REPORT OF MILK VALUE ADDITION TRAINING FOR LOGOLOGO AND MERILLE MILK CLUSTERS IN MARSABIT COUNTY, KENYA

Commissioned by World Vision Kenya under Milk for Nutrition (M4N) Project

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Cover photo: From top left clockwise: Testing milk quality before processing; pouring raw milk in the milk vat of the yoghurt incubator for processing; assembling manual cream separator; and draining whey from curd during cheese making. (Pictures by FO Wayua)
Abbreviations and Acronyms

ADP  Area Development Programme

Boda boda  Mode of transport using motor bikes

Boma  (Kiswahili, Rendille, Samburu) Animal pen built of irregular circular thorny high bushes perimeter. A smaller pen is built within or beside the main one for pre-weaned young stock.

CMA  Community Milk Assistant(s)

COB  Clot on Boiling

DVS  Direct Vat Set

FONSAREP  Food and Nutrition Security and Resilience Enhancement Project

fora  (Rendille, Samburu) A satellite pastoral camp built at a grazing site in the range. It is built by thorny bushes and is mainly comprised of animal pens. The camps are usually abandoned during shifting to new site.

GIZ  Deutsche Gesellschaft fur Internationale Zusammenarbeit GmbH

Jiko  Swahili word for cooking stove

KALRO  Kenya Agricultural and Livestock Research Organisation

KARI  Kenya Agricultural Research Institute

KSh  Kenya Shilling (local currency). KSh 100 was equivalent to US $ 1 in May 2016)

Lorien  Indigenous milk preservation technology among the Samburu involving smoking of milk containers with smoke from burned woods of specific trees

Mala  Cultured fermented milk

Manyatta  Small village settlement settings, i.e. referring to main dwelling unit or main camp (homestead) of the pastoralists households

M&E  Monitoring and Evaluation

M4N  Milk for Nutrition Project

Sufuria  Swahili word for cooking pot

WVK  World Vision Kenya Programme
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EXECUTIVE SUMMARY

Introduction
The milk value addition training for Logologo and Merille milk clusters was a follow-up of the training done in August 2015. The present training aimed at improving the capacity of the cluster groups on improved milk processing by capturing milk availability during the rainy season.

Methodology
The training was conducted from 23rd May to 27th May 2016 in Logologo and Merille clusters. Each cluster had two milk processing groups which assembled in one site for the training. Training facilitators were drawn from the Kenya Agricultural and Livestock Research Organisation and World Vision Kenya that had expertise on food science and low cost milk processing technologies. The training covered modules on cleaning of milk containers, milk quality testing, processing of various products and sensory evaluation of the processed products. The approach used was participatory with emphasis on practical “hands-on” sessions. Pre-training evaluation was done qualitatively through informal discussions with the cluster members to appraise the progress made, experiences and lessons learnt since the first training. Post-training evaluation was done using a semi-structured questionnaire to obtain feedback from participants.

Key Findings
A total of 40 women (Logologo=17 and Merille=23) were trained on low cost milk processing technologies. Mala, yoghurt and cheese (fresh and ripened) were successfully prepared using appropriate technology. Ghee could not be processed due to non-functioning cream separators, which was a frustration for all the groups. Sweetened mala and yoghurt, and fresh cheese were rated highly by participants. Ripened cheese was not liked because of the bitter flavour. The training was rated to be relevant and training methods used to be very good.

Lessons learn and best practices
(a) Logologo Merti dairy structure was located far from the manyattas and was not used as all the equipment were stored in the manyattas for security reasons. In contrast, the Ntumo dairy structure was within the manyattas with all equipment inside, and there was evidence of its use by the women.
(b) Groups without the jiko and yoghurt incubator were not processing milk as they perceived that milk processing was not possible without these equipment.
(c) All milk processing equipment should have been pre-tested before delivery to the milk clusters. Upon delivery to the groups, the women should have been shown the assembling and use of all the equipment (preferably during the first training, but this was not done, especially for cream separator and butter churn).
(d) Ntumo group was able to link the training on milk processing to that on cooperative and marketing, and also to the kitchen garden. Waste water from milk processing was used for irrigating crops in their kitchen garden.
Conclusions
Training on low cost milk processing was successfully conducted for Logologo and Merille clusters. *Mala*, yoghurt and cheese were successfully processed. Ghee could not be processed due to non-functioning cream separators. Sweetened *mala* and yoghurt, and fresh cheese were liked by participants. However, ripened cheese was not liked because of the bitter flavour.

Recommendations and way forward
(a) Refresher training on milk processing (and other aspects of the M4N project) need to be tailor-made to the needs for each specific group, as identified from regular monitoring data. For example, training for Ntumo women group should emphasise on ghee production, group dynamics and marketing of processed milk products. For Lekiji and Logologo groups, emphasis should be on ghee processing, milk processing in general, group dynamics and marketing of processed milk products.
(b) To enhance marketing of dairy products from the milk clusters, samples of processed products should be taken for analysis at the Kenya Bureau of Standards (KEBS) for certification so as to enhance consumer confidence.
(c) Cream separators for all the groups need to be repaired and tested with the groups.
(d) Due to seasonality in milk production in the pastoral set-up, the M4N groups should diversify their income sources so that they continue being active during times with low or no milk availability. Diversification options include kitchen gardens and mother-to-mother support groups. This provides a good linkage with the Food and Nutrition Security and Resilience Enhancement Project (FONSAREP).
(e) Very good progress has been made on the technology transfer component of the M4N project. However, the nutrition component has been salient and should form a significant focus of future programming.
1. INTRODUCTION
The Milk for Nutrition (M4N) project is being implemented by World Vision in Laisamis sub-county of Marsabit County, Kenya. The project has the goal to improve nutrition status of 200 children ≥ 6-59 months of age and income among 100 households by June 2016, and is currently being piloted in 10 milk clusters with Laisamis sub-county. The milk value addition training for Logologo and Merille milk clusters was a follow-up of the training on milk value addition done to the same milk clusters in August 2015 which was done during a dry season. The present training aimed at improving the capacity of the cluster groups on improved milk processing by targeting to capture milk availability following the April-May rains. The training was organised for three days per milk cluster and involved participants from the M4N milk processing clusters together with the Community Milk Assistants (CMAs). Training facilitators were drawn from the Kenya Agricultural and Livestock Research Organisation (KALRO) and World Vision Kenya (WVK) that had expertise on food science and low cost milk processing technologies. The training also acted as a monitoring and evaluation (M&E) of the progress with the M4N milk clusters since inception. This report describes the experiences of the training and recommendations the way forward for the milk clusters.

2. TRAINING METHODOLOGY
The training was conducted from 23rd May to 27th May 2016 in Logologo and Merille M4N clusters. Each cluster had two milk processing groups which assembled in one site where the training was organised. Before commencing the training, a pre-training evaluation was done qualitatively through informal discussions with the milk cluster members. The aim was to appraise the progress made, experiences and lessons learnt and challenges since the first training done in August 2015, as the second training was to be more of a refresher training. At the end of the training a post-training evaluation questionnaire (Annex 8.5) was administered to participants to obtain their feedback. There was also a brief meeting to discuss the way forward with the training participants in each cluster.

2.1 Training on Milk Value Addition
The training covered modules on cleaning of milk containers, milk quality testing, processing of various milk products and sensory evaluation of the processed products. The approach used was participatory with emphasis on practical “hands-on” sessions by participants. There were discussions and experience sharing to make the training experiential and learner-centred as much as possible. To accommodate the busy schedule of the trainees, the sessions begun at 10.30 am and ended at 5.00 pm. Community Milk Assistants (CMAs) acted as interpreters due to the language barriers. A training attendance form was used to monitor attendance (refer to Annex 8.2).

The training was done in milk sheds constructed by the women groups (Fig. 1). The milk shed for Merti group in Logologo was constructed of iron sheet and timber contributed by the group. The floor was, however, not cemented and this was a stumbling block for the group in terms of milk processing. For Ntumo group in Merille, the milk shed was an improvised traditional house (Fig. 1).
Fig. 1. Dairy structures in Logologo and Merille where the milk value addition training was done.

2.1 Cleaning of Milk Containers

The women were trained on how to clean milk containers (Fig. 2). The procedure adopted was that described by Bruntse (2015), with modifications to fit the local conditions as below:

- Washing hands with soap and rinsing
- Washing milk containers with soap or detergent and superbrite or similar non-metal scouring pad material (*Not Steel Wire!*)
- Rinsing out the soap/detergent
- Sterilising the containers in boiling water
- Drying the containers upside down in the sun on a clean table or rack
- Properly washing the cloth used for straining milk and also the cheese cloth. This is done by washing with cold clean water after use, then washing with detergent and sterilising along with the milk cans.

Fig. 2. Cleaning milk containers by the milk cluster women.

2.1.2 Milk quality testing

The milk samples were tested for basic platform tests (organoleptic tests, alcohol and clot-on-boiling tests (COB) following standard procedures, and only samples that passed the tests were used for processing.

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2.1.3 Milk Processing
The women were trained on processing of yoghurt, *mala* and cheese, and propagation of starter culture. Training on ghee making did not proceed to conclusion as the cream separators for the processing groups were faulty (see section 2.1.3.4).

2.1.3.1 Processing of Yoghurt

Requirements
- *Milk samples*: Fresh milk was obtained from herds owned by the milk cluster groups in the respective clusters and also purchased. Details of the raw milk used for processing are presented in Table 1. In Logologo, milk was brought in plastic containers whereas in Merille it was brought mostly in traditional milk containers. The milk was screened by organoleptic test (colour checking), alcohol test and COB test and only samples that passed the tests were used. The milk was sieved using cotton cloth before pasteurisation.
- Sugar
- Flavour (strawberry, vanilla)
- Yoghurt incubator
- Firewood, brought by the milk group
- Yoghurt starter culture (thermophilic ME 2 5 U, Kosher Dairy, *refer to Fig. 16, Annex 8.6*)

Table 1. Quantity of milk used for processing dairy products in Logologo and Merille

<table>
<thead>
<tr>
<th>Cluster</th>
<th>Volume (L) of milk used for processing products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logologo</td>
<td>Day 1 (23/05/2016)</td>
</tr>
<tr>
<td><strong>Milk type</strong></td>
<td><strong>Yoghurt processing</strong></td>
</tr>
<tr>
<td>Camel</td>
<td>nil</td>
</tr>
<tr>
<td>Cattle</td>
<td>2.6</td>
</tr>
<tr>
<td>Goat</td>
<td>5.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>7.6</strong></td>
</tr>
<tr>
<td>Merille</td>
<td>Day 1 (26/05/2016)</td>
</tr>
<tr>
<td><strong>Milk type</strong></td>
<td><strong>Yoghurt and mala processing</strong></td>
</tr>
<tr>
<td>Camel</td>
<td>4.725</td>
</tr>
<tr>
<td>Goat</td>
<td>4.55</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>9.275</strong></td>
</tr>
</tbody>
</table>

*NB: The milk was pasteurised as a batch and then divided into two – for processing yoghurt and mala*

**Yoghurt incubator**

Yoghurt was prepared using appropriate technology in a yoghurt incubator. The milk was sieved using sterile cotton cloth, and pasteurised in a yoghurt incubator (Fig. 3). The yoghurt incubator was designed and constructed using locally available materials. The

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incubator consist of an energy saving charcoal / firewood stove \((jiko)\) and a milk pasteurisation and incubation vat (Figs. 3 and 4). The milk pasteurisation and incubation vat consisted of a 1.5 mm thick food grade stainless steel cylindrical tank, with a 10-cm hot water jacket and an outer layer of 38-mm thick fibre glass insulation (Fig. 3). It was heated by energy saving \(jiko\). The water jacket had an inlet for cold water, which also acted as a vent valve to allow water inside the hot water jacket to expand while heating without a dangerous pressure build up. The water jacket held approximately 57 litres of water, whereas the milk tank had a capacity of 100 litres. The water jacket was heated directly by the firewood stove, and in turn heated the milk to be pasteurised. The milk vat had an openable insulated lid at the top and a 12.7 mm nominal diameter stainless steel pipe at the bottom sideways, which acted as an outlet of processed milk (pasteurised milk, \textit{mala}, and/or yoghurt).

\textbf{Preparation of yoghurt}

The following procedure was used:

- All the milk equipment were washed and sterilised (as described in 2.2.1).
- The water jacket of the yoghurt incubator was filled with water (Fig. 4) and heated to become hot. This also sterilised the inner milk vat.

- Milk (7.6 litres) was sieved using a normal tea sieve used in the households, and poured in the milk vat of the yoghurt incubator (Fig. 5).
- Pasteurisation was performed by using firewood to heat the water, which in turn heated the milk to be pasteurised. During this process, milk was stirred manually using a stainless steel stirrer at regular intervals (approximately every 20 minutes).
- When the desired temperature was reached (65°C, i.e. after about 45 minutes of heating), heating was stopped and the milk remained in this condition for 30 minutes (holding time).
- After 30 minutes holding time the milk was drained into a sterile stainless steel container (Fig. 6). Ideally, the milk could have been incubated in the yoghurt incubator. Experience from the milk cluster showed this required a lot of water and, therefore, the women suggested cooling and incubating the yoghurt in a water bath instead, which required relatively less water.
- Sugar was added at 2% (w/v) and stirred and the milk cooled in a water bath (Fig. 7) to 45°C by replacing the water in the water bath with cold water whenever it got hot. The hot water was used to wash milk utensils.

Fig. 5. Pouring raw milk into the milk vat for pasteurisation

Fig. 6. Draining pasteurised milk from yoghurt incubator / milk pasteuriser
Yoghurt starter culture (thermophilic ME 25 U, Kosher Dairy) was added at a rate of 2% (4 to 5 grains of the culture), stirred and incubated at this temperature for 4 hours. (NB: A variety of alternative yoghurt cultures are available depending on preferred viscosity and acidity).

The milk temperature remained at 45±5°C during the incubation period. The processed yoghurt was ready, but because of shortage of time (it had reached evening), sensory evaluation for the yoghurt was done the following day.

The following day, the coagulum of the set yoghurt was stirred using a stainless steel stirrer.

Strawberry flavour was added at a rate of 2% (i.e. 2 to 3 teaspoonfuls) and stirred, and the product poured into plastic cups for sensory evaluation (described later in section 3.3).

Shelf life of yoghurt is 2 days at ambient temperature and 3 to 4 weeks under refrigeration, depending on packaging conditions.

2.1.3.2 Processing of Mala

Requirements
- Milk
- Starter culture (CHN 22, Chris Hansen Laboratories)
- Yoghurt incubator
- Muzzy can
- Sugar
- Flavour (strawberry, vanilla)

Procedure
The following procedure was used:

• The milk was pasteurised as described for yoghurt (see section 2.1.3.1). Pasteurising 9.275 litres of milk, for example, took approximately 40 minutes.
• After 30 minutes holding time, sugar was added at 2% (w/v) and stirred.
• The milk was cooled to ambient temperature (25-30°C) in a water bath—with the water being replaced regularly with cold water and the milk stirred at regular intervals to enhance the cooling process. The water used to cool the milk was later used to wash milk containers.
• Mesophilic mala starter culture (CHN 22, Chris Hansen Laboratories) was added at a rate of 2% (4 to 5 grains of the culture) and stirred.
• The milk was incubated at room temperature overnight.
• The following day, the thickened product was stirred using stainless steel stirrer.
• Strawberry flavour was added at a rate of 2% (i.e. 2 to 3 teaspoonfuls) and stirred, and the product poured into plastic cups for sensory evaluation.
• Shelf life of mala is 5 to 10 days at ambient temperature (5 days in hot and 10 days in cooler climates).

2.1.3.3 Propagation of Starter Culture
Cultures are expensive if used on a daily basis. However, as they consist of freeze-dried living microorganisms, it is possible to propagate them for some time without having to buy new stock. The milk clusters were trained how to propagate starter culture. The procedure adopted is that described by Bruntse (2003)⁴.

Propagation method
• Bring 1 litre of milk to boiling point, cover with a lid and simmer for 30 minutes for complete sterilisation.
• Keeping the lid on the sufuria it is then transferred to a cooling water bath to cool quickly to ambient temperature.
• When the temperature has reached 25-30°C a few grains of freeze-dried culture are added and stirred with a sterilised spoon. Then the sufuria is again covered, and left to stay overnight.
• The following day the culture will have set and is ready for use and re-propagation. Again, 1 litre of milk is sterilised and cooled under lid. The set culture of the previous day is skimmed (cream is a better growth medium than skim milk for many harmful microorganisms), stirred with a sterilised spoon, and one spoon of skim culture is transferred to the new sterile milk. The rest of the previous day’s culture can now be used for making mala, yoghurt or fresh cheese.
• Propagation can, if strict hygiene is observed, be continued for several weeks. But it is recommended and safer to use new culture on a weekly basis. When only using a few grains each time, a sachet of culture can last a long time.
• One litre of prepared starter culture can easily ferment 50 litres of milk overnight.

2.1.3.4 Cheese Processing

Requirements
- Milk
- Yoghurt incubator
- Stainless steel stirrer
- Cheese tray
- Cheese cloth
- Cheese mould
- Cheese press
- White cotton cloth
- Muzzy cans
- Starter culture (thermophilic yoghurt culture, ME 25 U, Kosher Dairy)
- FAR-M® stick coagulant
- Sugar / salt

Procedure
The procedure adopted was that described by Bruntse (2015)\(^5\), with modifications to fit the local conditions as below:
- Milk (9.45 litres) was pasteurised as described for yoghurt and mala.
- The milk was cooled to 45°C in a water bath (hot to the touch but no burning sensation) as described for yoghurt preparation.
- Yoghurt culture (thermophilic ME 25 U, Kosher Dairy) was added at a rate of 2% (4 to 5 grains of the culture), stirred and left for 1 hour.
- FAR-M® stick coagulant was added (about 1 teaspoonful, but this depends on the quantity of milk) and left at room temperature for 2 hours. FAR-M® stick is a patented enzyme coagulant from Chr. Hansen Laboratories.
- After 1 hour the cheese milk was checked for coagulation (Fig. 8), and it was observed that the curd had started separating from the whey.

Fig. 8. Checking cheese milk for coagulation

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After 2 hours, the curd had separated from the whey and was cut to ease draining of the whey. The cheese milk was cut into a pattern of squares as follows; first one way, then crosswise, and lastly sideways as far as possible (Fig. 9). This helped to speed up the separation of cheese curd and whey.

![Fig. 9. Cutting of the cheese curd](image)

The cheese was salted and poured on a sterile cheese cloth, and the whey drained further (Fig. 10).

![Draining of whey](image) ![Pouring cheese on cheese cloth to drain further](image)

In a variation of this process practiced in Merille, the whey was just drained without cutting the curd—and this was found to be faster and easier to adopt by the women, without breaking the curds. The whey was drained into a clean and sterile container. This produced fresh unripe cheese.

To ensure maximum drainage of the whey, the cheese was left inside the cheese cloth and hung on a roof (Fig. 11) and left overnight to drain. This produced ripened cheese.

The whey was 6.15 litres, hence cheese yield was 3.3 kg (or 35%). This yield compares well with the yield of 23 to 30% of Ethiopian cheese found by Yilma et
The whey from milk fermented with thermophilic cultures is very delicious and nutritious. It can be consumed as a soft drink immediately with a bit of sugar added, or used to make delicious porridge.

- The cheese was salted and sensory evaluation done (results are presented in section 3).

![Image of hanging cheese](image-url)

Fig. 11. Hanging cheese on the roof to drain overnight

### 2.1.3.5 Ghee Processing

**Requirements**

- Cream separator (Model No. 60HSS, RPM 60/80, Capacity 60 litres, Serial No. 1506032, Manufactured by Mahesh Engineering Works, India)

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- Ghee pot
- Clean hygienic milk
- Butter churn
- 2 small sufurias
- Aluminium milk can
- Colander sieve
- Water (for cooling and cleaning)
- Storage containers
- Firewood for heating milk
- Clean sterilised cotton cloth
- 1 small sufuria for collecting cream
- Mesophilic starter culture (optional)

**Procedure**

The procedure adopted for ghee making was that described by Adongo and Wayua (2013)\(^7\), with modifications to fit the local conditions as below:

- All the utensils/containers were sterilised.
- The milk was heated to 45°C inside the yoghurt incubator.
- The warm milk was then poured into the manual cream separator to separate cream from skim milk (Fig. 12).

Fig. 12. Trial run for cream separation in Merti, Logologo

However, ghee could not be produced in all the groups in Logologo and Merille due to defects in the cream separators, as described below:

- The handle of the cream separator in Merti could not rotate smoothly to produce sufficient centrifugal force to separate the cream from skim milk. Cream separator for Odhola women group had never been used ever since it was delivered to the women group. The women brought it to the training venue in Merti where it was assembled. Trial runs done with a little milk showed that it was working, even though the handle required quite much force to rotate, which was going to be a burden to the women.
- The Merti cream separator was taken to the World Vision Laisamis ADP office for further tests but still could not function.
- The cream separator in Lekiji had the same defect as that of Merti. The Ntumo

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cream separator was not functioning as it did not have the centrifuge cones. The cones had been taken by WVK for repair and no feedback had been given to the group. The defects reported above could have been ironed out if the first value addition training could have been comprehensive to cover the range of possible recipes and equipment needed. The above defects with the cream separator were a source of dissatisfaction by the women, as evidenced from results of the post evaluation (see section 4).

**Highlights on Training on Milk Value Addition**

- A total of 40 women (Logologo=17 and Merille=23) were trained on low cost milk processing technologies over a period of 5 days.
- Mala, yoghurt and cheese (fresh and ripened) were successfully prepared using appropriate technology. Ghee could not be processed due to non-functioning cream separators for all the groups.

**2.2 Sensory Evaluation of Processed Dairy Products**

The processed dairy products (mala, yoghurt and cheese) were subjected to sensory evaluation to gauge the level of their acceptability. This was done according to the method of Igwebe et al. (2015) with modifications. The products were evaluated by 35 panellists (Logologo=18; Merille=17) from the milk clusters, CMAs and teachers in a nearby school who were familiar with dairy products; using a 5-point hedonic scale i.e. 5=like very much, 4=like, 3=neutral (neither like nor dislike), 2 = dislike and 1=dislike very much (Annex 8.4). As the panellists had limited previous experience of testing products, the rating test was simplified and limited in respect to consumer preference. The samples were evaluated for colour, smell, taste, consistency and overall acceptability. The instructions were given orally in the local language. The sensory evaluation data were analysed in SPSS Statistics Version 20 (IBM Corporation, SPSS Statistics Release 20.0.0; USA).

Data for sensory evaluation from children was determined qualitatively through participant observation (i.e. by noting the children’s interactions and non-verbal expressions as they tasted the products).

**3. RESULTS AND DISCUSSIONS**

**3.1 Attendance of the training**

Only six members of Merti cluster (out of 15) were available for the training during the first day, it appeared that mobilisation did not reach all the members. The reasons for the low attendance were given as: three had gone to fora (satellite livestock grazing camps), three had delivered babies, one was planning a wedding and one had travelled to Marsabit. None of the members of Odhola milk cluster were available for the training on this day. Reasons given by those who were reached were that two were sick and one was

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9 SPSS 2011 IBM SPSS Statistics Version 20 (Release 20.0.0). IBM Corp., USA
attending to her posho mill business. There was also the challenge of bringing the Odhola participants to Merti, those from Odhola who came on the second day had assembled to the local hotel which was the venue for the first value addition training. The poor mobilisation in both groups could be attributed to the lack of CMAs in these two villages. Informal discussions revealed that CMAs in these villages had gotten better jobs (e.g. some joined the Laisamis-Marsabit road construction activities on-going in the area) and quit their CMA jobs. Nonetheless, the training went on during the first day with the six members of the Merti milk cluster. The full list of training participants for the entire duration of the training is presented in Annex 8.2.

3.2 Processing of Processed Products
The women learnt skills of cleaning milk containers and testing for milk quality before processing. Only one milk sample (batch of 5 litres) failed the platform tests—this was in Merti group. It was evening milk brought from fora. Mala, yoghurt and cheese were successfully processed using low cost methods. However, ghee could not be produced in all the groups in Logologo and Merille due to defects in the cream separators, as described earlier (section 2.1.3.4).

3.3 Sensory Evaluation of Processed Products
3.3.1 Sensory evaluation of yoghurt
Mean hedonic ratings for colour, aroma, taste, consistency and overall acceptability of mala, yoghurt and cheese in the two milk clusters is shown in Table 3.

Table 2. Mean hedonic ratings for colour, aroma, taste, consistency and overall acceptability of yoghurt processed by milk clusters in Logologo and Merille

<table>
<thead>
<tr>
<th></th>
<th>Colour</th>
<th>Smell/ aroma</th>
<th>Taste</th>
<th>Consistency</th>
<th>Overall acceptability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logologo (n=18)</td>
<td>4.94±0.06*</td>
<td>4.94±0.06</td>
<td>4.88±0.08</td>
<td>4.88±0.08</td>
<td>5.00±0.00</td>
</tr>
<tr>
<td>Merille (n=17)</td>
<td>4.00±0.00</td>
<td>3.56±0.16</td>
<td>3.63±0.16</td>
<td>3.88±0.20</td>
<td>3.63±0.16</td>
</tr>
</tbody>
</table>

*Values are mean±SE; A 5-point hedonic rating scale (5=Like very much, 1=Dislike very much)

Yoghurt was so much liked especially by Logologo participants and some even stated, “We should have even continued to process only yoghurt. We took samples to our households and those who tasted liked the product.” The relatively less liking of yoghurt in Merille is that it was unsweetened, whereas that processed in Logologo was sweetened with sugar. Normally pastoralists of northern Kenya prefer sweet /sugared beverages (personal observation by the authors).

3.3.2 Sensory evaluation of mala
Mean hedonic ratings for appearance, colour, taste, texture, aroma and overall acceptability of camel milk yoghurt in the two milk clusters is shown in Table 2. The mala in Merille was not sugared and hence the reduced sensory rating. No mala was processed in Logologo.
Table 2. Mean hedonic ratings for colour, aroma, taste, consistency and overall acceptability of mala processed by milk clusters in Merille

<table>
<thead>
<tr>
<th></th>
<th>Mean hedonic ratings for yoghurt</th>
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<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Colour</td>
<td>Smell/aroma</td>
<td>Taste</td>
<td>Consistency</td>
<td>Overall acceptability</td>
</tr>
<tr>
<td>Merille (n=17)</td>
<td>4.00±0.00*</td>
<td>3.76±0.11</td>
<td>3.59±0.19</td>
<td>3.06±0.26</td>
<td>3.59±0.15</td>
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<td>Logologo (n=18)</td>
<td>-*</td>
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</table>

*Values are mean±SE; A 5-point hedonic rating scale (5=Like very much, 1=Dislike very much); **Dash (-) mean no data

Table 2. Mean hedonic ratings for colour, aroma, taste, consistency and overall acceptability of cheese processed by milk clusters in Logologo and Merille (n=42)*

<table>
<thead>
<tr>
<th></th>
<th>Mean hedonic ratings for cheese</th>
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<tr>
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<td>Smell/aroma</td>
<td>Taste</td>
<td>Consistency</td>
<td>Overall acceptability</td>
</tr>
<tr>
<td>Logologo (n=18)</td>
<td>4.00±0.00</td>
<td>4.00±0.16</td>
<td>3.92±0.18</td>
<td>3.92±0.18</td>
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<tr>
<td>Merille (n=17)</td>
<td>5.00±0.00</td>
<td>4.75±0.16</td>
<td>4.00±0.34</td>
<td>4.75±0.16</td>
<td>4.75±0.16</td>
</tr>
</tbody>
</table>

*Values are mean±SE; A 5-point hedonic rating scale (5=Like very much, 1=Dislike very much)

Cheese evaluated in Merille was fresh cheese whereas that in Logologo was ripened cheese. Participants liked the soft cheese because of its aroma, soft texture and good consistency which they likened to ugali (maize meal stiff porridge). The ripened cheese had a sour taste which many participants did not like. This is explained further under post-evaluation training below.

### Highlights on Sensory Evaluation of Processed Products

- Mala, yoghurt and cheese were evaluated by 35 panellists using a 5-point hedonic scale i.e. 5=like very much, 1=dislike very much.
- Panellists included milk clusters members, CMAs and teachers in a nearby school.
- Sweetened mala and yoghurt, and fresh cheese were rated highly by panellists. Ripened cheese was not liked because of the bitter flavour.

### 4. POST TRAINING EVALUATION

At the end of the training, an exit questionnaire was administered using a semi-structured questionnaire (Annex 8.5). The trainees also outlined practices they would adopt or change based on the acquired knowledge and skills. Informal discussion was also done with the CMA and a community mobiliser, the M4N project officer and other World Vision staff. The results are summarised below:

#### Training Time

All the women from both clusters rated the methods used for the training to be very good, and the training to be relevant. Comments given by all participants why the training was relevant are presented in Fig. 13.
Leant new ways of cooling milk in water bath
Leant assembling of cream separator
Learnt milk quality testing

Why training was relevant

Other comments why the training was considered relevant are presented in the following quotes by participants:

- *If members are committed to milk processing, they can get profit. If they come together and succeed, it will benefit everybody*
- *I have been enlightened on milk*
- *If we can handle milk processing well, it can generate income for use*
- *We handle mostly milk and have learnt that milk needs total hygiene and cleanliness*
- *Have learnt that our cream separator is faulty (i.e. in Ntumo, Lekiji and Merti)*
- *Learnt many things such as tying cheese cloth, adding starter culture, etc.*
- *Have gained new knowledge e.g. boiling milk, adding culture, processing of yoghurt, cheese and mala*
- *Before we never knew milk processing but now we know cheese processing and draining whey in a cheese cloth*
- *By knowing milk processing, we can process yoghurt and sell*

All the participants in Merille considered the training time to be adequate. However, all women in Logologo felt the training time not to be enough. The reasons given are presented in Fig. 14. Participants also felt that such a training should last at least 5 days per cluster. As adults, the participants reported that they were slow in learning and the concepts were new to them and, therefore, they required more time.
Topics considered important but not covered by the training

All the participants in both clusters felt the training did not cover all the areas that were important to them. Areas considered important by Logologo participants but were not covered under the training, in ranked order, were:

- Cream separation and ghee production
- Gardens and greenhouse
- Child feeding
- More training on milk processing

In Merille, areas considered important by the participants but were not covered under the training, in ranked order were:

- Cream separator and ghee production
- Cheese tying to drain whey overnight
- Food handling in general because the participants prepare food in the households on daily basis.

Training component found most useful

All women in Logologo rated yoghurt production to be the most useful part of the training because of the following reasons, in ranked order:

- The product had good consistency, taste and flavour
- Processing was easier
- Because of the good taste, many people could have bought the yoghurt when processed
In Merille, 50% of the participants rated cheese production as the most useful, followed by training methods used (33%) and yoghurt processing (17%). Participants liked the soft unripe cheese because the product “was like ugali” and had good texture and sweet taste. This is unlike the perceived bitter flavour of the ripened cheese prepared in Logologo which was not liked by the participants. Training methods were liked by participants who stated that the methods used were clear and easy to do. Yoghurt processing was liked because of the good taste, which was linked to the likelihood of it being purchased for income generation.

**Intended application of skills learned**

All the participants promised to put the gained knowledge and skills into practice, especially in milk testing, hygiene and cleanliness and keeping milk safe from contamination (Fig. 15).

Other intended applications included:
- applying the hygiene and processing methods at group level and in their own homes.
- boiling milk before feeding to children.
- boiling small amount of milk to check for clotting (i.e. COB) instead of boiling all milk in the sufuria just in case all is bad milk.

**General comments**

The general comments were as follows:
- All equipment need to be assembled in the Merti milk house. Equipment in Odhola had not been installed and the group had not processed any product since the first training in August 2015.
- Participants needed functioning cream separator, and some of them commented, “We do not know if the cream separator is the exact machine or just a sample. We need to be given proper machine.”
- Ripened cheese did not have a good taste
Post Training Evaluation Highlights

- Training rated to be relevant and methods used for training to be very good
- Merille participants considered training time to be adequate, unlike Logologo participants
- Yoghurt and cheese production were rated highly
- Participants were frustrated by non-functioning cream separators
- Participants intended to apply the knowledge gained

5. LESSONS LEARNT AND BEST PRACTICES

(a) Logologo Merti dairy structure was located near the borehole but had no security. Hence, this meant removing equipment every day after processing during the training and taking back to the manyatta or nearby school, which was cumbersome. This consumed much of the training time. As it is currently, the structure is not currently helping the Merti women group and need to be relocated to a place with security, preferably within the manyattas. This, together with the fact that the structure was not cemented on the floor made the group not to process milk in the structure. The group claimed that WVK had promised to cement the floor of the structure and were waiting for this to be done before they could commence processing.

(b) Ntumo dairy structure was located within the manyatta for security reasons, hence there was no need for transporting the equipment before and after processing as was the case in Logologo. Hence more time was devoted to training and this could probably explain why Merille participants considered training time to be adequate unlike their Logologo counterparts.

(c) Groups without the jiko and yoghurt incubator were not processing milk as they perceived that milk processing was not possible without these equipment. They believed that this was the reason why the two value addition trainings were done at the premises of the groups with these two equipment (amongst other equipment common to both groups). Upon this realisation, all the groups were told that they could still processing milk as long as they used a water bath—i.e. one large sufuria for hot water and a relatively smaller sufuria for milk which was to be put in the hot water bath. Another lesson learnt from this is that probably the 10 milk processing groups were too many for the pilot M4N project, as the project could not supply all the required milk equipment for the groups.

(d) All milk processing equipment should have been pre-tested before delivery to the milk clusters. Upon delivery to the groups, the women should have been shown the assembling and use of the equipment (preferably during the first training, but this was not done, especially for cream separator and butter churn).

(e) The first training on milk value addition should have been comprehensive to capture the range of possible products and identify any short coming on product processing methods and equipment used. This could have helped identify non-functioning equipment, especially the cream separator, and remedial actions promptly taken and rectified by the time of the second / refresher training.

(f) Ntumo group was able to link the training milk processing to that on cooperative and marketing, and also to the kitchen garden. Waste water from washing of dairy equipment was used for irrigating crops in the kitchen garden. This provides a
good linkage with the Food and Nutrition Security and Resilience Enhancement Project (FONSAREP).

6. CONCLUSIONS
Training on low cost milk processing was successfully conducted for Logologo and Merille clusters. There was adequate milk following the April-May rains and products such as mala, yoghurt and cheese (fresh and ripened) were successfully prepared using appropriate technology. However, ghee could not be processed due to non-functioning cream separators for all the groups in the two clusters. Sweetened mala and yoghurt, and fresh cheese were liked by participants. However, ripened cheese was not liked because of the bitter flavour.

7. RECOMMENDATIONS
(f) Refresher training on milk processing (and other aspects of the M4N project) need to be tailor-made to the needs for each specific group, as identified from regular monitoring data. For example, training for Ntumo women group should emphasise on ghee production, group dynamics and marketing of processed milk products. For Lekiji and Logologo groups, emphasis should be on ghee processing, milk processing, group dynamics and marketing of processed milk products.
(g) To enhance marketing of dairy products from the milk clusters, samples of processed products should be taken for analysis at the Kenya Bureau of Standards (KEBS) and certification secured so as to enhance consumer confidence.
(h) Cream separators for all the groups need to be repaired and tested with the processing groups.
(i) Due to seasonality in milk production in the pastoral set-up, the M4N groups should diversify their income sources so that they continue being active during times with low or no milk availability. Diversification options include kitchen gardens and mother-to-mother support groups. This provides a good linkage with the FONSAREP Project, which will also help to bring out the nutrition component of the M4N, which has been salient in the two years of implementation.
(j) Since this is a milk for nutrition project, very good progress has been made on the food science part. What is yet to be seen is the nutrition component, and this should form a significant focus of future works.
(k) The clusters still need a point person, the equivalent of the CMAs. The effectiveness of the CMAs need to be evaluated or alternative point persons provided and monitored to inform learning.
8. ANNEXES

8.1 Training programme

<table>
<thead>
<tr>
<th>Day /Date</th>
<th>Venue</th>
<th>Activity</th>
<th>Number of Cluster Participants</th>
</tr>
</thead>
</table>
| Day 1: 23/05/2016 | Merti (Logologo) | • Cleaning of milk containers  
• Testing milk quality  
• Yoghurt processing | 6                             |
| Day 2: 24/05/2016 | Merti (Logologo) | • Sensory evaluation of yoghurt  
• Cheese making | 14                            |
| Day 3: 25/05/2016 | Merti (Logologo) | • Sensory evaluation of cheese  
• Ghee making (trial runs with cream separator)  
• Post-training evaluation | 16                            |
| Day 4: 26/05/2016 | Ntumo (Merille)  | • Cleaning of milk containers  
• Testing milk quality  
• Yoghurt and mala processing | 16                            |
| Day 5: 27/05/2016 | Ntumo (Merille)  | • Sensory evaluation of yoghurt and mala  
• Cheese making  
• Post-training evaluation | 22                            |

8.2 List of Participants (Training Attendance Form)

**Day 1: 23/05/2016 Logologo Cluster**

<table>
<thead>
<tr>
<th>No.</th>
<th>Full Name</th>
<th>Gender (F/M)</th>
<th>Village /Organisation</th>
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<td>1.</td>
<td>Kureyo Sanchir</td>
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<td>Marti</td>
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<td>Ngereyo Kochale</td>
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<td>Rangian Sanchir</td>
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<td>Dan Shibale</td>
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<td>Manyatta Juu (translator)</td>
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<td>8.</td>
<td>Mary Karigo</td>
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<td>WVK</td>
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<td>Caroline Kanda</td>
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</tr>
<tr>
<td>10.</td>
<td>Francis O. Wayua</td>
<td>M</td>
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**Day 2: 24/05/2016 Logologo Cluster**

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**Day 3: 25/05/2016 Logologo Cluster**

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**Day 4: 26/05/2016 Merille Cluster**

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### Day 5: 27/05/2016 Merille Cluster

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<tr>
<td>16</td>
<td>Kopepei Lekulate</td>
<td>F</td>
<td>Ntumo</td>
</tr>
<tr>
<td>17</td>
<td>Ngeneyo Lenairoshi</td>
<td>F</td>
<td>Ntumo</td>
</tr>
<tr>
<td>18</td>
<td>Ntimbiko Lengaikipen</td>
<td>F</td>
<td>Lekiji</td>
</tr>
<tr>
<td>19</td>
<td>Sekuloa Lechakwet</td>
<td>F</td>
<td>Lekiji</td>
</tr>
<tr>
<td>20</td>
<td>Ntoponwa Lealo</td>
<td>F</td>
<td>Lekiji</td>
</tr>
<tr>
<td>21</td>
<td>Maristella Leinte</td>
<td>F</td>
<td>Lekiji</td>
</tr>
<tr>
<td>22</td>
<td>Ntityfon Letoeeye</td>
<td>F</td>
<td>Lekiji</td>
</tr>
<tr>
<td>23</td>
<td>Ambrose Leinte</td>
<td>M</td>
<td>CMA, Lekiji (0728914550)</td>
</tr>
<tr>
<td>24</td>
<td>Caroline Kanda</td>
<td>F</td>
<td>WVK/ Meru University</td>
</tr>
<tr>
<td>25</td>
<td>Francis O. Wayua</td>
<td>M</td>
<td>KALRO</td>
</tr>
</tbody>
</table>

### 8.3 Milk production record sheet—Quantity of Milk for Processing

<table>
<thead>
<tr>
<th>Date</th>
<th>Cluster</th>
<th>[1=Logologo; 2=Laisamis; 3=Lontolio; 4=Merille; 5=Ngurunit]</th>
<th>Processing site</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Full Name of Member</th>
<th>Milk type</th>
<th>Source of milk</th>
<th>Quantity transported from source to processing site (L)</th>
<th>Transport time taken (hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1. Camel</td>
<td>1. Own herd</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Cattle</td>
<td>2. Neighbours herd</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. Sheep</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

22
8.4 Sensory evaluation questionnaire for processed products

Date ____________________________
Cluster _________ [1=Logologo; 2=Laisamis; 3=Lontolio; 4=Merille; 5=Ngurunit]
Full Name of Panellist ____________________________ Gender _____ [1=Male, 2=Female]

Sensory Evaluation of Yoghurt
Please indicate the level of acceptability of yoghurt

<table>
<thead>
<tr>
<th>Product attribute</th>
<th>Level of acceptability (Tick ONLY ONE per product attribute)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Like very much</td>
</tr>
<tr>
<td>Colour</td>
<td></td>
</tr>
<tr>
<td>Smell / aroma</td>
<td></td>
</tr>
<tr>
<td>Taste</td>
<td></td>
</tr>
<tr>
<td>Consistency / texture</td>
<td></td>
</tr>
<tr>
<td>Overall acceptability</td>
<td></td>
</tr>
</tbody>
</table>

Sensory Evaluation of Mala
Please indicate the level of acceptability of *mala*

<table>
<thead>
<tr>
<th>Product attribute</th>
<th>Level of acceptability (Tick ONLY ONE per product attribute)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Like very much</td>
</tr>
<tr>
<td>Colour</td>
<td></td>
</tr>
<tr>
<td>Smell / aroma</td>
<td></td>
</tr>
<tr>
<td>Taste</td>
<td></td>
</tr>
<tr>
<td>Consistency / texture</td>
<td></td>
</tr>
<tr>
<td>Overall acceptability</td>
<td></td>
</tr>
</tbody>
</table>

Sensory Evaluation of Cheese
Please indicate the level of acceptability of Cheese

<table>
<thead>
<tr>
<th>Product attribute</th>
<th>Level of acceptability (Tick ONLY ONE per product attribute)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Like very much</td>
</tr>
<tr>
<td>Colour</td>
<td></td>
</tr>
<tr>
<td>Smell / aroma</td>
<td></td>
</tr>
<tr>
<td>Taste</td>
<td></td>
</tr>
<tr>
<td>Consistency / texture</td>
<td></td>
</tr>
<tr>
<td>Overall acceptability</td>
<td></td>
</tr>
</tbody>
</table>

8.5 Post training evaluation questionnaire

Date of training ____________________________
Training venue ____________________________
1. Full Name of Respondent ____________________________
3. How do you rate the trainer’s presentation methods?_______
   1. Very Good; 2. Good; 2. Fair, 4. Poor
4. Was the time allocated for training enough?_______[0=No; 1=Yes]
5. If No, please give reasons?
   1. _______________________________________
   2. _______________________________________
   3. _______________________________________
6. Suggest areas that you think are important but were not covered under this training.
   1. _______________________________________
   2. _______________________________________
   3. _______________________________________ 
7. Was the training relevant to you?_______ [0=No; 1=Yes]
8. If Yes, please comment.
1._______________________________________________________________________________
2._______________________________________________________________________________
3._______________________________________________________________________________

9. If No, please comment
1._______________________________________________________________________________
2._______________________________________________________________________________
3._______________________________________________________________________________

10. What part of the training did you find most useful and why?
    Part most useful________________________________________________________________
    Why useful? 1._________________________________________________________________
    2.___________________________________________________________________________
    3.___________________________________________________________________________

11. How are you intending to apply what you have learnt?
    1._____________________________________________________________________________
    2._____________________________________________________________________________
    3._____________________________________________________________________________

12. Other comments
    1._____________________________________________________________________________
    2._____________________________________________________________________________
    3._____________________________________________________________________________

8.6  Pictorial of the training

Fig. 16. Yoghurt culture used during the training
Fig. 17. Thermophilic yoghurt starter culture – YF-L812 [Freeze dried lactic culture for Direct Vat Set (DVS)]

Fig. 18. Mesophilic aromatic cultures for making mala i.e. CHN-22 and Flora Danica [Freeze dried lactic culture for Direct Vat Set (DVS)]
Fig. 19 FAR-M® sticks for cheese making

Fig. 20. Checking milk quality (left), and sieved residues from milk (right)
Fig. 21. Stirring set yoghurt after adding flavour (left) and processed yoghurt packed in plastic bottles

Fig. 22. Sensory evaluation of processed products by women and children