including in agricultural sector, plays instrumental and pivotal transformative role in upskilling and empowering bottom of pyramid community (Treichel et al. 2017). It promotes shared resources diffusion, opportunity for knowledge and technological transfer also networking in coordinated interdisciplinary approach (Murti, 2014) to increase capacity and capability which resulted in livelihood improvement and resilience of the community. Responding to the situation faced by the farmers and local government, a dairy development partnership program, known as Fonterra Dairy Cluster Partnership, was established by Fonterra Brands Indonesia, City Government of Padang Panjang and Mersi Dairy in 2018. The focus of the program by mobilising the resources and technical expertise is to develop and increase dairy capability and capacity of the local dairy farmers.

Community-based participatory action research was the ground framework of this intervention design. The real-life engagement with the dairy farmers played the most important functional element to deliver the objective of the intervention. The outline of the intervention started by identifying the major problem, obtaining the baseline data as well as observing the dairy farmer's natural practices on-farm. The baseline data and behavioural observation materials as starting point of intervention were reviewed and communicated to the dairy farmers to get the common understanding and agreed action plan. Series of thematic on-farm participative practical trainings on personal, equipment and environmental hygiene including knowledge of its bacterial exposures were conducted in a group cluster format. Monthly monitoring and review were carried out to figure out the habitual changes as expected. The necessary

reiteration of key practices on hygiene were refreshed and re-conducted to aim the common expected practices as agreed. The evaluation was conducted to determine the output achievement. The on-farm bacterial load from milk sampling result as behavioural reflection of each farm was the key indicator for the significant acquired output.

Mapping the common on-farm problems, due to the absence of on-farm data, the initial stage of the program was to focus on determining the actual degree of bacterial load as the main objective, as well as the compositional profile for generating the baseline data. A program operation centre was set up at Mersi Dairy where simultaneously the on-farm observations and casual engagements with farmers were carried out. Empirical data and information were collected along with the milk samplings from 13 farms, the farmers' profiles and farm data were also collected (Table 1: profile of respondents). Farmers' daily routine and behaviours on each farm were observed while milk samples were taken from each farm bulk storage after milking time was completed. Milk sampling activities were carried out for 7 days consecutively in June 2018. Daily samples were tested for the bacterial load by using aerobic plate count approach. All milk samples were collected in sterile containers and either refrigerated or placed on ice and plated within 2-4 hours. Milk samples were each diluted onto aerobic plate count petrifilm and incubated for average 48 hours. The bacteria colonies were counted using standard counting practices and reported as the number of colony forming units/millilitre (cfu/ml). Compositional milk samples were tested by using portable IndiFOSS MilkoScreen unit, a Fourier Transform Infrared Spectrophotometry (FTIR) technology, to measure the SNF, protein and fat and the results by default expressed as a percentage. Sampling activities were designed and executed with the active participation and on-hand involvement of the respective farmers, Mersi Dairy's staffs and technical experts from Fonterra Co-operative Group Limited, New Zealand.

Table 1. Snapshot Profile of Respondents

*Farm Number	Personal Information					
	Gender	Age	Education Level	Dairying Experience (year)	Total Herds (heads)	Average Daily Production (litre)
1	Male	45	High School	7	8	25
2	Male	51	High School	13	10	75
3	Female	48	University	25	5	25
4	Male	43	University	12	30	80
5	Male	49	Academy	24	6	15
6	Female	38	High School	14	7	20
7	Male	46	University	10	7	18
8	Female	43	High School	27	14	55
9	Female	62	High School	31	12	30
10	Female	62	High School	31	10	30
11	Female	64	High School	31	6	15
12	Female	43	University	9	4	12
13	Male	65	High School	31	12	45

Source: Dispangtan Kota Padang Panjang, 2019

(*Identity of the farmers are intentionally undisclosed by the researcher)

Baseline figures were used to determine the suitable engagement materials which deliberately designed to be delivered in active group dynamic participation and learning by doing on-site training instead

of the traditional one-way approach training in a class room format. Step by step approach was introduced in delivering the practical materials by considering the group dynamic. Group engagement materials consisted of pre-adjusted standard operating procedures (SOPs) predominantly by using pictures instead of lengthy instructional sentences. The group participants were defined with maximum 10 participants for more engaged and interactive sessions also to give more opportunities for engagement of the farmers participant to do exercise. The exercise started by the technical experts to demonstrate the SOP step by step then followed by the farmers participants. Discussions were stimulated naturally to explore more understanding and feedbacks from the farmers participants. This approach was run in maximum 3 hours to maintain effectiveness by considering adequate time of farm workloads and busy hours. Overall engagement intervention was intensively run in bi-weekly for five months from June to October 2018. The similar milk sampling and behavioural observation approach for verification of behavioural changes and its consistency were conducted in October and September 2019. The longer frequency period of verification was decided to substantiate the strength consistency of the farmers quality behaviour

III. RESULTS AND DISCUSSION

The baseline data revealed the various figure of daily bacterial load. Four farms (30%) were slightly consistent around 100,000 cfu/ml and nine farms (69%) were volatile. Within the volatile group, four farms (44%) were exposed above beyond Standar Nasional Indonesia (SNI) of fresh milk total plate count (TPC). The farms exhibiting volatile bacterial loads contributed to a high average bulk bacterial load at Mersi Dairy's final collection point. This baseline figures became the material for further on-farm investigation where the practical intervention for milk quality improvement was necessarily carried out. Notably in contrast, those farms with the highest bacterial load used milking machines whilst those farms which hand milking were practiced generally had the lowest bacterial load. This was contrary to most farmers' thoughts during the trials. Each farmer obtained the feedbacks of their milk quality report individually. One-on-one consultation was conducted to further investigate and plan the key agreed action of improvements. Each farmer was encouraged to do self-assessment for their improvement plan. This method triggered the understanding and willingness driver of the farmers to responsibly improve their milk quality.

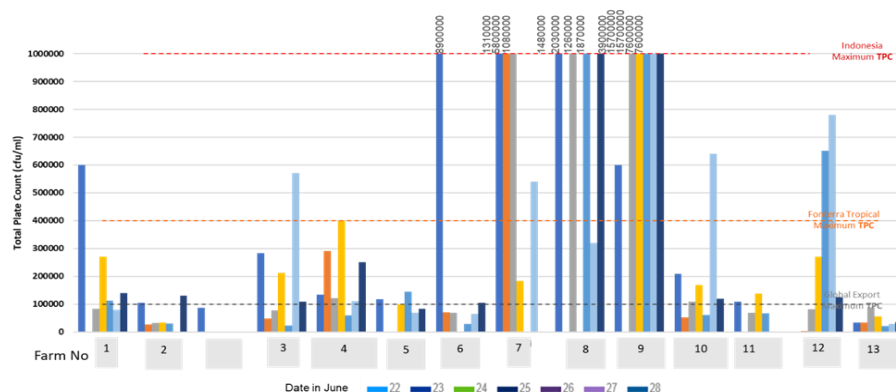


Figure 1. Microbial load of 13 farms in June 2018

Practical hands-on training materials emphasising milking hygiene regime were developed by considering the milking methods. The engaged trainings and technical assistance were conducted separately for hand-milking farmers group and the farmers using milking machines. The on-farm training practices stimulated more engaging environment where the farmer participants raised and discussed honestly their actual problems and challenges. Rather than more theoretical, on-farm training practices explore more interactions to respond the questions in practical ways. It modifies the constructive academic theoretical into commonly easy to digest and practicable by the farmers context. Having the knowledge and expertise

transferred consistently in a such accommodating mode for farmers, this promotes the farmers capacity and capability development. Farmers were able to identify the risk exposures of milk quality bacterial load, started with personal hygiene, equipment and environmental aspects. Pre and post milking activities were also comprehended, such as cow's udder cleanliness, warm water used for udder cleansing, stripping prior to milking, one cloth for one cow, clean and dry milk cans, using food grade stainless steel instead of plastic or corrosive buckets, rapid cooling and teat dipping after milking. Those practical experiences drive the on-farm quality behaviour consciously.



Figure 2. On-farm practical activities: (a) Food grade stainless steel exposition; (b) Compositional milk test trials

The follow-up bacterial load verification in October 2018 was conducted by means of the same sampling regime approach. Majority of the farms as of the October median value of milk quality bacterial load had positive progress. Despite of increase of median value on Farm 3, 4 and 13, the level of bacterial load was still below SNI of fresh milk TPC. It indicated the significant improvement at farm level. After October 2018, on-farm intervention was intentionally decreased with the objective to observe any behaviour changes which contributed to the milk quality failure.

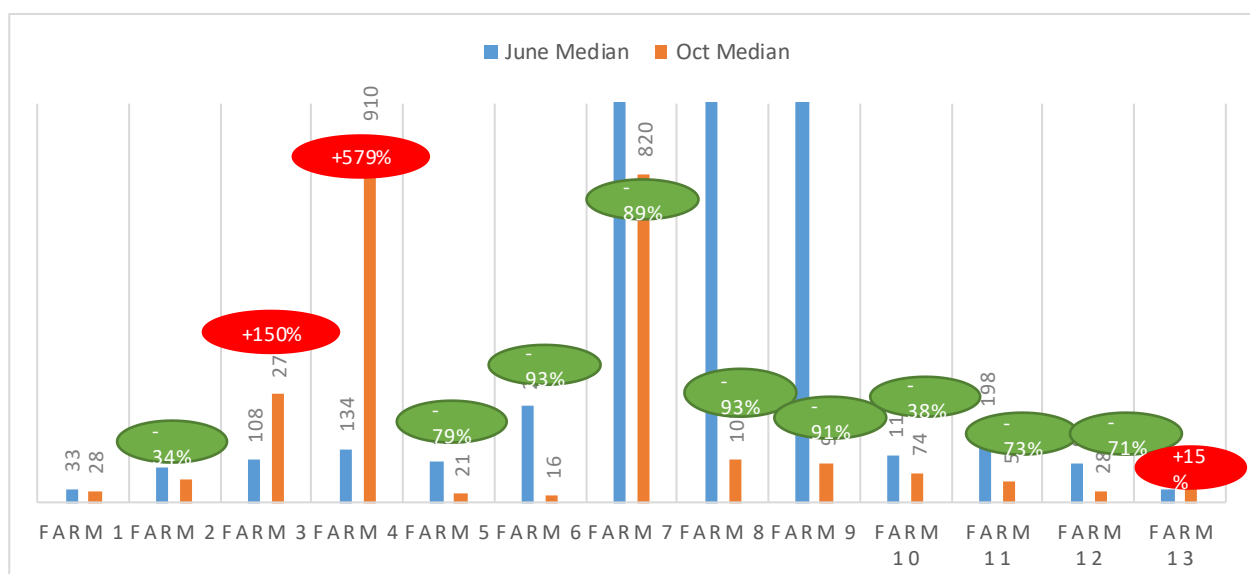


Figure 3. Comparison after on-farm intervention activities in October 2018. Red bubble: increase percentage; Green bubble: decrease percentage

The eleven month on-farm verification of milk quality after the second verification in October 2018 exposed the significant result that majority of the farms improved their milk quality bacterial load beyond expectation. The improvement showed the exceptional outcome that all farms achieved the milk quality bacterial load below 400,000 cfu/ml. Evidently, the three periods of data comparison led to the interpretation that behind the improvement of milk quality bacterial load there was a corresponding improvement in behaviours and attitude of the dairy farmers. The behavioural changes revealed the developing capability in identifying the adequate decision making, risk and impact assessment toward milk quality.

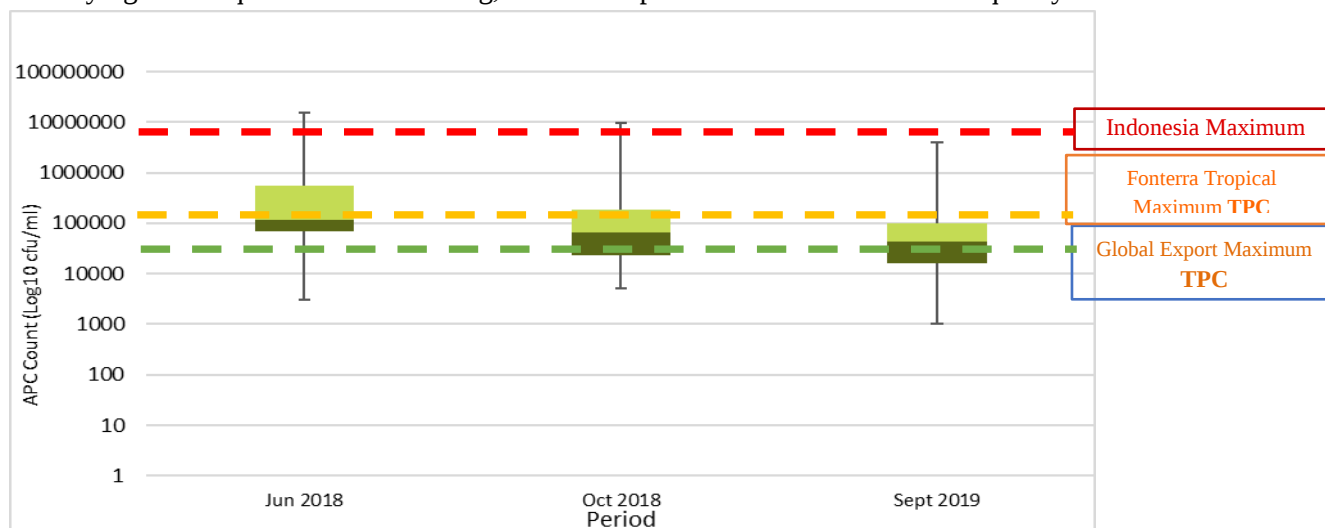


Figure 4. Progress Comparison milk quality bacterial load

The farmers behaviour changes toward the improvement of on-farm bacterial load milk quality corresponds with the practical on-farm intervention activities through consistent manner, two-ways communication on agreed key areas for improvement and re-iterative real-life learning by doing participation. Persistency of the on-farm extension where the casual cultural approach, such as knowing and respecting the existence of women's role within Minangkabau culture, remarkably played as the instrumental aspects in delivering the key messages for the improvement of practical skill and knowledge contents. Despite of majority of the farms had the similar exposure conditions of milk quality risks, the acceleration on implementing the milk quality techniques and constructive practices was vary from one farm to another. The women's role on-farm surprisingly have the significant influence on the responsiveness of adaptability of the new skill and techniques. It was revealed that the farms with a structured functional job arrangement were operated by the existence of women farmers. Empirically explained that women have more functions on pre-to-post milking, hygiene and sanitation activities, the significant vulnerable part of milk quality risk exposures. Figure 3 indicated that 5 out of 9 farms with significant milk quality improvement were operated by women farmers.

The posters with the content of casual and user-friendly milk quality instructions were placed at the most visible wall-spot of each farm. The instructional posters contained with the real pictures of the good example farm practices along with the short instructions. The intention of the poster is as a reminder and a quick guide for the dairy farmers to maintain the improved milk quality practices. This approach helps the dairy farmers to further disseminate their practical skill and knowledge to their workers, family members and temporal farm personnels. Incentives and rewards also encouraged the farmers' interest to try the new constructive practices as instructed. Celebrating the success with the key stakeholders to recognize with the tangible rewards for the efforts and achievement of the dairy farmers was also beneficial. It is to keep the

quality behaviour maintained and increase the self-pride of producing high quality milk. Subsequently, the self-pride drives the solid commitment on quality behaviours of the dairy farmers.

IV. CONCLUSION

Timely, regular and consistent on-farm practical hands-on intervention led to the development of capability improvement of the Mersi Dairy farmers. The persistence step by step approach in delivering practical concept in common terms was easily understood by the dairy farmers. It stimulated the meaningful perception and increase the awareness which drives toward quality behaviour. The on-farm quality behaviour and consciousness delivered the high-quality milk production as the output, both in compositional and especially to the bacterial load as the main focus of this research. The quality behaviour and consciousness evidently promote the self-pride and self-esteem of producing high quality of milk amongst the Mersi Dairy farmers as the major outcome. The larger end point is the availability of the high quality and accessible milk and milk products for the local communities. This achievement is a positive constructive milestone and an effort show case of empowering the common dairy farmers through dairy development partnership with multi-stakeholders. Further managerial implication of this achievement that quality fresh milk incentives regime needs to be considered by Mersi Dairy and key stakeholders for accommodating and maintaining the quality behaviour. Various innovative high quality dairy products including business to business expansions are lucrative to be explored to further increase the livelihood of Mersi Dairy farmers.

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