SAIRLA

Sustainable Agricultural Intensification Research and Learning in Africa

Exploring alternatives for livestock production in Lushoto, Tanzania

Playing the Transformation Game
Report of ResLeSS Workshop 2

September 2018

Prepared by SEI, ILRI and Sokoine University of Agriculture on behalf of SAIRLA

Exploring alternatives for livestock production in Lushoto, Tanzania: Playing the Transformation Game

Report of ResLeSS Workshop 2, held on 5-6 June 2018, at Lushoto Highland Park Hotel, Lushoto

September 2018

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Acroymns

Acronym	
A	Acceptable
A Level	Advanced Level
C1	Cross breed somewhat improved
C2	Cross breed much improved
Cb	Cross breed
CBR	Cross breed baseline
CGIAR	Consultative Group on International Agricultural Research
CLEANED	Comprehensive Livestock Environmental Assessment for improved Nutrition, a secured Environment and sustainable Development
CO2eq	Carbon dioxide equivalent
CRP	CGIAR Research Program
D	Desirable
DED	District Executive Director
DFID	UK Department for International Development
E	(mostly) Exotic breed
E1	(mostly) Exotic breed somewhat improved
E2	(mostly) Exotic breed much improved
EBR	(mostly) Exotic breed baseline
ECRC/EDRI	Environment and Climate Research Center (ECRC) at Ethiopian Development Research Institute (EDRI)
GCSE	General Certificate of Secondary Education
GHG	Greenhouse Gas
H	High
ha	hectares
ICARDA	International Center for Agricultural Research in the Dry Areas
ILRI	International Livestock Research Institute
INERA	Institut de l'Environnement et de la Recherche Agricole
kg	kilogram
L	Local breed
l	litre
L	Low
L1	Local breed somewhat improved
L2	Local breed much improved

LBR	Local breed baseline
LUC	Land Use Change
M	Medium
N	Nitrogen
NGO	Non-governmental organisation
NRI	Natural Resources Institute
O Level	Ordinary Level
ResLeSS	Research and Learning for Sustainable Intensification of Smallholder Livestock Value Chains
SACCOS	Savings and Credits Cooperative Societies
SAI	Sustainable Agricultural Intensification
SAIRLA	Sustainable Agricultural Intensification Research and Learning in Africa
SEI	Stockholm Environment Institute
SUA	Sokoine University of Agriculture
Tsh	Tanzanian Shilling
U	Unacceptable
UK	United Kingdom
UoY	University of York
VICOBA	Village community Bank

Executive Summary

This report presents the design for and preliminary results from the second ResLeSS workshop in Tanzania. The workshop is focused around the development of socio-economic indicators that are shared between stakeholders, and a "Transformation Game" that engages stakeholders in scenario development and assessment focused on the CLEANED environmental impact simulation tool. This approach enabled participants to engage with the knowledge about higher-yielding dairy production and an opportunity to plan for the future. An explicit focus on equity, through the design of the workshops and Game, and the treatment of economic indicators that encompass wider perceptions of value than finance alone, helped ensure that dialogue was able to emerge rooted in an appreciation of the different perspectives held by stakeholders. The Game opened a space for discussion that has yielded important insights for future development planning and was valued by the workshop participants. Participant feedback makes clear that the workshop developed new knowledge and achieved the objective of creating an opportunity for joint learning - participants welcomed the opportunity to plan for the future and to be challenged on what is feasible in the future.

The workshop revealed a shared desire among stakeholders for livestock livelihoods to provide an improved standard of living and wellbeing, and a shared appreciation that improved feed and animal management coupled with shifting to higher-producing breeds can double milk production. There were different opinions on how much to change – "he who dares wins" pitted against a more cautious approach recognising that many in Lushoto would not cope with the increased costs of keeping pure exotic breeds. The transformation game provided rhetorical space to explore the two perspectives, although participants missed having a simple cost calculator.

The results indicate a clear sense that participants are focused on meeting socio-economic goals (expressed for the most part in terms of increased income from livestock) and that, in the highland part of Lushoto, a strategy of moving to cross breeds and exotic breeds with good management presents an opportunity to reduce environmental impacts in Lushoto. Pressure on land and water is reduced and although greenhouse gas emissions increase, the emission intensity reduces. The move to zero-grazing will benefit soil fertility in Lushoto, as more manure can be applied to fields. However, three trade-offs arise:

i) There are financial costs of keeping the high-producing breeds to take into account, as they are more vulnerable to disease and have high feed and maintenance requirements – and as production increases, the milk price in Lushoto may fall. Not everyone in the district will have the financial resources to invest in high-producing breeds.
ii) The feedbasket for high-producing breeds relies mainly on planted fodder and purchased concentrates. In an area where land is restricted, the additional planted fodder will compete with existing crops, potentially affecting food security. Although there is a sense that planted fodder for milk would provide higher returns than ill-suited maize, producers will need to consider what is the best use of their land.
iii) The reliance on purchased concentrates effectively exports the environmental impact, allowing for the reduced pressure in Lushoto. Although this benefits Lushoto, national planning should take this into consideration.

Overall, the workshop was a positive learning experience for all, providing an important opportunity to come together, but it is only the start of an ongoing conversation.

1 Introduction

This report summarises the design and initial findings from the second workshop of the Research and Learning for Sustainable Intensification of Smallholder Livestock Value Chains (ResLeSS) project in Lushoto district of Tanga Region, Tanzania, which is part of the Sustainable Agricultural Intensification Research and Learning in Africa (SAIRLA) programme, funded by UK DfID and managed by the Natural Resources Institute (NRI) at the University of Greenwich and WYG. The overall aim of the second workshop is to support participants to undertake a shared evaluation of the social, economic and environmental consequences of plausible livestock futures. The workshop was officially opened by Lushoto District's Executive Director (DED), Adeladius Makwega, who urged the participants to assimilate and share the learning with other society members.

ResLeSS is investigating a process that supports decision-makers in using a rapid ex-ante environmental impact assessment tool (CLEANED[1]) and a participatory economics approach together with input from local stakeholders, to produce decisions that have taken into account three pillars of sustainability – the environment, economics and equity. Using a social learning approach, the project follows a facilitated process of two workshops supported by a reconnaissance tour and ongoing outreach that is designed to enable stakeholders to consolidate their own understanding and priorities before acknowledging the perspective of others.

Workshop 1, conducted in July 2017, gathered data from stakeholders connected to livestock livelihoods in relation to the environment and socio-economics. This work set the stage for the second workshop in two ways. First, the environmental data gathered enabled the parameterisation of the computer-based environmental impact assessment tool (CLEANED), so that it can be used to explore the impacts of alternative livestock futures in the study area in Tanzania. Second, engaging with participants around desirable socio-economic futures started a process of capturing an understanding of value that is wider than that offered by a financial assessment alone. Together, these two steps provide the grounding for a process of disciplinary integration and participatory appraisal of potential livestock futures, which we understand to constitute a transdisciplinary research approach.

This transdisciplinary enquiry into livestock futures, via a participatory process that explores the relationship between economics and the environment, is the focus of Workshop 2. The second workshop is a two-day event (balancing the need for sustained interaction with the realities of stakeholder time commitment) that builds on Workshop 1 through:

- Use of the CLEANED R tool to generate environmental impact data for different livestock scenarios, parameterised for the case study site in each country using the data gathered in Workshop 1
- The assessment of livelihood impacts of alternative livestock scenarios, using the socio-economic indicators developed during Workshop 1.

Taken together, the two workshops offer a systematic process that works towards the development of more equitable relationships between stakeholders through improved mutual understanding and shared learning.

1.1 Workshop design

To achieve the workshop aims, the design incorporates five central tools and concepts.

First, the workshop makes use of a computer-based environmental simulation tool, called ***CLEANED***. CLEANED calculates environmental impacts (water use, greenhouse gas emission, biodiversity loss and nitrogen balance) for a given area based on the livestock production that is being undertaken in that area. This production is expressed in terms of parameters that can be defined via a user interface (developed during the project). The underlying code consists of 5 modules: livestock productivity, water, greenhouse gas, biodiversity and nitrogen balance.

1 Comprehensive Livestock Environmental Assessment for improved Nutrition, a secured Environment and sustainable Development.

Second, the report refers to ***livestock production practices*** to describe ways of keeping livestock (a combination of livestock species - cows or sheep, traditional or improved breeds - feed requirements, and management). In CLEANED, each livestock production practice is parameterised by approximately 17 parameters (differences in land use for feed production, feed basket, animal productivity, manure management etc.).

Third, a ***vignette*** is a pre-defined narrative description of a particular livestock production practice (e.g. traditional cattle extensively grazed, or improved cattle tethered and fed with locally grown grasses). A combination of vignettes can be used to quickly formulate a plausible livestock future for the landscape – referred to as a ***scenario***. For each vignette all CLEANED parameters are fixed, and by only selecting which vignettes to include and the number of animals assigned to each vignette, the participants can define a scenario (e.g. 5000 animals in vignette A, 500 in B, 7000 in C).

Thus (and fourthly), a ***scenario*** refers to one possible mix of different livestock production practices in a defined landscape. This encompasses the types of livestock production practices assumed to be present and the proportion (or scale) of each practice. For a particular scenario, CLEANED calculates the environmental impact from the mix of livestock production practices in a landscape.

Finally, the workshop culminates in participants playing the ***Transformation Game.*** The Transformation Game enables groups of participants to define a livestock scenario using the vignettes, and then explore the socio-economic consequences of that scenario (via indicators developed in Workshop 1 and refined at the outset of Workshop 2) and environmental consequences (using computers running the CLEANED simulation).

Through discussion of how these results might be interpreted and valued, the Transformation Game enables learning to develop between stakeholders with different viewpoints on livestock livelihoods. Together, the group can then revise their scenario, and test this new scenario using the socio-economic indicators and CLEANED. In this way, the game allows participants to explore livestock futures and develop a better sense of the trade-offs that are embedded in different choices and how these trade-offs are experienced by different stakeholder groups.

1.2 Report structure

The report is organised into three substantive sections, together with this introduction and a conclusion that draws together the main findings. Additionally, there is a companion report that sets out the parameterisation of CLEANED for Tanzania (Pfeifer et al., 2018). Section 2 describes the design of the Transformation Game, setting out the key features, how it is initialised to provide a representation of plausible livestock futures in Lushoto, how it is played and how it forms part of the overall participatory workshop design. Section 3 presents the results of the workshop and Game, in terms of the socio-economic indicators jointly agreed between stakeholder groups, the desirable scenarios developed by each stakeholder group, and the discussions and trade-offs that emerged during playing of the Transformation Game in mixed stakeholder groups. Section 4 provides a discussion that reflects on the results in terms of stakeholder priorities, the conditions for learning, trade-offs and synergies, and the wider context that was not embedded into the Game but became an important part of the discussion.

1.3 Participant selection

As far as possible, we invited the same participants that were present in Workshop 1. Throughout we used purposive sampling to select participants, with the primary objective to have representation from each type of stakeholder connected with the value chain, and as a secondary objective, to aim for gender balance. The workshop had 34 participants, representing 6 types of value chain stakeholders, identified in consultation with local researchers: livestock producers; traders; processors; consumers (hotel and butchers); government administration; and extension services. For further detail of the composition and selection of chosen stakeholders and groups, see Appendix A.

For the activities, participants were split into four roughly equal-sized groups in Workshop 1, and these groups were maintained for the first section of Workshop 2[2]. These four groups were homogeneous with respect to stakeholder type, so that members within a group were more similar to each other, in terms of experiences and perspective on the value-chain, than to the members of other groups. The 6 stakeholder categories were arranged into 4 groups as follows:

- Two farmer groups – the number of farmers was so large that they were split into two groups, including the representatives of the (dairy) livestock farmer groups that were set up in each village by the Maziwa Zaidi programme[3] (9 + 10)
- Traders – this included milk processors, milk collectors and butchers (8)
- Local administration and experts – this included the Regional and district administration, extension services, Chairpersons from milk collection centres and village chairman and henceforth referred to as the 'policy-makers' group (7)

1.4 Sources of data

The material in the report is drawn from documentation recorded and discussions held during and after the workshop:

- flipcharts that recorded intermediate outcomes during the two workshop days;
- six reports written by the workshop facilitators recording their observations and reflections on the proceedings of the workshop;
- reflections by the facilitators and project team collected in de-briefing conversations during and after the workshop;
- pre- and post-questionnaires filled in by the participants; and
- thirteen individual semi-structured interviews held with selected participants following the workshop (selected because they showed particular interest in the proceedings or were representative of specific groups; representing livestock producers from villages around Lushoto, milk traders, Tanga Dairy cooperatives and the regional secretariat).

2 The Transformation Game in Lushoto

The 'Transformation Game' is a novel contribution of the project that allows participants to devise and assess future livestock scenarios. It forms the central focus of Workshop 2.

For the basic methodology, which is the same as was used in the Workshop 2 in Burkina Faso, see Appendix B. Changes made for Workshop 2 in Tanzania based on consultation with the local facilitators or in response to how the workshop unfolded are included in Appendix B (Section 9.4). The following section describes the initial parameters of the CLEANED tool and Transformation Game for Lushoto District, Tanzania (Section 2.1).

2.1 Initialising the Transformation Game for Lushoto, Tanzania

Full details of the parameterisation of CLEANED for the study site can be found in the companion report (Pfeifer et al., 2018). Here, we summarise the key points that define how the Transformation Game is played to allow interpretation of the results.

[2] However, there was some confusion in remembering which groups some individuals belonged to, with the result that a hotel representative and processor were in one of the farmer groups but chose to stay when asked if they were in the right group, and a milk collector joined the policy-maker group instead of the trader group. The misplacement was only realised late or after the workshop.
[3] The Maziwa Zaidi or MoreMilkIT programme is an initiative of the CGIAR Livestock Research Program, run by ILRI, to support the development of the smallscale dairy value chain across Tanzania, by setting up innovation platforms in high potential areas, including Lushoto. See https://cgspace.cgiar.org/handle/10568/81347 for more information

Three livestock categories were maintained based on the reflections from workshop 1.

1. Local animal
2. Cross breeds
3. (mostly) Exotic breeds

A cross breed is a mixture between the local Zebu and an exotic dairy breed such as Jersey, Ayrshire or Friesian; the differentiation between Cross-breed and (mostly) Exotic is in the ratio of exotic:local genes. A mostly exotic breed is considered to have more than 80% exotic genes, based on expert consultation, because there are reportedly no or very few pure exotic breed dairy cows in Lushoto according to the experts consulted.

Based on a literature review on livestock productivity and most recent research data available at ILRI in Tanzania, the vignettes were developed in relation to each of the production categories. Each vignette represents a credible combination of feed basket[4] and animal productivity for each animal category. Parameters defining the feed basket required to support a particular milk yield have been derived from the literature and reviewed by a feed and fodder expert. These define vignettes that are credible and based on nutrition available in Lushoto. Table 1 sets out a total of 11 vignettes; each of these was pre-programmed into CLEANED to allow them to be rapidly accessed during the workshop.

Table 1 : Vignettes and their descriptions.[a]

	Code	Description
Local Breed (L)	LBR: Baseline (current state)	Current way of keeping local breed dairy animals, relying on grass and crop residues only
	L1: somewhat improved	Local breed dairy animals, kept extensively, fed little planted fodder and little concentrates (bran and oil seed cake), with hay and silage in dry season
	L2: much improved	Good quality local breed dairy animals, fed some planted fodder and little concentrates (bran and oil seed cake), with silage in the dry season
Cross Breed (Cb)	CBR: Baseline (current state)	Current cross-breed dairy animal, fed little planted fodder and little concentrates (bran and oil seed cake), with little hay in dry season
	C1: somewhat improved	Cross-breed dairy animals, fed some planted fodder and some concentrates (bran and oil seed cake), with hay and silage in dry season
	C2: much improved	High-quality cross-breeds, are fed an optimum amount of planted fodder and concentrates (bran and oil seed cake) with hay and silage in the dry season
Mostly Exotic Breed (E)	EBR: Baseline (current state)	Current specialised dairy production with 'mostly exotic' breeds, fed on some planted fodder and little concentrates (bran and oil seed cake), with hay and silage in the dry season
	E1: somewhat improved	Intensive dairy production with 'mostly exotic' breeds, fed mainly on planted fodder and some concentrates (bran and oil seed cake), with hay and silage in the dry season
	E2: much improved	Intensive dairy production with 'mostly exotic' breeds, are fed an optimum of planted fodder and some concentrates (bran and oil seed cake) and hay and silage in the dry season
Land use change (x%)		Choose how much feed biomass you need (in terms of % of existing cropland), for which you want to convert to crop land. Cropland will be converted from any land use (excepted protected area and forests) based on proximity of already existing cropland and suitability for crop.
Crop productivity (+20%)		Increase crop and fodder yields by 20%. More manure and chemical fertiliser is applied to croplands.

[4] A 'feed basket' is the type and proportion of feeds used (e.g. 40% grass, 40% crop residues, 5% maize bran etc.)

[a]The current version of each production category is comprised of three vignettes; there are a further two progressive futures for each category (six vignettes); An additional two vignettes offer opportunities to allow land use change, and a crop productivity increase. Total = 11 vignettes.

The baseline or current state number of animals in each production category have been defined for Lushoto as set out in **Error! Not a valid bookmark self-reference.**, along with the number of animals represented by each brick used in the Transformation Game.

Table 2 : Number of animals[a] in the baseline scenario in Lushoto, Tanzania

Category	Baseline CLEANED	Bricks	Single Brick value
L Local breed	25,000	25	1000 animals
Cb Cross breed*	15,000	15	1000 animals
E (mostly) Exotic breed	0 (less than 1,000)	0	1000 animals
Total animals	40,000		

[a] The CLEANED tool only considers the dairy animals in Lushoto District, therefore the total number of cattle in Lushoto District is in fact higher
* The Cross-breed category includes cross-bred cows with 50 - 80% exotic genes; the (mostly) Exotic breed category includes cross-bred cows with more than 80% exotic genes

The productivity and environmental measures presented in the workshop to contribute to the discussion were tailored to capture relevant aspects of resource use in Lushoto. The results indicate the average impact for the whole study area for that scenario, showing how the measure has changed as a percentage difference compared to the baseline. The baseline is an approximation of the current situation.

Productivity measures (See Table 25, in Appendix B, for the scorecard template):

- Milk produced (litres): how much more/less milk is produced in total by all the cows in the study area in one year (+/- x%)
- Maize produced (tons): how much more/less maize might be produced in the study area as more/less crop residues are used by the herd in the study area (+/- x%)[5]
- Cropland required (ha), Grazing land required (ha): how much more/ less crop and grazing land is required to produce the feed needed by the herd in the study area for this scenario (+/- x%)
- Import: whether feed needs to be imported because there is not enough land in Lushoto to produce it, as how much land is in excess (+x% or 0)

Environmental measures, in terms of the change in resources used to produce the feed for the scenario compared to today (See Table 26, in Appendix B, for the scorecard template):

- Water used, both in total (litre) and as an intensity (Litres water per animal, Litres water per kg milk)
- Green-house gases emitted, both in total (kg CO_2eq) and as an intensity (Total CO_2eq (kg) per animal, Total CO_2eq (kg) per kg milk)
- Soil fertility: how the Nitrogen balance may change (kg Nitrogen in minus kg Nitrogen out), and how much manure is produced by the herd in the study area (tons)
- Biodiversity: the number of endangered species losing critical habitat in the event of a land use change

[5] This is inferred from how much less maize crop residues are required in the new feedbasket, and therefore how much less maize corn is associated with livestock in this scenario, and therefore raising for group consideration the possibility that planted fodder, for example, might replace that amount of planted maize, assuming livestock feed needs have influence in whether or not maize is planted

3 Workshop results

3.1 Socio-economic performance indicators

Each stakeholder group was asked to revisit the socio-economic indicators which they had co-defined in their groups in Workshop 1, which had been developed from the group's "Narrative of success" focused on a day in the life of a fictitious individual ten years in the future (Table 3). These indicators were refined during the opening session of Workshop 2, to make them more specific and measurable, such that they could measure progress towards the achievement of the successful futures envisioned during Workshop 1. Details of the refined group indicators, and the discussion that underpinned their refinement, are provided in Appendix D.

Table 3 : Individual group co-defined indicators, in order of priority

Farmers 1	Farmers 2	Traders	Local administrators and experts
Improved livestock	Education	Having improved dairy livestock breeds	Owning land and modern house
Good livestock practices	Modern cattle house (with store for feeds)	Building a modern house for the family	Ability to pay for education
Education	Owning land	Educating 2 children	To own improved animal livestock breeds
Land	Enough food for entire year (food secure)	Purchasing more land for food and feed production	Having a stable, healthy and happy family
Livestock advisor	Modern Livestock breeds	Buying a car for carrying pasture	Being food secured

The three indicators refined by each group are highlighted.

Combined indicators[6] that would represent all participants were developed in a two-step process: first, drawing together similar indicators from the different stakeholder groups and identifying an average or dominant trend in the low/medium/high targets[7]. It was important that, as far as possible, (a) the particular views of a group were not subsumed within a cluster (i.e., being sure to emphasise subtler differences within each cluster), and (b) that those groups with 'outlier' views (e.g., in a cluster of one) were not ignored or undervalued.

Second, this initial set of combined indicators was refined following feedback from each stakeholder group. Feedback was invited per stakeholder group to ensure that each group's consideration of the combined indicators was undertaken with the support of their facilitator, enabling each group to voice its concerns/satisfaction at this stage in a coherent and representative manner. A plenary feedback session may not have achieved this. Once agreed upon, the combined indicators were used in the rest of the workshop to assess the socio-economic impact of different scenarios. The following provides the detail for each finalised combined indicator, incorporating changes arising from the group feedback, along with a summary of the stakeholder group priorities from which it was derived.

[6] The combined indicators are equivalent to the Key Performance Indicators (KPI) anticipated in the project design. They are evaluated in terms of the scenarios developed for Tanzania during the Transformation Game; the Game is a process of evaluating the indicators under emerging scenarios.

[7] Time constraints meant that the clustering was undertaken by the project team, with time allowing for only one round of reaction and feedback with the participants. The combined indicators should thus be considered provisional, and ideally would be confirmed by further consultation with the stakeholders, including negotiation over the final meaning associated with indicators that have been clustered due to their similarity.

Education

Description	Progress towards achieving success			
	Final level	Low	Medium	High
Percentage of families that are able to educate at least 2 children.	**Primary school**	≤80%	80-90%	90-100%[8]
	Form 4	≤70%	70-80%	80-90%
	Form 6	≤30%	30-50%	50-70%
	University	≤15%	15-30%	30-40%

This indicator collates the priorities expressed by Farmer group 1, Farmer group 2, Traders, Policy-makers.

The objective of this indicator was that children should get an education which will enable them to get employed or create employment. This indicator was hotly debated when refining indicators in groups, in terms of what would allow someone to be employable. To account for different objectives of education, the progression markers were disaggregated, to acknowledge that most children should be educated to at least Form 4 (as education in Tanzania is free until Form 4) but that far fewer might be expected to reach University level, although it was agreed that a University level degree or a diploma is the ultimate ambition to give children the edge over those leaving school with just Form 4 (GSCE/ O level) or Form 6 (A level) education.

Fertile land

Description	Progress towards achieving success	
Percentage of households that own fertile land with certificate of ownership in the lowland and upland of at least 1 acre.	**Low**:	≤10%
	Medium:	10-30%
	High:	30-70%

This indicator collates the priorities expressed by Farmer group 1 and Farmer group 2.

Improved livestock

Description	Progress towards achieving success	
Percentage of households that own at least 2 cross breed and 2 exotic breed dairy cows	**Low**:	≤20%
	Medium:	20-50%
	High:	50-80%

This indicator collates the priorities expressed by Farmer group 1, Farmer group 2, Traders, Policy-makers.

Modern house

Description	Progress towards achieving success	
Percentage of households to own a modern house made of bricks, with water and electricity	**Low**:	≤20%
	Medium:	20-50%
	High:	50-70%

[8] To be statistically correct, the 'High' ranges should be read as 90<x≤100%.

This indicator collates the priorities expressed by Traders, Policy-makers.

Food security

Description	Progress towards achieving success	
Percentage of households that are food secure with a diversity of nutrition throughout the year	**Low**:	≤60%
	Medium:	60-80%
	High:	80-100%

This indicator was added by the facilitators as it was one of the top 5 indicators in two groups initially, but did not make it to the top 3 indicators that were refined in this workshop. It was brought back into the initial suggestion for combined indicators to avoid losing a potentially important indicator due to lack of time. All groups agreed that it should stay in.

3.1.1 Group reactions and discussion of indicators

The five indicators above incorporate minor changes made following plenary feedback from each stakeholder group. The immediate reaction to the proposed indicators was broad agreement, but as the groups gave their feedback, some details were hotly debated. The following provides an outline of the perspectives aired in the meeting for each indicator.

Education

Farmer group 2 suggested corrections to the thresholds, raising them for all education level categories on the basis that the ambition was too low for the good future previously envisioned, particularly as education is free and mandatory until Form 4 ("O" Level). All agreed to increase the thresholds for primary school, as all children should finish primary school. After arguments from Farmer group 1 that not all children will reach Form 4, for various reasons including costs for supporting materials, all agreed that only 90% of children could be expected to finish Form 4 for the 'High' threshold. A heated and lengthy debate started between the groups about the feasibility of increasing the thresholds for higher education – on the one hand, there should be an even larger drop-off because it is more difficult to access Form 6 ("A" Level) and university, based on cost and availability of places in schools. On the other hand, some said "*aiming high will stimulate us to achieve better outcomes*". The debate was eventually cut short and the corrections stayed.

Improved cows

Feedback from the traders group about the definition of what 'improved cows' should entail sparked a lively discussion. The debate focused on whether, in the future, Lushoto farmers should have local, cross-breed, exotic breed or a mixture of them. The initial proposal indicated that a farmer could retain his/her local breed but must also have at least two cross-breed dairy cattle to attain a good life. The traders[9] emphasised that everyone should just have exotic breeds by 2030, citing a new factory that was recently inaugurated by the president, to add to the existing demand from Tanga Fresh. Furthermore, they argued that in the current production system, there are a few farmers with some cross breeds in their herds and they have not attained a good life, but a few in Lushoto with exotic breeds have made a good life. In response, others raised concerns about the expense of managing exotic breeds which are more delicate than local breeds and require extra management and a high start-up capital, which many farmers in Lushoto would not be able to manage. As such, they argued instead to keep to cross breeds in the indicator, although some might of course go beyond and have exotic breeds. The debate raised a discussion about local breeds, with some arguing that local breeds will not be abandoned completely because they are hardy and because of their existing value for customary rituals and dowry: the milk and meat tastes good, and the cows are smaller and therefore a more manageable size to obtain for a ceremony. The initial group argued in turn that money should not limit new changes, saying for example that "*we can't attain good life without changing our current practices*". Selling local breeds and using the money to buy exotic ones was suggested as a way of securing financial capital. Each group was somehow convinced by some of the arguments raised by the other, concluding with an agreement that a

[9] Including a member of the Farmer Group 1 who was actually from Tanga Fresh, and not a farmer

household is at liberty to retain the local breeds but must keep at least two cross breed and two exotics. The policy-makers group tried to suggest that the indicator should talk about livestock productivity and associated costs and benefits rather than specifying breeds. However, this was not taken up and did not influence changes of how the indicator was stated.

Fertile Land

There was a brief discussion and refinement of the Land indicator. Initially the indicator mentioned 'title deeds' but Farmer group 1 and others argued that 'title deeds' are too restrictive, as one can also get a habitat license or a customary law title deed, which may be easier to achieve as having land officially surveyed for title deeds is expensive and/or can be difficult. Therefore, the wording was altered to 'certificate of ownership' to include any other certificate of land ownership authorized by the government. No changes were made to the thresholds. It was pointed out that 70% of household owning 1 acre of land in low land and upland is a reasonable 'High' threshold for achievement because, by 2030, with population increase it will not be possible to have large land area per household for farming and/or livestock keeping.

The policy-makers were surprised to see that fertile land and housing were separate indicators, contrary to the group's idea that 'you need land to have a house' which was why they had grouped it into one indicator. This highights a decision by the research team to reflect a difference between the groups – all groups had an indicator about land, but it seemed that the focus for the traders and policy-makers was to have the modern house, whereas the focus for the two farmer groups was on having land for farming and/or livestock keeping. For this reason, two separate common indicators were proposed.

Methodologically, securing feedback from each group ensured that all voices were heard at this stage and enabled a structured discussion (group by group), rather than a potentially more long-winded plenary negotiation. Starting with a proposal stimulated debate about just the issues that were important to the groups to refine, rather than needing to also discuss those indicators that everyone agreed on (modern house and food security[10]).

3.2 Stakeholder group scenarios

The combined socio-economic performance indicators were used by each stakeholder group as a basis for a desirable future livestock scenario – that is, one in which the group believes significant progress will be made against the socio-economic indicators. The scenarios discussed and agreed by each stakeholder group are listed in Table 4. This details, for each stakeholder group, the vignettes chosen and the number of animals per vignette (see Appendix E for details of each group's scenario design, results and discussions).

The four stakeholder group scenarios tell a common story of improving the genetics of the current herd to give higher milk production per cow by cross-breeding with high-producing exotic breeds such as Jersey or Ayrshire to a point where the dairy population is a mix of cows that are cross-breeds of more than 50% exotic genes and cows that have mostly exotic genes. Local breed cows (Zebu) should also be of improved quality and management to maximise their potential, with a small portion kept as they are today for fulfilling traditional roles. Better livestock management and provision of high quality feed are implicit in these changes, in order to reach the potential higher productivity. As anticipated in Workshop 1, there are more pure (exotic) breeds than now, and fewer local breeds, but the total number of animals kept does not vary much due to land pressure.

To translate the story into a selection of vignettes to form the input into CLEANED, groups shifted the composition of the current herd in two ways:

i) Management – moving **within each category**, by improving the quality of the animals and improving how the animals are kept and fed, by shifting from the current situation (base run vignettes, BR) to a Level 1 or Level 2 improvement within the same category (e.g. for local breed, LBR to L2); and

[10] Although the trade-off is that there was no discussion about what these two indicators actually meant in practice – this would be properly explored if there was a separate workshop just for developing and refining the indicators.

ii) Genetics – moving **between categories** by changing the animals to higher producing breeds, based on the information that the 'mostly exotic' breed (E) produce generally more than the cross breed cows (Cb) which produce generally more than the local breed cows (L)[11].

Table 4 : Scenarios agreed in stakeholder groups

	Farmers 1		Farmers 2		Traders		Policy-makers		Baseline scenario (representation of present day)	
Category	**Vignette chosen**	**Number animals**	**Vignette chosen**	**Number animals**	**Vignette chosen**	**Number animals**	**Vignette chosen**	**Number animals**	**Vignette chosen**	**Number animals**
L Local breed	L2	8,000	LBR	10,000	L2	10,000	L2	12,000	LBR	25,000
Cb Cross breed*	C1	14,000	C2	20,000	C2	15,000	C2	12,000	CBR	15,000
E (mostly) Exotic breed	E1	3,000	E2	10,000	E1	10,000	E1	5,000	EBR	0
Total animals		**25,000**		**40,000**		**35,000**		**29,000**		**40,000**

Groups' motivations and concerns underlying their final choices of herd composition are summarised in Table 5, indicating which choice of vignette they made and reasons for or against that choice. For the most part, groups identified one vignette in each category to which they would move all their dairy cows of that category. However, in the case of local breeds and cross breeds one or more groups wanted to keep a small portion of cows in the current state (the 'Extra portion' choices in Table 5), because the current local breeds and crossbreeds are hardier and easier to manage than the higher producing breeds and management levels.

In all groups, the overall number of local breed cows reduced by half or more. The farmer group 2 increased their number of cross-breed cows by a third, while the other groups maintained or slightly reduced their numbers. All groups introduced (mostly) exotic breeds, up to 10,000 animals, from less than 1,000 currently. Overall, groups maintained or slightly reduced their total herd for Lushoto.

Table 5: Motivations and concerns in designing the dairy herd in the future

Category		Choice	Motivations	Concerns
Local breed	Current [a]	F2[b]: 10,000 Extra portion[c]: F1: 5,000 T: 10,000 PM: 5,000	- good tasting meat, hardy, used for traditional functions such as funerals and dowry, small enough to buy for these rituals (all groups[d]) - the Maasaai in the lowland would not give up their LBR cows (F2)	- Low milk production (all groups) - free grazing is increasingly restricted and penalised in the highlands, so stall-fed cross breeds and exotics were seen to be the path for the future, as they require less land (F2, T, PM)
	Level 1	-		
	Level 2	F1: 8,000 T: 10,000 PM: 12,000	- higher milk yield but still has advantages of the local breed (F1, T, PM) - stronger than C and E breeds (F1, T, PM)	- weaker than LBR (F1, T, PM)
Cross	Current	Extra portion: PM: 5,000	- less demanding and more tolerant to environment and diseases as compared to C1, C2 and E breeds (PM)	
	Level 1	F1: 14,000	- cheaper to manage than C2 (F1)	

[11] Local breeds 500-1500 litres per cow per year; Cross breeds 2000- 2500 litres per cow per year; (mostly) Exotic breeds 2300- 3500 litres per cow per year

	Level 2	F2: 20,000 T: 15,000 PM: 12,000	- higher milk production (F2, T) - larger, healthier calves that fetch a high price (F2, T) - easier and cheaper to keep than the E categories (vulnerability to diseases, feeding practices etc.) (F2, T) - easily accessible from local cross-breeding farm (F2, T) - not overstretching their resources as much as E2 would (PM)	- cost and maintenance requirements still high (F1, PM)
(mostly) Exotic breed	Current	-		
	Level 1	F1: 3,000 T: 10,000 PM: 5,000	- more feasible than E2 (F1, T, PM)	
	Level 2	F2: 10,000	- by rough calculation, the high milk output of E2 outweighs the high costs and maintenance (F2)[e]	- costs and maintenance requirements too high (all groups) - 12 years is too short to cross-breed up to the standard of E2 (F1, T, PM)

[a] Current (LBR, CBR, EBR): current type of feeding and management; Level 1 (L1, C1, E1): somewhat improved feeding and management; Level 2 (L2, C2, E2): much improved feeding and management

[b] F1 = Farmers group 1; F2 = Farmers group 2; T = Traders; PM = Policy-makers

[c] In some cases, groups allocated most animals in a category to one level (e.g. L2) but would want to keep a smaller portion at another level, to retain certain benefits. It is not possible in the CLEANED tool to choose two vignettes in one category, so only the vignette with the higher number of animals was entered into the CLEANED tool.

[d] F1, T and PM would want to keep a small portion of animals as current local breeds (LBR) in addition to their main choice of Level 2 local breeds to retain these benefits.

[e] Farmer group 2 acknowledged that although not all farmers would manage to keep this type of cattle because of the high costs, there are some farmers with good economic status who will need to keep this type of breed for the maximum production of milk.

3.2.1 Groups' reactions to the CLEANED results of their scenarios

The results produced by the CLEANED tool for the groups' scenarios were presented in two parts, the productivity measures (Table 6) and the environmental measures (Table 7). Tables 6 and 7 include results for an Average scenario that was drawn from the four group scenarios to be used as the starting point for Activity 4 in mixed groups on workshop Day 2 (Section 3.3).

There are similar trends across all groups – despite yielding between 18% and 100% more milk than currently, all scenarios may produce about 50% less maize than currently, but also require 30-50% less crop and grazing land for the feed. The pressure on land is released as the feed required by the scenarios shifts from natural grass and crop residues to planted fodder which has a much higher yield and produces more per hectare, and purchased concentrates (brans, oilseed cakes and molasses) which do not require land in Lushoto as they are classed in CLEANED as a by-product and therefore not accounted for in the impact calculations (and are likely to come from outside Lushoto anyway). As such no import is needed, apart from the concentrates.

Farmer group 2 has results that are most different, also being the only group whose scenario has the same number of animals compared to the base run, where the other groups all have fewer animals, either intentionally or unintentionally[12]. Their scenario produces 100% more milk, compared to around 18-56% in the other groups, but uses the most water overall (lowest reduction in water use) but the water is used more efficiently per animal and per kg milk than the other groups. On the other hand, total greenhouse gas emissions

[12] The traders intentionally reduced their total herd, to be able to sell livestock to fund buying exotic breeds, but also an error in entering their livestock numbers in CLEANED meant that they have even fewer animals than planned; the farmer group 1 and poliymakers distributed animals over two vignettes in the Local breed category, and only the vignette with more animals was taken into the tool.

increase (total kg CO_2eq), whereas for all other group scenarios it decreases, although the carbon intensity (CO_2eq per animal or kg milk) is the same as the other groups. The farmer group 2's scenario is the only one to produce more manure than currently, and consequently have less of a negative impact on the soil balance.

Overall, the farmer group 2, with 100% extra milk, were the only group that was happy that their scenario would achieve their aim, because a good life could be obtained from selling milk (good health, education and increased income). The other groups were disappointed by the results of their scenarios, feeling that even with 56% more milk production, the financial income would be too little to contribute to achieving a good life.

Table 6: Comparison of the Productivity score cards for the individual groups and for the average scenario

	Farmers 1	Farmers 2	Traders	Policy-makers	AVERAGE
	% change from baseline*	% change from baseline	% change from baseline	% change from baseline	% change from baseline
Milk produced (litres)	+19% (U)	+100% (D)	+56% (U)	+18% (U)	+66%
Maize produced (tons)	-51% (A)	-46% (A)	-46% (A)	-51% (U)	-55%
Cropland required (ha)	-50% (A)	-29% (A)	-46% (A)	-50% (U)	-39%
Grazing land required (ha)	-50% (A)	-51% (D)	-45% (A)	-51% (A)	-51%
Import	0 (U)	-	0	-	

*Letters in brackets present the groups' evaluation of the results as Desirable (D), Acceptable (A), or Unacceptable (U).

The groups were not concerned about potentially losing about 50% of the current maize production (assuming that the land may be re-allocated to planted fodder in the new basket, for example) on the basis that they would be able to buy maize with the proceeds from selling milk, instead of growing it, so food security would not be a concern. Two reasons were given, mainly that maize is not well-suited to the area (it is too cold), so maize takes too long to mature and would be better grown in the lowlands like Mombo (just outside Lushoto). The traders group mentioned that since 2008 more land that was used for maize production has been on sale, so nobody will hesitate to changing land from maize production to other uses. Secondly, farmers have other sources of income from vegetables which would also allow them to purchase maize.

The reactions to the reduction in crop and grazing land required by the scenarios were mixed. Some were concerned that there would be less land available, but not unduly, because intensive livestock keeping would require less land than free grazing and make more manure available, which could be used to increase crop productivity[13]. Others were happy that the scenario would free up land that could then be used for other purposes.

Table 7 : Comparison of Environmental score cards for the individual groups and for the average scenario

		Farmers 1	Farmers 2	Traders	Policy-makers	AVERAGE
Other indicators		% change from baseline	% change from baseline	% change from baseline	% change from baseline	% change from baseline
Water	Total (litre)	-56% (-)[a,b]	-42% (O)	-51% (A)	-55% (A)	-48%
	Litres water per animal	-27% (-)	-41% (O)	-27% (A)	-27% (U)	-33%
	Litres water per kg milk	-61% (-)	-70% (O)	-61% (A)	-62% (U)	-39%
Green-house gases	Total $CO2_{eq}$ (kg)	-24% (-)	+23% (O)	-17% (A)	-23% (A)	+1%
	Total $CO2_{eq}$ (kg) per animal	+23% (-)	+24% (O)	+23% (A)	+23% (-)	+30%
	Total $CO2_{eq}$ (kg) per kg milk	-35% (-)	-38% (O)	-34% (A)	-36% (A)	-39%

[13] Note that this reasoning may not be an entirely accurate simplification of a complex result, and reflects some confusion about the meaning of the land use results.

Soil fertility	Nitrogen balance	-28% (-)	-7% (O)	-28% (A)	-29%(U)	-37%
	Manure produced (tons)	-29% (-)	+16% (O)	-25% (A)	-30% (O)	-12%
Biodiversity		None (-)	None	-	-	

[a] Letters in brackets present the groups' evaluation of the results as Acceptable (A), OK (O) or Unacceptable (U).
[b] The farmer group 1 made no evaluations of the environmental results because they could not interpret these results, and they ran out of time

There were mixed reactions to the environmental scores – some happy that water use would be reduced and that the change in greenhouse gas emissions is acceptable by international standards. They noted that the shift to keeping livestock indoors would reduce the damage to water sources and reduce reliance on firewood by using biogas. Some were concerned that water availability would reduce but resolved that water could now be used cleverly in an intensified system, and that as long as milk production remained high it would be ok.

Farmer group 2 were happy about the increased availability of manure for use on crops and for biogas, whereas the policymakers were concerned about the loss of manure and consequences for soil fertility. The traders were less concerned about the loss of manure on the basis that less manure would be needed if fodder were to replace maize.

Table 8 : Mixed stakeholder groups' first and second refined scenarios: vignettes and livestock numbers

			Group A				Group B					
	Starting Scenario – Average of group scenarios		Group A Scenario 1		Group A Scenario 2		Group B Scenario 1		Group B Scenario 2		Baseline scenario (representation of present day)	
Category	Vignettes chosen	Number animals	Vignettes chosen	Number animals	Vignettes chosen	Number animals	Vignettes chosen	Number animals	Vignettes chosen	Number animals	Vignettes chosen	Number animals
L Local breeds	L2	10,000	L2	5,000	L2	5,000	L2	10,000	L1	10,000	LBR	25,000
Cb Cross breeds	C2	15,000	C2	15,000	C2	15,000	C2	8,000	C2	15,000	CBR	15,000
E (mostly) Exotic breeds	E1	6,000	E1	21,000	E1	21,000	E2	17,000	E2	10,000	EBR	0
Crop productivity +20%	-		-		yes		-		-		-	
Total animals		31,000		41,000		41,000		35,000		35,000		40,000

3.3 Towards a shared vision: mixed stakeholder group scenarios

In this session the workshop was split into two groups, with a mix of stakeholders in each group. One 'average' scenario was used to initialise both groups, as the four stakeholder group scenarios tell a common story of improving milk production. Variations in how groups implemented the shift to higher-producing breeds and the level of improvement (level 1 or level 2) are summarised in Table 9. The Average scenario was taken as the most popular vignette in each category and the average number of animals for that vignette (given in bold in Table 9).

Table 9: Identifying an average from the stakeholder group scenarios

	Local breed	Cross breed	Mostly Exotic breed
Level 2 (2)	Farmers 1: 8,000 Traders: 10,000 Policy Makers: 12,000 **Average: 10,000**	Farmers 2: 20,000 Traders: 15,000 Policy Makers: 12,000 **Average: 15,000**	Farmers 2: 10,000
Level 1 (1)		Farmers 1: 14,000	Farmers 1: 3,000 Traders: 10,000 Policy Makers: 5,000 **Average: 6,000**
Current (BR)	Farmers 2: 10,000		

The resulting average scenario represents a 22.5% reduction in the total herd size (from 40,000 dairy cattle currently to 31,000 dairy cattle).

In general, similar to the individual group scenarios, the implications of the average scenario as shown by the CLEANED tool are positive (Table 6 and Table 7). Milk production increases and pressure on land and water is released. On the other hand, maize production may decrease, greenhouse gas emissions increase and the amount of manure decreases with associated decline of the soil balance. There was no biodiversity change because there was no land use change.

This average scenario was used to initialize the Transformation Game at the start of Day 2, with participants split into two mixed stakeholder groups[14]. Each group contained an equal number of participants from each stakeholder group (or as near as was practical). This is a significant change in workshop dynamics: up to this point, stakeholders had worked together to develop their understanding of their particular needs and interests. The moving to mixed groups ensured that there were least two representatives from each stakeholder group in discussions that were facilitated to build understanding between stakeholders, through the activity of playing the game and negotiating game strategies. Note that steps had been taken throughout the workshop up to this point to start building towards shared understanding, principally through sharing and discussing group interests in plenary sessions.

3.3.1 Group A

Negotiation of first refined scenario

The first scenario discussed, as an advancement on the average scenario, is outlined in Table 10. Currently the local industry imports milk from Uganda and participants were ambitious to fulfil this demand. However, all agreed that the cost of production will increase, resulting from more veterinary services, concentrates,

14 Participants were split randomly by going around each groups and allocating individuals A-B-A-B etc., not specifically looking at the roles and splitting them out

improved cowshed, increased use of industrial fertilizers, improved crop and fodder seeds and the requirement to employ a cattle servant because exotic breeds require so much maintenance. A key debate within the group was about which breeds to choose. Some participants wanted to see a total shift from local and cross breeds to exotic breeds. But other participants raised arguments that women wanted cross breeds due to perceptions that it is expensive to raise exotic breeds. But, a few participants argued forcefully that it is time for change and they should not look behind. One reminded the participants that a new milk processing factory with a capacity of about 120,000 litre of milk per day was recently launched by the president in Tanga, in addition to the existing milk processing factory which needs about 50,000 litres per day that the local producers do not yet adequately supply. This final argument convinced participants, who were eager to fulfil this demand and thus they must adopt new production practices.

Table 10: First refined scenario for Group A

	Group A Scenario 1			
	Negotiated scenario		Difference vs average scenario	
	Vignettes	Number	Vignettes	Number
L Local Breed	L2	5,000	L2	-5,000
Cb Cross Breed	C2	15,000	C2	no change
E (mostly) Exotic breed	E1	21,000	E1	+15,000
Total animals		**41,000**		**+10,000**

Group discussion about the first refined scenario

Participants were happy with the new scenario because the projection shows there will be more milk production. Table 11 shows the initial productivity score card for Scenario A. The scenario leads to much more milk produced (+154%) compared to the average scenario (+66%). Cropland is still saved, but less than in the average scenario. Maize production loss and saved grazing land are similar to the average scenario. For the group, the increased amount of milk is acceptable because it will contribute to the household income which in turn will be used to: educate children, build modern houses for the families and for renting out, availability of more land, pay for veterinary services, construct cowsheds. The income can also help families to create new employment. The maize production has been reduced but, this decrease will be compensated by increased income from increased milk production. The decrease in crop land is not a problem because the use of manure and fertilisers will compensate for as it will lead to more yields from small farm plots. More manure will be applied than industrial fertilisers. The decrease in grazing land is acceptable because Lushoto livestock keepers will use zero grazing (about 2-4 cattle). The group did not foresee any land use change for producing fodder, as there is no land to be cleared because land is limited. Furthermore, there are by-laws which prohibit community members from cropping or harvesting trees from reserved land. Instead, the reduced requirement for crop land will open up more space for growing fodder.

Table 11: Group A first refined scenario - Productivity score card

Group A Scenario 1 – L2 5,000, C2 15,000, E1 21,000			
	% change	CLEANED score (High, Medium, Low)	Group evaluation (acceptable, ok, unacceptable)
Milk produced (litres)	154%	High	Acceptable
Maize produced (tons)	-55%	High	Acceptable
Cropland required (ha)	-16%	Low	Acceptable
Grazing land required (ha)	-64%	High	Acceptable
Import	-	-	-

Table 12 shows the environmental impact from the first refined scenario for group A. Water saving is not as high as the average scenario, but the scenario suggests much less water used per litre of milk. More greenhouse gases are emitted, as the scenario has a third more animals than the average scenario, although the CO2eq per litre of milk is still reduced. More manure is produced in this scenario, and the nitrogen balance is improved compared to the average, but still worse than the baseline. For the group, the reduction in water use reflects reality because the cattle are no longer using more water as they are now fed with concentrates. Besides, the cattle will not destroy water catchments because they are no longer left to graze in grassland. Greenhouse gas emissions are acceptable because modern animal keeping will allow use of biogas. Zero grazing will also allow for little environmental destruction. In any case, the existing bylaws do not allow for tree cutting without a formal approval. It will not be a big problem as with reduction of maize planting, less manure is needed. Fodder does not need much manure.

Table 12: Group A first refined scenario - Environmental score card

Group A Scenario 1 – L2 5,000, C2 15,000, E1 21,000				
Other indicators		**% change**	**CLEANED score (High, Medium, Low)**	**Group evaluation (acceptable, ok, unacceptable)**
Water	Total (litre)	-34%		Acceptable
	Litres water per animal	-36%		
	Litres water per kg milk	-74%		
Greenhouse gases	Total $CO2_{eq}$ (kg)	+38%		Acceptable
	Total $CO2_{eq}$ (kg) per animal	+35%		
	Total $CO2_{eq}$ (kg) per kg milk	-46%		
Soil fertility	Nitrogen balance (N in minus N out)	-9%		Acceptable
	Manure produced (tons)	+24%		
Biodiversity - # endangered species losing critical habitat		-	-	-

Discussing the socio-economic indicators, participants mentioned that the scenario contributes by providing higher income from milk and selling calves, and by providing labour opportunities. Women were ambitious about achieving the new indicators because they have access to micro-credits (like Savings and Credits Cooperative Societies –SACCOS, Village community Bank - VICOBA, revolving funds among farmers group), and noted that it is possible to raise financial capital because men have no influence on their funds.

Participants observed that in the chosen scenario there will be winners and losers - those who will be optimistic in adopting or venturing to the new scenario and those who are pessimistic or consider themselves unable to venture into the new business. There will be early adopters and late adopters.

Negotiation and discussion of second refined scenario

The group was generally happy with the first refined scenario, but it was suggested to try applying an increase in crop productivity of 20% to see what impact it could have on land availability.

The results and group's reactions are largely the same as the first refined scenario – green text indicates those measures that improved: more crop land is saved (Table 13) and less water is used (Table 14). The nitrogen balance is significantly improved, even over the baseline (+21%), because the crop productivity increase is largely driven by applying manure and chemical fertiliser to the fields.

Table 13: Group A second refined scenario - Productivity score card

Group A Scenario 2 - L2 5,000, C2 15,000, E1 21,000 +20% crop productivity			
	% change	CLEANED score (High, Medium, Low)	Group evaluation (acceptable, ok, unacceptable)
Milk produced (litres)	+154%	High	Acceptable
Maize produced (tons)	-55%	High	Acceptable
Cropland required (ha)	-29%	Medium	Acceptable
Grazing land required (ha)	-64%	High	Acceptable
Import	-	-	-

New comments on the environmental measures were that greenhouse gas emissions will be low because of zero grazing. No trees will be cut and the manure could produce biogas which can be used for cooking and other household uses, reducing hydro electricity use and consequently contributing to reduced GHG emission. The group also mentioned that more manure would be applied to the soil.

Table 14: Group A second refined scenario - Environmental score card

Group A Scenario 2 - L2 5,000, C2 15,000, E1 21,000 +20% crop productivity				
Other indicators		% change	CLEANED score (High, Medium, Low)	Group evaluation (acceptable, ok, unacceptable)
Water	Total (litre)	-46%		Acceptable
	Litres water per animal	-48%		
	Litres water per kg milk	-79%		
Greenhouse gases	Total $CO2_{eq}$ (kg)	+38%		Acceptable
	Total $CO2_{eq}$ (kg) per animal	+35%		
	Total $CO2_{eq}$ (kg) per kg milk	-46%		
Soil fertility	Nitrogen balance (N in minus N out)	+21%		Acceptable
	Manure produced (tons)	+24%		
Biodiversity - # endangered species losing critical habitat		-	-	-

Group reflections on the activity

Most participants learned that it is possible from change local breeds that produce less milk to cross breeds or exotic breeds that produce more milk. This was a new lesson that brought excitement to the participants.

Lessons learnt during the workshop:

- how to improve livestock systems: to select better livestock breeds and improve how to keep them;
- the importance of keeping livestock according to the carrying capacity;
- how to improve livelihood and family living standards through keeping improved livestock breeds: by increasing milk production for income which can educate the family and obtain a good house, and to have more milk for family use;
- how to increase income without affecting the environment and by using a smaller area;
- the value of having a future focus, and to make good decisions to reach goal; and
- to improve environment by use biogas; and by having biogas you get manure and insecticides.

3.3.2 Group B

Reaction to the average scenario

The participants assessed the average scenario using the indicator of 'having enough food for the entire year' as a guideline and concluded that the increased milk production will lead to food security for most because currently farmers do not use their land to grow maize. Increased milk production will increase household income which will be used to purchase foods. On the other hand, it was agreed that overall the milk production increase is satisfactory but not desirable because most farmers Lushoto depend on milk production to earn income. Therefore, considering the different breeds of cows, food security will not be achieved by some of the farmers despite having cows.

Negotiation of first refined scenario

Keeping the last point in mind, the group discussed how to change the scenario to increase milk production and more importantly to put farmers in the situation of reaching the indicator targets, considering the opportunities as well as the cost implications of the Level 1 and Level 2 cross-breed and exotic breed vignettes - managing these breeds at the required standard is very expensive. On other hand, the facilitator reminded the group that as you keep more local breed cows more land is needed. The participants explained what they had understood before making changes:

- Keeping more improved breeds (Cross breed and exotic breed) reduces land use for grazing cattle and hence there will be enough land for maize production, fodder production and for keeping these improved breeds;
- By keeping Level 2 exotic breed cows (E2) more milk will be produced, more manure will be produced and there will be less soil degradation because this breed is zero grazed and fed more on concentrates, planted fodder, hay and silage;
- However, concerns were raised that in the District in general it is difficult to get enough concentrates, planted fodders and the other feeds needed to the improved breeds. For this reason, in some parts of Lushoto district where land is still available, cross-breed and exotic cows are still taken out to graze, raising a second concern about controlling disease, particularly as cross-breed and exotic cows are more susceptible to disease than local breed cows. Therefore, in order to keep such improved cows farmers must devote more efforts to growing planted fodders and would need more money to buy concentrates;
- Those in favour of E2 cows were confident that the increased milk production would pay for the increased fodder requirements – but also because farmers tend to have other small businesses such as vegetables and fruit that could support the costs of improved breeds.

Based on these points, the participants agreed on the following refinements to the average scenario (Table 15), making no change to the local breed category, but reducing the number of cross-breed animals (C2) in favour of mostly exotic breed animals and improving the type of exotic breed from E1 to E2. The change was driven by the expectation of producing more milk. The market for the increased milk is available, including dairy cooperatives, and the price of selling the calves is high, which could offer more income generation.

Table 15 : First refined scenario – Group B

	Group B Scenario 1			
	Negotiated scenario		Difference vs. average scenario	
	Vignettes	Number	Vignettes	Number
L Local Breed	L2	10,000	no change	no change
Cb Cross Breed*	C2	8,000	no change	-7,000
E (mostly) Exotic breed*	E2	17,000	+	+11,000
Total animals		**35,000**		**+4,000**

Group discussion about the first refined scenario

Table 16 shows the productivity score card for the first scenario negotiated by Group B after reviewing the average scenario. The scenario leads to higher milk production and a greater decrease in maize production and land use than the average scenario. For the group, more milk produced will increase household income. Also having more exotic cows (E2), which are kept at home, will provide more manure for improving soil fertility (it does not get 'lost' to the pastures). The lower maize production and cropland is ok because in Lushoto farmers do not usually produce more maize. Therefore, reduced production of maize for the sake of growing of planted fodders will not affect their food security. The reduced grazing land required is desirable because already farmers are not allowed to take their cross breed animals out to graze around the fields. Punishment has been put in place including paying Tsh.50,000 per hoof seen on the ground.

Table 16: Group B first refined scenario - Productivity score card

Group B Scenario 1 – L2 10,000; Cb2 8,000; E2 17,000			
	% change	CLEANED score (High, Medium, Low)	Group evaluation (acceptable, ok, unacceptable)
Milk produced (litres)	+122%	High	Desirable
Maize produced (tons)	-68%	Medium	Satisfactory
Cropland required (ha)	-50%	Medium	Satisfactory
Grazing land required (ha)	-59%	Medium	Desirable
Import	-	-	-

There was more discussion about the exotic breed animals requiring more green fodder than the local breeds (not yet including concentrates) and that the local breed animals can withstand disease whereas the E2 animals cannot. The group found it frustrating to assess the costs involved without a concrete way to calculate the costs – the discussion relied only on an abstract acceptance that 'E2 are more expensive'.

Table 17 shows the environmental impact from the first refined scenario. The scenario uses less water than the average scenario (due to more planted fodder and concentrates), and more GHG emissions (due to more cows) although the CO2eq per litre of milk is less than in the average scenario. The nitrogen balance is reduced compared to the average scenario. The environmental results were not presented or discussed as the group ran out of time.

Table 17: Group B first refined scenario - Environmental score card

Group B Scenario 1 – L2 10,000; Cb2 8,000; E2 17,000				
Other indicators		% change	CLEANED score (High, Medium, Low)	Group evaluation (acceptable, ok, unacceptable)
Water	Total (litre)	-64%		
	Litres water per animal	-64%[15]		
	Litres water per kg milk	-84%		
Greenhouse gases	Total $CO2_{eq}$ (kg)	+23%		
	Total $CO2_{eq}$ (kg) per animal	+41%		
	Total $CO2_{eq}$ (kg) per kg milk	-44%		
Soil fertility	Nitrogen balance (N in minus N out)	-49%		
	Manure produced (tons)	0		
Biodiversity - # endangered species losing critical habitat		-	-	-

[15] This was copied out wrong – this result is actually the ratio of water used:rainfall; the correct number is -59%.

Negotiation of second refined scenarios

When deciding the first refinement to the average scenario, two participants (one man and one woman) had repeatedly raised a concern about the cost of production that would be incurred to keep more E2 because this breed is more susceptible to diseases as compared to C2. Therefore, they suggested that the best scenario is one with more C2 than E2. However, most participants (particularly men) insisted that more E2 cows are needed for more milk production. For them, cost might not be a problem since milk produced will be sold to earn more money as well.

To resolve this debate, the scenario suggested by the two participants was the second refined scenario tested (Table 18), to determine from the CLEANED tool results which scenario is the best.

Table 18 : Second refined scenario – Group B

	Group B Scenario 2			
	Negotiated scenario		Difference vs. average scenario	
	Vignettes	Number	Vignettes	Number
L Local Breed	L2	10,000	no change	no change
Cb Cross Breed*	C2	15,000	no change	no change
E (mostly) Exotic breed*	E2	10,000	+	+4,000
Total animals		**35,000**		**+4,000**

Group discussion about the second refined scenario

The scores of this second refined scenario are presented in Table 19 for productivity and Table 20 for the environment. The same scenario was run with a crop productivity increase of 20% (results shown in brackets in Table 19 and Table 20) but not presented to the group for discussion as the results were not very different to the scenario without a crop productivity increase.

Table 19 shows the productivity score card for the second scenario negotiated by Group B after reviewing the average scenario. Milk production is slightly less than the first refined scenario. Similarly, slightly more maize is produced and slightly more land is required, but the differences are likely to be insignificant. For the group, although milk production was evaluated as high and desirable, the amount produced was less than that of the first refined scenario. No comment was made on maize production and land use.

Table 19: Group B second refined scenario - Productivity score card

Group B Scenario 2 – L2 10,000; Cb2 15,000; E2 10,000			
	% change (% with +20% crop productivity)	CLEANED score (High, Medium, Low)	Group evaluation (acceptable, ok, unacceptable)
Milk produced (litres)	+106% (+106%)	High	Desirable
Maize produced (tons)	-60% (-60%)	Medium	Satisfactory
Cropland required (ha)	-42% (-51%)	Medium	Satisfactory
Grazing land required (ha)	-52% (-52%)	Medium	Desirable
Import	-	-	-

Table 20 shows the environmental impact from the second refined scenario for Group B, which uses relatively more water than the first refined scenario but still less than the base line (-34.8% compared to -64.4%). Water use per animal and the soil balance is similar to the first refined scenario. Greenhouse gas emissions are the same as the number of animals did not change. For the group, the reduced water use was welcomed. The greenhouse gas emissions were evaluated as ok. It was raised that trees will be planted to use some of the carbon dioxide produced. There is already a small project encouraging farmers to plant trees, proposing that the project would then pay the farmers not to cut those trees, based on the diameter at breast height.

While the project has only been to raise awareness, no money has been received yet, but the farmers are now saying that maybe it is good to keep more trees. It was discussed that nitrogen was important for soil fertility.

Table 20: Group B second refined scenario - Environmental score card

Group B Scenario 2 – L2 10,000; Cb2 15,000; E2 10,000				
Other indicators		**% change (% with +20% crop productivity)**	**CLEANED score (High, Medium, Low)**	**Group evaluation (acceptable, ok, unacceptable)**
Water	Total (litre)	-35% (-64%)	High	Desirable
	Litres water per animal	-55% (-59%)		
	Litres water per kg milk	-78% (-82%)		
Greenhouse gases	Total $CO2_{eq}$ (kg)	+23% (+19%)	Medium	Satisfactory
	Total $CO2_{eq}$ (kg) per animal	+41% (+36%)		
	Total $CO2_{eq}$ (kg) per kg milk	-45% (-42%)		
Soil fertility	Nitrogen balance (N in minus N out)	-41% (-21%)	Medium	Satisfactory
	Manure produced (tons)	0% (0%)		
Biodiversity - # endangered species losing critical habitat		-	-	-

Comparing the two refined scenarios, the second scenario produced less milk (+105.9%) than the first scenario (+122.4%). Therefore, because the target of the participants was to have more milk produced, the group suggested that the second scenario could not beat the first one. All participants agreed to opt for the first livestock scenario with 10000L2, 8000C2 and 17000E2.

With this agreement, group members left with the workshop with the ambition that by 2030, every livestock keeper should increase milk production by 122.4%, and every livestock keeper should be keeping at least one exotic breed type E2.

Group reflections on the activity

Lastly, the participants gave the following reflections on the activity, in response to three questions: i) What did you learn from the scenario?; ii) What compromise do you need to make?; and iii) What surprised you in this workshop?

Participants gained a good understanding of the different breeds of cows, management styles, environment where the cows are kept and their advantages and disadvantages. Some were surpised that good management and good choice of breeding[16] can transform your life, and indeed that there is a difference between cross breeds and exotic breeds. Similarly, some were surprised that keeping many cows does not guarantee more milk production. What matters is the type of the cow and how it is managed.

They learned that achieving more milk depends on having good plans, and widened their understanding of livestock keeping from thinking at individual level to thinking about the community level.

Other highlights were that feeding cows in the shed is equal to having small enterprise for manure production, and that the computer can be used to calculate percentages which show how the livestock keeping practices will be in the future.

[16] Not only local breed, cross breed or exotic breed, but also understanding that there are certain types that will be good for meat and others that will be good for milk.

4 Discussion

Reflections from two experts who have been working with dairy in the area for a long time sum up the workshop nicely. The first is that participants left with a great sense of hope, seeming to have engaged for the first time with the information about the potential for higher milk production, although it has been available from several initiatives promoting small scale dairy (e.g. the Maziwa Zaidi programme[17]). The scientific lessons learnt about sustainable intensification in Lushoto may not be new; the workshop confirmed that improved breeds will need more inputs but will release pressure on land locally and the environmental impact per unit of milk is reduced. Yet, for many participants who still keep local breeds, it was an eye opener to see what they can gain from improved livestock keeping – both from better livestock management and feeding, and from improving the genetic quality both of local breeds and by cross-breeding with exotic. At the same time, for participants the trade-off between the costs of production and the promise of increased productivity was the most debated in all groups and remained unresolved by the end of the workshop. The second reflection is that, participants were asked to think beyond their own farms and think about their area as a community. They have seen the benefit of working together to ensure that all the necessary inputs to keep improved animals are available locally at a good price. Yet, this will probably also imply that milk price will reduce as more farmers supply more milk to the market.

The two groups had different scenarios in the end in terms of number of animals (Table 23). Group A had 6,000 more animals than group B. With more emphasis on exotic animals and less on local animals than Group B, Group A produced more milk (+155%) than Group B (+122%), but used more water and cropland than Group B (Table 21 and

Table 22). Although Group A's overall greenhouse gas emissions are higher than Group B, emissions per cow are lower, and with the higher number of animals the soil balance is better for Group A than for Group B.

Nonetheless, the discussions emerging in the two groups were very similar – debating the costs of keeping exotic breeds against the potential income that the higher milk production can offer; and generally striving to achieve the highest milk output on the assumption that lower milk output will not be able to support the good life envisioned in the socio-economic indicators. The discussions brought to light the importance of having a simple cost calculator to better inform the debate. If the highest milk output is associated with tighter finances and a strain on household resources, the socio-economic goals may still not be achieved.

Table 21 : Comparison of the Productivity score cards

	Scenario A1	Scenario B1	Difference	Scenario A2	Scenario B2	Difference
	% change from baseline	% change from baseline	% (B1-A1)	% change from baseline	% change from baseline	% (B2-A2)
Milk produced (litres)	154%	+122%	-32%	+154%	+106%	-48%
Maize produced (tons)	-55%	-68%	-13%	-55%	-60%	-6%
Cropland required (ha)	-16%	-50%	-34%	-29%	-42%	-14%
Grazing land required (ha)	-64%	-59%	4%	-64%	-52%	12%
Import	-	-	-	-	-	-

[17] See an overview by Amos Omore (2017) at: https://livestock.cgiar.org/2017/06/26/maziwa-zaidi-past-present-future/

Table 22 : Comparison of the Environmental score cards

Other indicators		Scenario A1	Scenario B1	Difference	Scenario A2	Scenario B2	Difference
		% change from baseline	% change from baseline	% (B1-A1)	% change from baseline	% change from baseline	% (B2-A2)
Water	Total (litre)	-34%	-64%	-31%	-46%	-35%	+12%
	Litres per animal	-36%	-64%	-29%	-48%	-55%	-7%
	Litres per kg milk	-74%	-84%	-10%	-79%	-78%	+1%
Green-house gases	Total $CO2_{eq}$ (kg)	+38%	+23%	-15%	+38%	+23%	-15%
	Total $CO2_{eq}$ (kg) per animal	+35%	+41%	+6%	+35%	+41%	+6%
	Total $CO2_{eq}$ (kg) per kg milk	-46%	-45%	+1%	-46%	-45%	+1%
Nitrogen balance	Nitrogen balance	-9%	-50%	-40%	+21%	-41%	-62%
	Manure produced (tons)	+24%	0%	-24%	+24%	0%	-24%
Biodiversity		-	-	-	-	-	-

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Table 23 : Comparison of first and second refined scenarios for the two mixed groups

	First refined scenario				Difference (first refined)		Second refined scenario				Difference (second refined)	
	Scenario A1		Scenario B1		A1-B1		Scenario A2		Scenario B2		A2-B2	
	Vignette	Number	Vignette	Number	Vignettes	Number	Vignette	Number	Vignette	Number	Vignettes	Number
L Local Breed	xx	5,000	L2	10,000		**-5,000**	xx	5,000	L2	10,000		**-5,000**
Cb Cross Breed	xx	15,000	C2	8,000		**+7,000**	xx	15,000	C2	15,000		**0**
E (mostly) Exotic breed	xx	21,000	E2	17,000		**+4,000**	xx	21,000	E2	10,000		**+11,000**
Crop productivity +20%	No		No				Yes		No			
Total animals		**41,000**		**35,000**		**+6,000**		**41,000**		**35,000**		**+6,000**

4.1 Synergy of the crop-livestock system

There are synergies to be found, in the high-potential area of Lushoto District, between vegetable production and livestock production, but land is an underpinning factor. The story of one farmer in the workshop illustrates it. She started with vegetables and a bit of planted fodder for selling. The income from these was invested in some high-producing dairy cows. The manure from the cows fertilises the vegetables, and the income from the vegetables funds the supplementary food that the cows needs. Both vegetables and milk provide a steady income throughout the year, and the surplus income funds improvements to the house, sending children to university and other benefits to the family. Selling a calf or one of the cows can provide lump sums when needed to make investments, for example to buy more land to expand planted fodder or vegetables and reinforce the positive cycle. The manure aspect is a useful reminder to consider the multiple benefits of livestock, beyond simply milk production; participants want to keep higher-producing breeds because they get more manure (or at least by needing to keep cows indoors, they can easily collect the manure and use it).

In a landscape where land is limited and population is expanding, the above story illustrates the potential of dairy production, but may not be possible for everyone. There is a tradeoff between livestock production and crop production when the livestock system begins to demand high-yielding planted forage which should be grown on cropland rather than grazing land. In Lushoto, it is likely that planted fodder would use land that is currently used to plant maize, raising two questions: i) whether this will impact food security by reducing maize production; and ii) how best to use the land. Participants did not recognize the maize-fodder exchange as a problem for food security as, in their experience, maize is not suited to the highlands, taking longer to grow and the productivity is low. The recurring response was that they would rather produce milk and buy maize from areas where maize is better suited (or indeed have a piece of land to grow maize in the lowlands where it is better suited). In addition, producing milk also provides manure to grow vegetables to gain more income to buy food or other elements of a good life, so keeping dairy cows gives two means of compensating for the maize.

There is, at the same time, a synergy between having higher-producing breeds and reducing pressure on land – so although livestock will require crop land for planted fodder, overall the system requires less cropland which can free land to be used for other purposes. This is because a significant portion of the feed and fodder necessary for higher-producing livestock are agro-industrial by-products and therefore not directly linked to the local land. De facto, this corresponds to an export of the land use as well as the environmental impact. As long as these can be sourced relatively locally, for example the molasses and sunflower oil seed cake that are by-products from the sugar and sunflower production in the lowlands of Tanzania, this is OK, also because the by-products is produced anyway and not for the sake of the livestock sector. However, these agro-industrial by-products are not unlimited, and if one needs to import from further afield, it raises the issue of sustainability of the dairy value chain. Similarly, because improved breeds consume agro-industrial products from elsewhere the nitrogen in those feeds is not extracted from the study area, so the nitrogen balance is improved locally, but by mining nitrogen from other areas. Because CLEANED does not account for anything that is not produced within the boundary of study area, these considerations about by-products were not discussed in the workshop.

4.2 Assessing tradeoffs – complexity of costs and benefits

Yet, there are also financial costs of keeping the high-producing breeds to take into account when deciding how best to use the land. There is a growing appreciation for dairy production in the area because farmers see the milk price offered by the hotels (1000 Tsh/l) which is much higher than the milk price offered by the Tanga cooperative (600 TSh/l). As milk production increases and the local hotel milk demand is saturated, Tanga cooperative will happily come and take the excess milk as they are running at less than half their capacity, but the milk price in Lushoto will drop. At this new price level, milk might actually not be such a clear better choice if there is scope to improve on maize productivity or use the land for other high value crops such as vegetables or beans. CLEANED does not have any economic module and therefore does not raise these

issues in the workshop, and therefore this reflection was missing. A simple cost-benefit analysis with some price simulations could address this issue easily.

There is also the tradeoff between the benefit of more milk production and the costs associated with keeping E2 cows (high-performing, best kept exotic breed). Throughout the workshop, this was hotly debated, and the way it was debated may give insights on the eventual distribution of high-input dairy. On the one hand, men and a few women (businesswomen), who were confident that the income from the high increase in milk would pay for all the costs, argued that without a modern outlook no progress would be made. On the other hand, women (farmers) raised concerns about costs and advocated a more moderate progression with an emphasis on high-performing cross-breeds rather than pure exotics. Exotic breeds are more sensitive than local breeds and therefore require more labour and a higher quantity and cost of input (feeds and vaccines). The labour costs hides a time cost - collecting a significantly larger amount of feed, cleaning out stalls, seeking treatment when the cows get ill – which take away from other duties. It is likely that one either requires large capital or outside income or owning land to support the costs of maintaining exotic cows. It may be that, in the absence of a simple cost calculator to give the costs of production, the women farmers had a better sense of the costs as the ones who are working with cows every day. At the end of the day, the hopeful and ambitious scenarios were taken forward on the basis that they produce more milk.

4.3 Food security – beyond income

The current approach to socio-economic indicator aims at going into a more complex measure of well-being than simple monetary measures. Yet, the three retained socio-economic indicators, namely better houses, better education and more fertile land are all items that can be acquired by the logic of: more milk is more money so more wealth, raising the issue of the added value of this exercise. Hints of other conditions required to achieve the indicators were briefly collected while refining the indicators, but it was still difficult to make the link between how a livestock livelihood would contribute to those additional conditions, beyond providing more income. For example, requiring a good temperament for learning and security for girls while travelling to school so that they can finish school without dropping out; or being able to inherit cross-breeds or exotic breeds or land from family; or having protective policies against dumping of cheap milk.

Interestingly, food security, that includes having more diverse food, is the only indicator that could be reached without monetary input at least by farmers, for example by changing their agricultural practices and selling behaviours, with having a home garden with highly nutritive crops (papaya, potatoes, vegetables) or small animals such as chicken for home consumption. Yet, participants did not retain it in their top three indicators to be refined with the argument that if they have enough money for the nice houses and good eduction, then food security will be sorted too. There is a growing evidence from literature in malnutrition across the continent that shows that this is not automatically true. As healthy diets are key to healthy lives, and to successful eduction for children, these results show that awareness raising for healthy diets is needed along with economic development in the value chains. More broadly, this reflects that it is not a simple task to think beyond income, which has been the standard (or imposed) measure of well-being for so long.

4.4 Participant engagement

Overall, the workshop was a positive learning experience for all. Three lessons resonated with many participants. First that it is possible to change the quality of the local breed to produce more milk and that a cross breed cow was different from an exotic breed cow. For the local breed, it is easy to know the difference between those that are good for meat and those that are good for milk, but for cross-breed and exotic cows it is more difficult. Second, they learned that the type of management of an animal affects milk production.

A third, significant point that participants raised was that it was nice to have a brainstorming, to be pushed to consider questions of planning – several reflected that it was new to think about having a plan, to think about what they want and how they would get there instead of just keeping cows without a specific target. This is

a reminder that the opportunity and tools to plan are not normally available. This quite clearly stands in the way of (considered) change and movement towards more desireable futures.

All discussions were lively with active input from the participants. As with any discussion, some were dominant and others were quieter, but the facilitators were surprised by how actively the women engaged in the discussions in light of the Shambaa culture in which women were not allowed to speak when men were also present. It was noticeable that the policy-makers and traders were less active than the farmers in the mixed group discussions.

Yet facilitators also noted that participants were quieter when the discussion moved out of their area of knowledge. The vigorous debate among the participants while discussing the economic indicators suggests that the participants had strong views about how their future should look, and actively negotiated those views. There was a shift to being passive learners during the Transformation Game, which brought new concepts and new ways of viewing and processing knowledge. At these points, group members waited for those who understood the information to speak before agreeing with them (or not), as they were unsure what to say themselves. Participants in general had less to say about the environmental implications than about the change of milk production and land use.

Nonetheless, different views were brought forward and countered and the outcome decided, largely, on whose arguments were more convincing. The main set of differing perspectives that clashed repeatedly throughout the workshop was to move directly to exotic breeds or more conservatively to a robust compromise between cost and output in good cross-breeds. While defining common indicators, both sides appeared to learn something from the other – that the demand is there for higher milk production and opportunity to supply it should not be passed up, while at the same time that the local breeds have many functions beyond milk production that the exotic breeds cannot supply. In the transformation game, however, the promise of high milk production was the deciding factor, assuming that it would yield high income. The local adminstrators and experts' perspective was much less dominant, which encouraged a consideration of the *profit* from each option, rather than simply the income, so as to take into account the costs and choose the most cost-effective option rather than the highest-producing option.

4.4.1 Different interpretations

The reactions to the CLEANED results, captured in the responses on the scorecards suggest that in several groups there was confusion over what the results were telling them. The reduction in cropland and grazing land required by the scenario (meaning in the scenario less land is used to produce the fodder for the animals in that scenario) was often interpreted by groups as meaning that less land would be available in the district for cropping and grazing. Another group commented that a reduction in water would reduce the milk production, whereas the two are not in fact linked – both are an output of the choice of breed and management.

For example, in reaction to reduced crop land required:

> *"Land has reduced but not much; Still production of crops will be high due to application of manure"*
>
> *"They agree that this is acceptable because if someone needs more fodder they will have to automatically reduce land for cropping. A decision on the change of the available land use will have to be made."*
>
> *"Based on the same argument of food security and population increase[18], the decrease in area for crop production was ranked as high and not undesirable"* (meaning that with population increase, a reduction in cropland and therefore crop production may lead to food insecurity)

[18] i.e. with population increase, a reduction in cropland and therefore crop production may lead to food insecurity

For example, in reaction to reduced grazing land required:

> *"Intensive livestock keeping will leave more land for farming; Keeping animals indoor will lead to accumulation of more manure"*
>
> *"Members altogether agree that this is acceptable because animals are now kept indoor. More fodder can be bought by those in need. The available land can be cleverly used by planting good species like elephant grass"*

These responses may not be what we intended, but shed light on different issues – that manure is an important output of the system, feeding into the synergy between livestock and high-value crops; and that there is a tradeoff between planting fodder and planting crops, which will need to be decided.

4.5 Remembering heterogeneity

CLEANED and the Transformation Game operate at the landscale scale, considering the whole of Lushoto. As such, it is useful for exploring the variety of climatic and socio-economic situations facing people. Yet the discussions still tended towards one answer for the district rather than exploring the diversity; in practice, it was difficult to move from an individual perspective to a landscape perspective. This underlines the importance of facilitation, and time, in guiding the conversation to unpack the complexity of the story. This was clear in two aspects of the workshop.

First, when defining the socio-economic indicators the groups started by thinking about them at an individual level ("What do I want in a good future?"). It was difficult to then translate the individual wishes into targets to measure progress towards achieving the indicators at the landscape scale. Second, it was easy to forget that Lushoto district covers a large area of warmer, drier lowlands with different climate and crop suitability, and more importantly, where large herds controlled by the Maasaai are kept. Livestock keepers from the lowlands were not present in the workshop, so their voice was not always represented; this is something to keep in mind for all the reflections and conclusions drawn in this report. Most of the discussions are relevant to the highland part of Lushoto that is cool and wet, as this is where smallscale dairy kept indoors with cross breeds or mostly exotic breeds is burgeoning. For example, the statement that '*maize is not suitable and therefore it is better to produce milk and buy maize*' may not hold in the lower parts of Lushoto.

Second, this workshop provided an important opportunity to come together, but it is only the start of an ongoing conversation. Playing the Transformation Game inspired hope and excitement, which serves a valuable function – but with limited discussion time not everything was discussed. Also, it is only a game, a simplification of reality, which is constrained by how much we, as outsiders, could pick up from Workshop 1 and experts who helped develop it. It relies on the participants to raise issues that are important and not included – which requires time to first understand and then explore relevant issues. Realising the importance of having a simple cost calculator is an example.

There was some mention of the distribution of costs and benefits (equity). Participants pointed out the scenarios might impact people differently, mainly because of different levels of livestock keeping knowledge and access to capital, breeds and extension services. Not all farmers would have the economic status to keep the highest-producing animals (E2) – but some would. For this reason, groups would have liked to keep different classes of the same breed in a scenario (e.g. LBR and L2), to cater for low inputs and high inputs. The challenge for the future livestock plan will be to address the translation from individual to landscape level. Engaging more fully with distribution and equity may be part of the answer.

For the facilitators and research team, two observations that have significance for future work emerge from these reflections. First, in the Transformation Game (and, more generally, where simulation tools are relied upon) it appears that the setup of the game, and the information available with the game, frames the subsequent conversation, opening up or closing down the potential for learning, but does so in complex and potentially unexpected ways. Second, and in relation to this, the experiences in both Burkina Faso and

Tanzania suggest that the utility of a simulation device such as CLEANED requires rhetorical space – that is, the opportunity to be the focus for a constructive conversation – to be an effective learning tool.

5 Conclusion

This report has presented the design for and preliminary results from the second ResLeSS workshop in Tanzania. More detailed analysis of the results of the workshop will follow later in the project, focused around contributions to the academic literature. However, at this stage a number of observations can be made. Overall, the blending of the CLEANED simulation tool with scenario development via the Transformation Game enabled participants to explore the benefits and trade-offs of improving livestock breeds for dairy production, namely local breeds (*kienyeji*), cross-breeds (*chotara*), and mostly exotic breeds (*kisasa*). The improved breeds require better management in terms of housing, veterinary services and sufficient high value feed. A move to improved breeds therefore requires more planted fodder, which competes with staple food production, and requires more concentrates such as brans or oil seed cakes that need to be purchased. The group agreed that this will compete for limited financial resources for many households in Lushoto.

The scenarios for 2030 agreed by the two group showed that an increase of up to 155% of current milk production is possible at the potential cost of 50% of total staple food production. Participants felt that they had no competitive advantage in staple production and already today need to purchase it. Getting more income from milk will allow them to be more food secure than today as well as fulfil their other objectives such as educating children or having a brick house with running water and electricity. In addition, the move to purchased concentrates that do not require land will reduce the overall pressure on land, allowing more higher-producing animals to be kept, or freeing the land for planting fodder or other economic activities. By exploring options for 2030 they discovered that understanding their constraints and planning how to overcome these will help them to reach their objectives.

The outcome of the workshop is not a full design for livestock futures in Lushoto but, rather, a better understanding among and between stakeholders, and for the research team. This includes understanding of the key trade-offs and the socio-economic context within which those trade-offs need to be negotiated. While moving to higher-performing animals could boost milk production and income from milk, and release pressure on land for feed, the cross breeds and exotic breeds require more financial resources for purchased feed, medicine and maintenance. Therefore not everyone will be able to move to the highest-performing animals.

The experience of the workshop showed that to adequately explore issues requires allowing time to let the participants immerse themselves in the discussion – to get used to the Transformation Game and understand the dynamics of the scenarios and the accompanying results, in order to engage with and respond to the results. Whereas participants vigorously debated the economic indicators, showing confidence in what they hope for and consider achievable in the future, there was a shift to being a passive learner during the Transformation Game. Where too little time was allowed for introducing the Game, this raised the risk of the fast learners or those with prior knowledge dominating and leading the discussions, while the others were still trying to learn. It also showed the difficulty of covering the wide range of economic and environmental aspects to consider in designing and evaluating scenarios, meaning that nuances such as exploring the distribution and equity of future changes and their implications received little or no attention. Having a simple cost calculator could help to bring the consideration of the socio-economic indicators into the scenario evaluations, to complement the environmental information.

Overall it was a positive experience for all - even where there are points that need further clarification; we now know what those points are, as well as the significant debates that need to be kept at the centre of decision making.

6 References

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Pfeifer, C., Morris, J., Soka, G., Moses, E.A., Ensor, J., 2018. CLEANED Documentation: Conceptual overview of CLEANED and parameterisation of a CLEANED tool for Lushoto, Tanzania (SAIRLA Project report). Stockholm Environment Institute, York.

7 APPENDIX A – Workshop participants

Table 24 describes the 4 categories of stakeholders identified as important in the smallscale dairy value chain in Lushoto, Tanzania.

Table 24: Workshop 2 Stakeholder groups, Lushoto, Tanzania

Stakeholder group	Total number	New since Workshop 1
Livestock producers – representatives of village livestock farmer groups	17	
Traders (feed supply, milk collection and processing, butcher, hotel manager)	12	
Administration (Tanga Regional Sectrateriat, extension services, village chairman, milk cooperative union leader)	5	1

8 APPENDIX B - The Transformation Game in Lushoto

The 'Transformation Game' is a novel contribution of the project that allows participants to devise and assess future livestock scenarios. It forms the central focus of Workshop 2.

As noted in section 1, the aim of the workshop is to support participants to undertake a shared evaluation of the social, economic and environmental consequences of plausible livestock futures. Central to this is the use of CLEANED. While the results of CLEANED are relatively straightforward to interpret, developing sufficient understanding of the model and how it can be parameterised is beyond the scope of a multi-stakeholder workshop. The workshop design is therefore driven by two requirements:

- To simplify the use of CLEANED in real-time, so that alternative livestock futures can be assessed without the need to understand, discuss and enter all possible parameters; and
- To simplify the process of making choices between (a potentially huge number of) livestock management options.

The 'Transformation Game' addresses these requirements through the use of vignettes. Each vignette is parameterised prior to the workshop and is available to be called-up via the CLEANED user-interface, allowing

rapid but straightforward user engagement. At the same time, the vignettes define a limited number of livestock management options, reducing the complexity of decision making in the workshop by constraining the number of options available to participants. Together, these factors enable interaction with CLEANED within a manageable time, allowing for relatively quick iterations of scenario development, meaningful discussions of results, and deliberation over potential scenario revisions.

As set out in Section 1.1, vignettes and scenarios are deployed within the Transformation Game to allow iterative assessment of the socio-economic and environmental impacts of scenarios, as illustrated in **Error! Reference source not found.** and explained in Section 2.1.

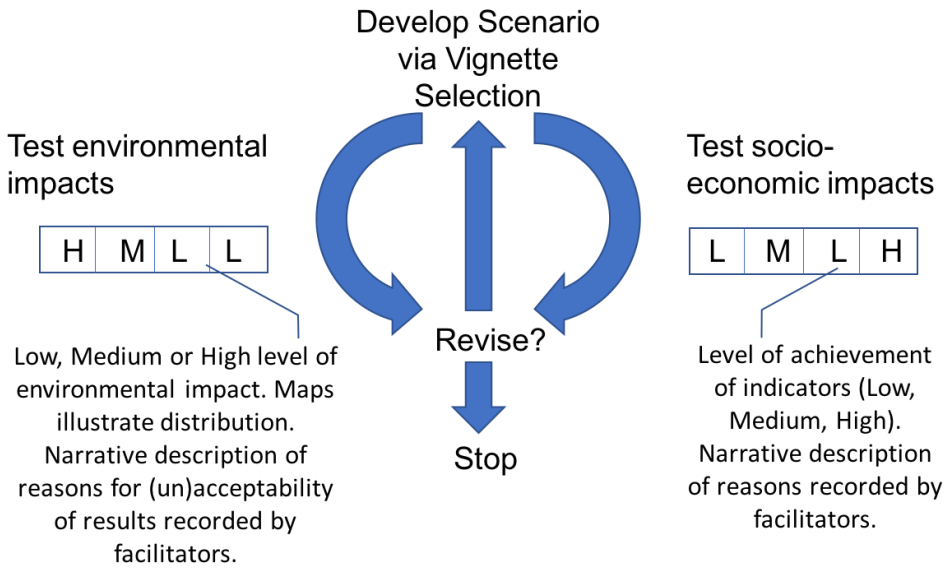

Figure 1 : The Transformation Game. An initial scenario is revised until participants are satisfied with the environmental and socio-economic impacts.

8.1 Playing the Transformation Game

The Transformation Game comprises five components that are deployed by players in the workshop:

- **Vignette cards:** Central to the game is the vignette, or short description of key elements of a livestock management practice. Each vignette is printed on a card, with an image illustrating the vignette on the front. On the back, an interested participant would find all the associated CLEANED parameters that define the vignette. **Error! Reference source not found.** provides an example from the Tanzania game. For each production category (e.g., fattening animals, dairy animals; in the Tanzania case there are three, as discussed below) one vignette represents today's practice, and a further one or two vignettes are provided describing possible (and plausible) future changes to animals, feed and/or management for that category (e.g. introduction of high yielding dairy cows). These vignettes are pre-set within the CLEANED tool, so that the non-expert can develop credible scenarios (that is, combinations of vignettes defining the production across the landscape).
- **Game board:** The game board allows participants to select a combination of vignettes. **Error! Reference source not found.** provides an example from Tanzania. The bottom row sets out the current scenario – representing what is found in the study area today. This is fixed. The top row is initially blank, allowing participants to choose which vignette card they wish to place in each production category to define their future scenario.
- **Bricks (defining number of animals):** Lego-type bricks are provided to participants, with each brick corresponding to a defined number of animals. The bricks are placed on each vignette card to allow the participants to select the number of animals involved in each vignette across the 'landscape'. Sufficient bricks are provided to represent the total number of animals currently in the study area, as well as allowing for an increase in animal numbers in future scenarios. **Error! Reference source not found.** illustrates the bricks in use in Tanzania.

- **Environmental score cards:** Once a scenario has been selected, participants use CLEANED to produce a set of productivity indicators (recorded in Table 25), and environmental impacts (water, greenhouse gases, and nitrogen balance; Table 26). The results are presented by CLEANED in tables and provide average impact measures for the whole study area for that scenario, as well as a percentage difference in these measures for the scenario from the baseline. Two environmental score cards are provided to allow participants to record the key results given by CLEANED tool for a particular scenario. CLEANED also provides an automatic guide as to whether this change is low, medium or high, relative to the range of possible impacts for the study area (based on plausible scenarios; Appendix C). This assessment allows the participants to gain a sense of the scale of change. The participants then make their own (subjective) evaluation of what this impact means to them, recording their view as to whether the impact is desirable, acceptable or unacceptable and why. This evaluation is captured in the 'Participant Evaluation' column.

Table 25 : Environmental scorecard - productivity indicators

Productivity indicators	% change compared to baseline	CLEANED Generated Score Low/medium/high	Group evaluation (acceptable, ok, unacceptable)	Comments
Milk produced (tons)				
Maize produced (tons)				
Cropland used (ha)				
Grazing land used (ha)				
Import				

Table 26 : Environmental scorecard – environmental impact indicators

Other indicators		% change compared to baseline	CLEANED Generated Score Low/medium/high	Group evaluation (acceptable, ok, unacceptable)	Comments
Water	Total (litre)				
	Litres water per animal				
	Litres water per kg milk				
Greenhouse gases	Total $CO2_{eq}$ (kg)				
	Total $CO2_{eq}$ (kg) per animal				
	Total $CO2_{eq}$ (kg) per kg milk				
Soil fertility	Nitrogen balance (N in minus N out)				
	Manure produced (tons)				
Biodiversity - # endangered species losing critical habitat					

- **Socio-economic score cards:** Once a scenario has been selected, participants discuss the anticipated socio-economic impacts in relation to each of the indicators agreed during the first day of the workshop (Table 27). The score card encourages the participants to think in terms of the different impacts felt by different groups. Based on these discussions, participants score their assessment of the progress the scenario makes against the indicator as low/ medium/ high.

Table 27 : Socio-economic scorecard

Indicator	What are the benefits?	What are the costs? Why?	Who benefits most and least?	Score
Combined indicator 1 etc.				

Having assessed the environmental and socio-economic consequences of a particular scenario, participants negotiate a revised scenario – using vignette cards and bricks – that they believe will better meet their environmental and socio-economic goals. The revised scenario can then be evaluated and revised in a further iteration of the game.

LBR: Local Breed		
Alive weight (kg)	lwes	180
Milk production (kg/cow/year)	myes	500
Feed basket dry season		
Natural grass	efng1	20
Cereal crop residue	efrc1	80
Rice crop residue	efrr1	0
Legume crop residue	efrl1	0
Planted fodder	efpf1	0
Concentrate – bran	efconc1	0
Concentrate – oil seed cake	efconos1	0
Hay	efhay1	0
Silage	efsil1	0
Feed basket wet season		
Natural grass	efng2	98
Cereal crop residue	efrc2	2
Rice crop residue	efrr2	0
Legume crop residue	efrl2	0
Planted fodder	efpf2	0
Concentrate – bran	efconc2	0
Concentrate – oil seed cake	efconos2	0
Hay	efhay2	0
Silage	efsil2	0
Manure management		
% in lagoon	es_lagoon_perc	0
% as liquid slurry	es_liquidslurry_perc	0
% as solid storage	es_solidstorage_perc	0
% as drylot	es_drylot_perc	0
% left on pasture	es_pasture_perc	80
% daily spread	es_dailyspread_perc	10
% in digester	es_digester_perc	0
% used as fuel	es_fuel_perc	3
% other management	es_other_perc	7

Figure 2 : Example of a vignette card showing the title and illustration on the front (left) and the CLEANED parameters on the reverse side (right). (created by authors)

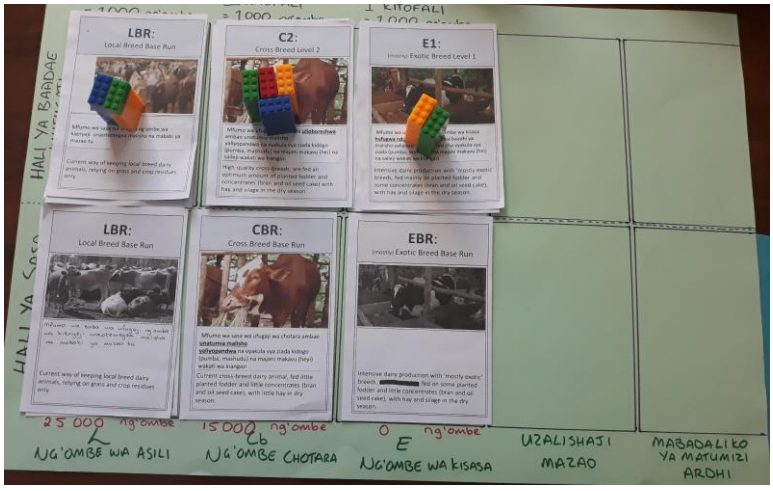

Figure 3 : Game board used in Tanzania. Vignette cards can be placed in the top row by participants to select their future scenario. (Photo: J. Kahamba)

Figure 4 : The game being played in Tanzania. Participants are selecting the number of bricks that they want to assign to each vignette, representing the number of animals. (Photo: G. Soka)

8.2 Initialising the Transformation Game for Lushoto, Tanzania

Full details of the parameterisation of CLEANED for the study site can be found in the companion report. Here, we summarise the key points that define how the Transformation Game is played to allow interpretation of the results.

Three livestock categories were maintained based on the reflections from workshop 1.

4. Local animal
5. Cross breeds
6. (mostly) Exotic breeds

A cross breed is a mixture between the local Zebu and an exotic dairy breed such as Jersey, Ayrshire or Friesian; the differentiation between Cross-breed and (mostly) Exotic is in the ratio of exotic:local genes. A mostly exotic breed is considered to have more than 80% exotic genes, based on expert consultation, because there are reportedly no or very few pure exotic breed dairy cows in Lushoto according to the experts consulted.

Based on a literature review on livestock productivity and most recent research data available at ILRI in Tanzania, the vignettes were developed in relation to each of the production categories. Each vignette represents a credible combination of feed basket[19] and animal productivity for each animal category. Parameters defining the feed basket required to support a particular milk yield have been derived from the literature and reviewed by a feed and fodder expert. These define vignettes that are credible and based on nutrition available in Lushoto. Table 28 sets out a total of 11 vignettes; each of these was pre-programmed into CLEANED to allow them to be rapidly accessed during the workshop.

Table 28 : Vignettes and their descriptions.[a]

	Code	Description
Local Breed (L)	LBR: Baseline (current state)	Current way of keeping local breed dairy animals, relying on grass and crop residues only
	L1: somewhat improved	Local breed dairy animals, kept extensively, fed little planted fodder and little concentrates (bran and oil seed cake), with hay and silage in dry season
	L2: much improved	Good quality local breed dairy animals, fed some planted fodder and little concentrates (bran and oil seed cake), with silage in the dry season
Cross Breed (Cb)	CBR: Baseline (current state)	Current cross-breed dairy animal, fed little planted fodder and little concentrates (bran and oil seed cake), with little hay in dry season
	C1: somewhat improved	Cross-breed dairy animals, fed some planted fodder and some concentrates (bran and oil seed cake), with hay and silage in dry season
	C2: much improved	High-quality cross-breeds, are fed an optimum amount of planted fodder and concentrates (bran and oil seed cake) with hay and silage in the dry season
Mostly Exotic Breed (E)	EBR: Baseline (current state)	Current specialised dairy production with 'mostly exotic' breeds, fed on some planted fodder and little concentrates (bran and oil seed cake), with hay and silage in the dry season
	E1: somewhat improved	Intensive dairy production with 'mostly exotic' breeds, fed mainly on planted fodder and some concentrates (bran and oil seed cake), with hay and silage in the dry season
	E2: much improved	Intensive dairy production with 'mostly exotic' breeds, are fed an optimum of planted fodder and some concentrates (bran and oil seed cake) and hay and silage in the dry season

[19] A 'feed basket' is the type and proportion of feeds used (e.g. 40% grass, 40% crop residues, 5% maize bran etc.)

Land use change (x%)	Choose how much feed biomass you need (in terms of % of existing cropland), for which you want to convert to crop land. Cropland will be converted from any land use (excepted protected area and forests) based on proximity of already existing cropland and suitability for crop.
Crop productivity (+20%)	Increase crop and fodder yields by 20%. More manure and chemical fertiliser is applied to croplands.

[a]The current version of each production category is comprised of three vignettes; there are a further two progressive futures for each category (six vignettes); An additional two vignettes offer opportunities to allow land use change, and a crop productivity increase. Total = 11 vignettes.

The baseline or current state number of animals in each production category have been defined for Lushoto as set out in Table 29, along with the number of animals represented by each brick used in the Transformation Game.

Table 29 : Number of animals[a] in the baseline scenario in Lushoto, Tanzania

Category	Baseline CLEANED	Bricks	Single Brick value
L Local breed	25,000	25	1000 animals
Cb Cross breed*	15,000	15	1000 animals
E (mostly) Exotic breed	0 (less than 1,000)	0	1000 animals
Total animals	40,000		

[a] The CLEANED tool only considers the dairy animals in Lushoto District, therefore the total number of cattle in Lushoto District is in fact higher
* The Cross-breed category includes cross-bred cows with 50 - 80% exotic genes; the (mostly) Exotic breed category includes cross-bred cows with more than 80% exotic genes

These vignettes and numbers of animals initialise the Transformation Game on the game board. Important elements of the game board are (**Error! Reference source not found.**):

A: the name of each production category – translated into the appropriate language

B: two rows of spaces to place vignettes – the starting situation (B1) and the scenario to be designed (B2)

C: a definition of what 1 brick represents – how many animals or troupeaux (C1) – leading to a corresponding number of bricks in the current scenario (C2).

During the game, vignettes are laid in the squares (along the row B2) and bricks piled on each vignette commensurate with the number of animals to be represented.

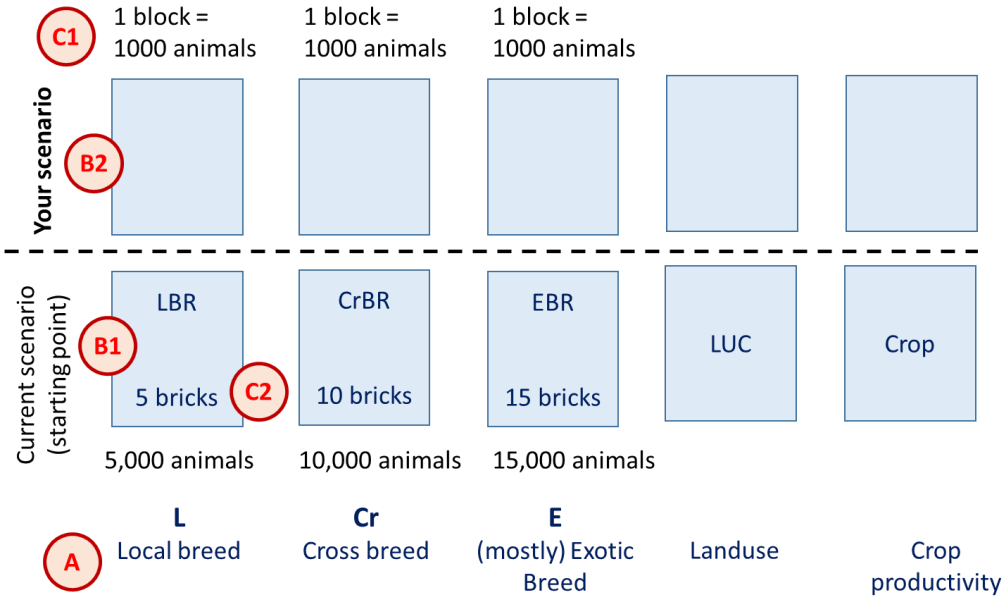

Figure 5 : Game board for selecting vignettes to build a scenario for Lushoto, Tanzania

8.3 Workshop structure

The two day workshop reviews and expands on the findings from Workshop 1, culminating in the participants playing and reflecting on the Transformation Game. The key stages in the workshop are set out below.

8.3.1 Refining the Socio-Economic Performance Indicators

Workshop 1 defined and ranked socio-economic indicators for each stakeholder group. Workshop 2 commences with an opportunity to review and refine these indicators (to avoid ambiguity, where similar indicators had a different meaning for different groups, and to ensure each indicator is specific and measurable, allowing for progress to be assessed). In the second workshop session, combined indicators, representing the views of the entire workshop participant group, are discussed.

Activity 1: Refining indicators by group (Day 1, morning)

> **Expected output:** For each homogeneous stakeholder group, a maximum of 5 ranked, specific, measurable indicators including narrative description of low, medium and high progress in the case-study context.

The facilitator presented the 5 top indicators agreed in Workshop 1 to check that everyone still agreed with those indicators, and to introduce the indicators to any newcomers who were not at WS1. The facilitator then led the group in a process of refining each indicator, using a reporting sheet to structure the discussion (**Error! Reference source not found.**). The objective was to reach a description that was as specific as possible, with thresholds defined for what constitutes low, medium and high progress towards the overall goal. For qualitative indicators, the groups gave a narrative description of what low, medium and high progress look like.

The indicators were expressed at the level of the district, not in terms of individuals. Each group was provided with an opportunity to present their detailed indicators to the plenary.

Indicator:		
Description:		
Low:	Medium:	High:

Figure 6 : Reporting sheet for defining Socio-Economic indicators

Activity 2: Combined indicators (Day 1, afternoon)

> **Expected output:** Maximum 5 Key Performance Indicators, agreed by all stakeholder groups as the shared priorities for the workshop. Increase in understanding between those in different stakeholder groups of the differences in socio-economic priorities.

The research team reviewed the detailed indicators and proposed common themes to the plenary. Each group was then provided with time to reflect on the proposal and provide feedback to the questions: Could the group live with the indicator list, even if it is not perfect? If yes, identify one or (max) two key changes that would improve the list. If no, identify key changes that would enable them to live with the indicator list, even if not ideal. From this, the research team developed a final list of indicators for use in the Transformation Game.[20]

8.3.2 Designing and refining scenarios of future livestock production

The second part of the workshop comprised two stages. The first stage, on Day 1, introduced participants to the Transformation Game (the vignettes and the game board) as a way to think about how livestock production in Lushoto might look in the future – and in terms of how to design a scenario. In their homogenous stakeholder groups, they then discussed and designed an initial scenario from their group's perspective. This was used to inform the starting scenarios for Day 2. In the second stage (Day 2), the CLEANED environmental impact assessment tool was introduced, before splitting participants into two new groups, now with a mix of stakeholders, to evaluate the scenarios using the CLEANED results and the socio-economic indicators. Each group started the Transformation Game with a different initial scenario. The workshop closed with a reflection in each of the two groups about what they liked about the final scenario that they had developed; what challenges they faced in arriving at it; and what they learnt in the process.

Activity 3: Initial scenarios in homogeneous stakeholder groups (Day 1, afternoon)

> **Expected output:** Stakeholders introduced to CLEANED production categories, vignettes and scenarios. Appreciation of how scenarios translate into socio-economic impacts. Development of shared scenario to satisfy economic indicators. Shared understandings developed between stakeholders from different groups.

This session began with introducing the three production categories, explaining these as the research team's interpretation of how participants described livestock management in Lushoto in Workshop 1. Then, the vignettes were introduced as our interpretation of how the participants see those livestock keeping categories

[20] The intention had been for this then to initiate several rounds of group discussion and feedback to plenary, allowing gradual refinement of the combined indicators. However, time constraints prevented more than one round of discussion.

changing in the future – the pathways of transformation. The participants were then introduced to and played the Transformation Game to produce an initial scenario[21].

Activity 4: Common scenarios in mixed groups (Day 2, morning and afternoon)

> **Expected output:** Each mixed group arrives at their preferred scenario through exploration of trade-offs between environmental and socio-economic impacts – by playing several rounds of the Transformation Game.

Following an introduction to CLEANED, the two mixed stakeholder groups played the Transformation Game. Each group started from a different initial scenario, produced overnight by the research team based on the outputs from Day 1. Trend(s) observed in the scenarios developed on Day 1 were used as the starting point(s) for Day 2. Facilitation was required to ensure representation and voice for all stakeholders in the mixed group, such that all stakeholders were able to express themselves. The participants first discussed the initial scenario giving their subjective evaluation of the CLEANED environmental impacts, using their knowledge of the local area (for example, thinking of what the impact means in terms of availability and access of resources, and competing users). These discussions were captured in the score card. The participants then evaluated the socio-economic indicators, considering the cost and benefits and their distribution in terms of who the winners and the losers might be. The participants scored the scenario against each of the socio-economic indicators, as low, medium and high.

8.4 Changes made for Lushoto, Tanzania

Activity 1: Refining indicators by group (Day 1, morning)

Being conscious of time constraints, we asked groups to refine the three most important indicators of their top five indicators from Workshop 1 (and if they finished early, they could then do the final two). For some groups this meant an initial activity of choosing which three were the most important. Secondly, we added a sub-section to the Description in the indicator definition sheet (Figure 6), called 'Enabling Environment', to prompt the group to consider what is needed to move from the present situation to their target.

Activity 3: Initial scenarios in homogeneous stakeholder groups (Day 1, afternoon)

On the morning of Day 2, we decided to extend Activity 3 for an hour on Day 2, to introduce and explain the CLEANED tool and results while participants were still in four stakeholder groups, and carry out the first evaluation on their scenario. This would allow them to see the outcomes of the scenarios they designed on Day 1, and to learn how to interpret the CLEANED results in smaller groups with more opportunity to ask for clarification. This change was motivated by two reflections. First, the facilitators reported how interested the participants were in the scenario development, and that a few had been promised that they could try out their ideas on Day 2. We felt there might be disappointment and a disconnect to instead discuss a scenario that was not theirs. Second, unlike Burkina Faso where two conflicting storylines emerged, all four groups followed a similar storyline. Therefore, we felt that there would be time to allow groups to explore and understand CLEANED using their own scenarios before moving into mixed groups. The facilitators all supported this change.

Activity 4: Common scenarios in mixed groups (Day 2, morning and afternoon)

As in Burkina Faso, the scenario that the mixed groups started with was produced overnight by the research team based on the outputs from Day 1 – however, only one average scenario was produced, which both groups used as a starting point.

Following the change to Activity 3, participants came into the mixed groups with a good idea of what their scenario could deliver, which would be somewhat different to the average scenario. Therefore, we suggested that the mixed groups could give just a brief reaction to the average scenario and start with discussing

[21] A common method across the groups was to start from the current number of animals in each category and ask: "What will happen to these animals?" to build a storyline of how the animals in that category move up or out or disappear or new ones arrive.

immediately how to change the average scenario, based on their knowledge of their Day 1 group scenarios. This means skipping the initial evaluation of the average scenario, as they already did an evaluation of their group scenarios. The game continued as normal from the first refined scenario in each mixed group, with an evaluation and then discussion of any changes needed – with an ambition to iterate quickly and test two refinements of the average scenario.

Changes to the Environment and Socio-economic scorecards

Environmental score-cards

Impact results were tailored to be relevant to Tanzania (see Section 2.2). Two new indicators were added to the environment score-cards ().The amount of manure produced in the scenario was added to the environment results sheet upon realising that manure is an important commodity for the participants. A maize production measure was added to the productivity results sheet as an indicator of potential trade-offs between fodder fr animals and feed for humans as you move to higher quality fodder that relies on cropland.

Facilitators selectively presented the automatic evaluation of each results, that is generated by the CLEANED tool (Appendix C), based on their feel for whether group would understand it.

Socio-economic score-cards

The socio-economic score-cards were replaced with a simpler method of capturing the socio-economic evaluation of the scenarios. The challenge was to better trace and record the link between the scenarios and the socio-economic indicators – how did groups design the scenarios to support progress towards achieving the indicators, and upon seeing the results, how did they evaluate whether the scenarios could fulfil their expectations? The score-card (Table 27 in Appendix B) were seen as cumbersome to fill in – a trade-off between having an explicit prompt to discuss and capture reflections about each socio-economic indicator, and having a complicated form that would mire the conversation and sap energy from the group by becoming repetitious.

Instead, we asked groups on Day 1 to reflect on the scenario they had designed and capture on a sheet 'Why do we like this scenario?'. On Day 2, we anticipated that most socio-economic evaluations would be connected with the productivity results, and could therefore be captured in the comments to the productivity score-card. We also asked for a general reaction to the average scenario.

9 APPENDIX C – Defining CLEANED-generated scores

In order to support stakeholder discussion, the research team proposed an automatically generated score for each impact of a scenario, represented in terms of a low, medium or high change from the baseline.

In order to generate an automatic score to indicate the relative scale of impact of the different scenarios, i.e. to define whether the change is low, medium or high with respect to plausible change in the study area, scenarios have been developed. The different scenarios define the range of plausible change. This range was cut into 3 equal intervals defining what would be scored as low, medium and high.

9.1 The developed scenarios

Forecast scenarios based on a partial equilibrium model IMPACT (Enahoro et al., 2018), show that by 2030 demand for milk in Tanzania will double, however part of that milk will be imported. The domestic production will have to increase by 50% compared to today.

The two scenarios developed were quite simple:

1. Animals in all categories are increased by 50% at current feeding strategy.
2. Animals in all categories are increased by 50% at their respective best feeding strategy.

9.2 Assigning the score to changes

The environmental indictors were computed for each scenario. The difference to the base run was computed in absolute values. The maximum of this absolute value provides the credible range for the scenarios. This range value divided by three is the threshold value that has been used, as shown in **Error! Reference source not found.** below, where X is the absolute value of the difference between a scenario and the base run.

Table 30: Assigning an automatic score to changes in environmental impact

Condition	Score
X < threshold	Low
Threshold < X < 2*threshold	Medium
X > 2*threshold	High

This rule has been applied to each environmental indicator.

10 APPENDIX D – Stakeholder group socio-economic performance indicators

The following sections detail the target and associated indicators decided by each stakeholder group. Any additional discussion in reaching the final decision is also reported, together with any facilitator reflections. Note that these results constitute the "co-defined indicators" anticipated in the project proposal. Prioritisation of these indicators is provided by the ranking, with indicator 1 being the highest priority.

10.1 Farmer group 1

1. Improved livestock breeds

Description	Progress towards achieving success	
Proportion of total population in Lushoto that have breeds that perform well (15-20 litres per milking), that have good health and are kept in a good animal shelter.	**Low**:	≤20%[22]
	Medium:	≤50%
	High:	≤70%

For comparison, current average performance of cows in Lushoto is 5-6 litres per milking. Good health means avoiding East Coast Fever, Black Quarter and other tick borne diseases, and normal conditions such as worms. The group discussed that Jerseys and Ayrshire would be good breeds, which are also environmentally suited for the cooler conditions of the highland part of Lushoto. A good animal shelter was highlighted, because it is easier to feed and water them, easier to treat them when are sick and easier to collect the manure. It is easier

[22] The thresholds reported in Appendix 11 are as provided by the groups, and are not always statistically consistent.

to provide a good quality fodder mix, including planted fodder, because they are stationary and dependant on you.

Improved breeds can be accessed in several ways: buying from livestock markets or from a neighbour; with the help of government or NGO loans; by inheriting animals from ones parents; being given animals by ones parents; or through a popular scheme of 'local heifer in-calf', a scheme whereby you are given a heifer that is in calf, and when it has birthed you keep the heifer and give the calf back to the person who gave it to you.

There was some differences of opinion about the difference in production between cross-breed and exotic breeds here, some arguing that the production is the same. After explanation by the facilitator and other members they agreed that the indicator should refer to exotic breeds as they will produce more. However, one pointed out that exotic breeds can produce less than cross breeds, if they are not well fed and maintained.

2. Educating children

Description	Progress towards achieving success	
Proportion of children in Lushoto educated to university level, until they have a university degree.	**Low**:	≤10%
	Medium:	≤20%
	High:	≤30%

For children to reach university, the group agreed that families need to have enough food to provide good nutrition for the children. Children need to have extra time for learning, and a favourable home environment for studying and learning, including good shelter, and reading books and school material. The children also require a good character, meaning that studying and learning suits them. The family needs a good family income – although education is free, and mandatory, up to Form 4, families still need to buy the uniforms, books and stationary. The group agreed that having better livestock breeds would help to provide family income from the sale of livestock products (e.g. milk, manure, calves). Furthermore, good school infrastructure is required – buildings, laboratories, equipment and highly qualified professional teachers. Finally, children should be secure on the journey to school, particularly the girls, to prevent them getting pregnant and then needing to drop out of school.

3. Land ownership

Description	Progress towards achieving success	
The proportion of total population in Lushoto who own 5 acres of land.	**Low**:	≤70%
	Medium:	≤20%
	High:	≤10%

Land is acquired either by inheriting or buying land. The ranking is different here because the wanted to highlight that in the future land will become smaller and smaller so in the future fewer people will be able to have 5 acres, and may even have to shift where they grow crops.

10.2 Farmer group 2

Choosing the top 3 indicators

Each participant was asked which were their three top indicators from the five produced in Workshop 1. For all participants, education ranked the first. Reasons included:

- Education will enable people to have vision. A person can have different resources but can fail to use them to achieve success if he/she has no education.
- Even without cow, if someone has education they can still do other activities to earn income.

Owning land was agreed to be ranked the second. However, before agreeing to that, while some participants thought owning land should rank the second, others thought that having enough food for the whole year should be ranked the second with the reason that food was important (these were two female participants). However, after a long discussion, it was agreed by all participants that owning land was slightly more important than the latter with the reason that if someone has land, they can grow crops and keep animals which would eventually secure food in the households.

The third indicator agreed by participants was having modern livestock breeds. Again before reaching this conclusion, one participant thought having a modern cattle house with store for feeds was supposed to be ranked the third. However, through discussion the rest participants were able to convince her that having modern livestock breed is more important than having modern cattle house because you can have modern cattle house with poor breeds with low milk production. They said that because the target is to have more quality milk for selling to get more income, modern livestock breed overweighs modern cattle house. One participant gave simple argument that it is easy to build modern cattle house while you already have modern livestock breeds and not vice versa.

1. Education

Description	Progress towards achieving success	
Proportion of households whose children are educated to form six level (as the minimum education level) and above.	**Low**:	10-20%
	Medium:	30-40%
	High:	79-80%

- One male participants targeted education of first degree level with the reason that currently there are many Form IV leavers, but without the skills to enable them get employed.
- Another female participant suggested that Form IV education level is okay if in the curriculum they can be taught skills on livestock production.
- Another female participant insisted on the environmental education.

However, it was finally agreed that Form six education level is a good minimum description of educated children for Lushoto since an educated child to Form six level can easily go to diploma and degree studies. It was also explained that without having educated a new generation, Lushoto is at risk of losing its resources to educated people from other places who may come to work in Lushoto in the future.

The high target of achieving this indicator was suggested to range from 70%-80% with the reason that not all children would like to continue with school despite that their parents might be willingly to support them. The medium measure of achieving this indicator was agreed to range from 30%-40% and 10%-20% being the low precision of achievement. The participants acknowledged that cultural norms hindering girls to go to school is still existing in Lushoto and awareness of importance of education is still low in the areas outside Lushoto town, all of which might affect achieving this goal by 2030.

Enabling conditions/ steps needed:

- There should be good school from primary level to secondary level
- More colleges (offering programmes on agriculture and livestock) should be established in Lushoto
- Qualified teachers
- Raising children in a good manner
- Income from different sources such as petty businesses, selling crops, selling milk, small industries (for processing milk)....

2. Owning fertile land

Description	Progress towards achieving success	
Every farmer has one acre of land in the lowland for vegetables and fruits production and one acre of land in the upland for food crops and fodder production. This land should be fertile.	**Low**:	10-20%
	Medium:	30%
	High:	70%

It was easy to describe this indicator. Participants pointed out that every household has land. However, that land is in different plots of which if their sizes are summed up, most of households (70%) are having at least 1.5 – 2 acres. Their very concern was keeping that land fertile for improved food crops and fodder production. They therefore insisted that having livestock in each household is important for manure production, and hence for soil fertility improvement.

In the case of achieving the target, they agreed that if 70% of household will be able to own land of 2 acres (one acre in lowland and one acre in upland) that will be the high achievement. This is because there is still a lot of land for inheritance among households. Two participants suggested 80% of households, however, it was agreed that it will not be possible to reach that figure for three major reasons:

- There is no virgin land which can be used by farmers in the future.
- Capacity of buying as price of land is increasing year after year.
- Population is increasing therefore by 2030 the number of acres owned by households for farming will be reducing automatically.

Therefore, due to the above reasons participants agreed that if 30% and 10-20% of household will own 2 acres of fertile land by 2030 that will be medium and low achievement respectively.

Steps needed:

- Livestock for manure production.
- Improving soil fertility by using contours and crop residues (Mainly about leaving the maize stubble in the farm to stabilize the soil).
- Capacity of purchasing land.
- Ability to inherit land.

3. Owning modern livestock breeds

Description	Progress towards achieving success	
Every household has 2-3 cross breed or Exotic breed cows.	**Low**:	10-40%
	Medium:	50-60%
	High:	80-90%

There was much discussion on this indicator. All participants said improved livestock should be cross breed cows and exotic breed. Arguments were made on the numbers. While some suggested at least 4 improved cows for more milk production, others argued that it will be expensive to take care of improved breeds as per current experience. Therefore, they agreed that 2-3 improved breed of cows would be reasonable to be available in majority of households by 2030.

Therefore, they agreed that for that amount of improved breed of cow, by 2030 the high achievement will range from 80%-90% because most of Lushoto farmers are aspiring to keep improved breed cows (Cross breed and exotic). They also agreed that if 50%-60% of households will be keeping such improved breeds that will be a medium achievement.

Steps needed:

- Availability of improved or pure bulls.
- Availability of experts for artificial insemination.
- Drugs/vaccines.
- Availability of improved semen.
- Availability of planted fodders, concentrates, silage and hay).
- Education on livestock keeping environmental conservation.

Talking about the lowlands, some people reminded the group to also think of those people in the rest of Lushoto – Lushoto district is BIG – not just Lushoto town, so it is far to travel around, and difficult for them to come to Lushoto town, so the target cannot be to simply reduce all cows to mostly exotic breeds with a high standard of management.

10.3 Traders

Choosing the top three indicators

Every group member was given a chance to mention and provide reasons for the 3 top indicators. In the first round, the indicator 'buying a car for carrying pasture' was not mentioned by either of the group members. The group easily agreed on the choice of indicators to 'acquire more improved dairy cattle (at least 2)' and 'build a modern house (at least 4 rooms)'.

The choice of the 3rd indicator was challenging. Two indicators collided and these are 'educating children (at least two)' and 'buy more land for food and pasture production.' After voting 7 members voted for the indicator concerning educating children (at least two). There were several reasons that were mentioned to cement their voting on education, and these are: educated people will be needed in managing exotic breeds (knowing the diseases, breeding (use of natural and artificial insemination) and cattle breeds, clearly understanding what to do when animals are sick), there will be a need for families to have people who will help in marketing and negotiating on selling milk. The woman in the group mentioned that to have an educated child is an investment, for the reasons that those who are educated and are employed somewhere act as a source of extra income when parents need help. Parents with educated children are more likely to get help in terms of for example extra income for buying fodder, medicines for animals and even help in choosing better quality breeds of animals. Therefore, three indicators i.e. 'acquire more improved dairy cattle (at least 2)'; 'build a modern house (at least 4 rooms)' and 'educating children (at least two)' were chosen and are presented below.

1. Build a modern house (at least 4 rooms)

Description	Progress towards achieving success	
Proportion of population of Lushoto that have built a modern house with 4 rooms.	**Low**:	10-15%
	Medium:	45-50%
	High:	80-90%

The modern house being referreed to here was seen to be a house with the following qualities:

- A house made of blocks
- A house with big windows with enough air space
- A house with nice aluminium doors
- A house with iron grills on the doors and windows
- A house with a parking lot/space
- A house with iron sheets roofs
- A house with electricity and water

Steps required:

- A person needs to have quality livestock's that may lead into enough productions and that through selling of the products like milk, manure the individual receives income for house construction
- To have a piece of land with title deed/any other official document that approves ownership. Participants mentioned that in the villages land is not officially surveyed so it is difficult to get title deeds. They are just given an offer in form of customary land use.

2. To acquire more improved dairy cattle

Description	Progress towards achieving success	
Households have at least 2 improved dairy cattle, meaning a good breed that can produce up to 20 litres of milk per day, from a historical clean breed, for which characteristics of the parents can be traced, for example Friesian, Jersey etc.	**Low**:	10%
	Medium:	40%
	High:	70-80%

Participants also highlighted that the cows should have four milk teats. They mentioned that there are cows with 5 teats and normally the additional teat is not functional.

Steps required:

- Good shelter for the animals . They mentioned that the shelters must have concrete floor for easy manure collection and the iron sheet roofs that will shield animals from rains. The walls to have timbers.
- Availability of supplementary foods like hays
- Availability of water for animal drinking and dipping
- Vaccinations for protection against diseases
- Availability of fodder and areas for planting additional fodder

3. Educate children

Description	Progress towards achieving success	
Households are able to educate at least 2 children.	**Low**:	
	Medium:	
	High:	

It was agreed that educating a children meant to at least send a child up to a University level where someone acquires a degree. Also educating children means having someone to school up to FORM IV or FORM VI. The general objective of having someone educated and that they have skills for either self-employment or being employed

Steps required:

- A child needs to have the will, supported by good learning environments from home and at school (s).
- A child needs to have been morally shaped with guidance from parents/guardians
- That parents/guardians are able to provide for things like school fees and other needs

10.4 Policy-makers

1. Owning land and a modern house

Description	Progress towards achieving success	
Each household owns at least 2 acres of land, with title deeds, on which to build a modern house that is built from bricks (at least burnt bricks), with running tap water and electricity, an iron sheet roof, an internal toilet and bathroom, and enough rooms to accommodate parents, children and guests.	**Low**:	20%
	Medium:	50%
	High:	60%

The rationale was that one must have land before one can build a house, therefore the group considered these two elements as the same indicator. At the same time, one also needs a place to keep animals and get fodder for animals.

Land scarcity in Lushoto highland was mentioned as a big challenge. The major reason for land scarcity was mentioned to be high population density. It was hinted that families in Lushoto tend to have a high number of children. Examples from within the group were given where some members had over 8 children. The group estimated the average number of children per family to be 8.

The group suggested that 4 rooms would be required: 1 for the parents, 2 for the children, and 1 for guests.

Enabling environment:

The group stated enabling environment as being:

- Improved extension services
- Improved land use planning
- Reliable market for milk and milk products
- Reliable infrastructure such as electricity, roads and water pipes
- Policy which safeguard local market
- Financial services

On enabling environment, it was discussed that currently the market is stable, despite relatively low prices offered by the cooperatives. However, the stability of the market was unpredictable since introduction of cheaper milk and milk products may interfere and affect the local market. Examples from other products such as rice were given. So on enabling environment they mentioned presence of local market protective policies to control importation of milk and milk products as an enabling environment…

2. Ability to pay for education

Description	Progress towards achieving success	
A family should be able to pay for at least first degree for at least two of their kids; for vocational training of at least one of their kids; and a family should be able to access livestock keeping education for the parents.	**Low**:	20%
	Medium:	40%
	High:	60%

Enabling environment:

Issues listed in the enabling environment by the group were:

- Presence of quality schools
- Availability of loans to pay for higher learning
- Presence of sufficient education institutions (universities and vocational)
- Suitable curricula
- Willingness to study by the kids

The issue of number of kids came up again in this indicator. The facilitator probed about targeting two kids for degree and one for vocational training if it is not over ambitious. They defended this by saying they normally have a big number of children per family. It was however, noted that the family size is decreasing due family planning. When discussing about the number of institutions, it was first thought as if Lushoto may not be able to have all the needed institutions. But furthering the discussion, members argued that even for institutions present in Lushoto, not all students are from Lushoto. Therefore, they will send their children somewhere else for education provided they will have the enabling environment.

It was also noted that parents may have the willingness and ability to send their kids to school. But a number of other factors may interfere. These were mentioned as children's willing ness to study and their brightness.

Another issue which came out was the projection time. The indicators are projected to be fulfilled by 2030 (12 years from now). This brought challenge in conceptualizing because of the number of years a kid need to spend in Tanzania's educational system (7 in primary school, 4 in O-level, 2 in A – level, and later to University)

On parents livestock education, a member raised it saying technology is changing, therefore the livestock keepers need to update their knowledge on keeping the animals. Thus, as an indicator of success, parents should be able to access education intended to further their livestock keeping.

For this indicator, the thresholds (Low/Medium/High) were easy to reach following prior discussions on number of kids per family and use of education facilities outside Lushoto.

3. Owning improved livestock breed

Description	Progress towards achieving success	
Each household should have at least four cows, of breeds with a productivity that is higher than the inputs, and have an improved shelter for the cows.	**Low**:	20%
	Medium:	50%
	High:	80%

Enabling environment:

- Artificial insemination
- Presence of improved extension services
- Capital
- Infrastructure
- Availability of markets for milk
- Availability of sufficient feeds all year round

The group agreed not to specify type of breed, but insisted on having dairy cattle which at the end of the day produces more than what it consumes cost-wise. Market availability of dairy products and constant supply of feeds were unanimously agreed as the key enabling environment.

11 APPENDIX E - Stakeholder group scenarios in detail

11.1 Farmer group 1 (Pink group)

Table 31: Re-distribution of animals in the future for the Farmer group 1

	Local breed	Cross breed	Mostly Exotic breed
Level 2 (2)	8,000		
Level 1 (1)		14,000	3,000
Current (BR)	5,000		
Starting scenario	25,000	15,000	0

The game was hard to understand for the farmers, and needed extra introduction and explanation, but after some time of explanation they started to understand. The scenario was discussed as follows (Table 31).

First scenario :

- Still keep a few current local breed (LBR): 5 000
- **L2 8000** – for friendly to environment, easier to feed, milk production is higher than local breed, and the meat is also good, they use it in customary law (they can pay for dowry etc.)
- **C1 14 000** - because it is cheaper to manage than exotic cows (feeding, health, maintenance)
- **E1 3 000** - they want this because the management is high, they need treatment and concentrates, which are expensive, so only a few animals (and not E2 because that would be higher management)

Evaluation of the scenario:

After agreeing on the vignettes and number of animals, the scenario was run in the CLEANED model and the tables below show the productivity and environmental implications of the scenario (Table 32 and Table 33).

Table 32: Farmer group 1 - Productivity score card

Scenario 1: L2 8,000; C1 14,000; E1 3,000			
	% change	CLEANED score (High, Medium, Low)	Group evaluation (acceptable, ok, unacceptable)
Milk produced (litres)	+18.6%	Low	Unacceptable
Maize produced (tons)	-51%	Med	Acceptable
Cropland required (ha)	-50%	Med	Acceptabe
Grazing land required (ha)	-50%	High	Acceptable
Import	0	Low	Unacceptable

The group were unhappy with the scenario overall, because it would only offer an 18% increase in milk production (Table 32), which they considered to be too low, particularly when putting it into perspective that it means only increasing from, for example, 5 litres to 6 litres over 12 years (to 2030). Therefore, they felt the scenario would need to change.

Reactions to the other productivity results:

- The livestock keepers will sell their milk and buy maize – so the 51% decrease in maize is ok – but also they have other economic activities like selling potatoes, tomatoes, onions and beans that would also allow them to buy maize
- They will cultivate a smaller area – they will use the area saved from keeping animals to plant other crops like irish potatoes or other vegetables and beans, using expertise to get good productivity, to replace the maize
- because they reduced the number of local cattle, they think they will reduce the damage to the environment, and the saved grazing land they can use to plant fodder and food crops
- For import – other feeds – participants acknowledge that they need to import other feed for the livestock from outside the area so that they can increase milk production – like concentrates, minerals

Table 33: Farmer group 1 - Environmental score card

		Scenario x	
Other indicators		% change	Group evaluation (acceptable, ok, unacceptable)
Water	Total (litre)	-56%	
	Litres water per animal	-27%	
	Litres water per kg milk	-61%	
Greenhouse gases	Total $CO2_{eq}$ (kg)	-23.5%	
	Total $CO2_{eq}$ (kg) per animal	+22.5%	
	Total $CO2_{eq}$ (kg) per kg milk	-35%	
Soil fertility	Nitrogen balance (N in minus N out)	-28%	
	Manure produced (tons)	-29%	
Biodiversity - # endangered species losing critical habitat		None	

The group made no evaluations of the environmental results because they could not interpret these results, and they ran out of time (Table 33).

11.2 Farmer group 2 (Blue group)

Table 34: Re-distribution of animals in the future for the Farmer group 2

	Local breed	Cross breed	Mostly Exotic breed
Level 2 (2)		20,000	10,000
Level 1 (1)			
Current (BR)	10,000		
Starting scenario	25,000	15,000	0

Farmers objected to the base run number of having 0 (mostly) exotic breeds, until it was pointed out that it should be seen as 'less than 1,000 mostly exotic breed', as 1 brick represents 1,000 animals. They discussed a built a scenario as follows (Table 34).

10,000 LBR:

Participant argued currently there many LBR cows in Lushoto and most of these are kept by Maasai people. With regard to the number, they think the best scenario will be to reduce to about 10,000 LBR cows. This is because of the current government slogan of environmental conservation which requires livestock keepers to avoid grazing their animals in open fields. Therefore, grazing fields will be reduced and Maasai and other LBR livestock keepers will be forced to reduce the numbers of their cows. However, it was also pointed out that not all Maasai will accept to get rid of their LBR cows, therefore, there will still be LBR cows in Lushoto by 2030. The participants argued that having such numbers of LBR will lead to a good scenario because there will be LBR for meat, ritual functions and for other purposes like paying the bride price which is important for Lushoto people.

20,000 C2:

Participants felt very comfortable choosing C2 with 20,000 cows. Their main reason was to increase milk production which will enable them to achieve their goals by 2030. They explained that with the current motivation people have to keep cross breeds, the possibility of farmers choosing this type of cross breed and its management is high, because it not as expensive to keep it as it is to keep the (mostly) exotic breed (EBR) in terms of vulnerability to diseases and feeding practices. They also said that land is available for growing fodders hence planted fodder production will not be a problem in Lushoto.

10,000 E2:

It took some discussion regarding what type of Exotic breed to choose and how many cows. Participants did some analysis on the cost and milk produced and came into consensus that, for a better livestock scenario for Lushoto, E2 was desirable because they produce the highest amount of milk. Participants pointed out that although not all farmers will manage to keep this type of cattle because of having different economic status, there are some farmers with good economic status who will need to keep this type of breed for the maximum production of milk. They further explained that the market for milk is not a problem in Lushoto, for example currently the milk processing factory needs 12,000 litres/day of milk which Lushoto producers have not managed to provide.

So in summary, the participants thought the developed scenario was good for the following reasons:

- Availability of local breed (LBR) meat.
- Availability of LBR for other purposes such as paying pride price and other rituals.
- Having more well-managed cross breed (C2) is advantageous because they produce more milk and they are not vulnerable to diseases like the exotic breed (EBR).
- Having a few well-managed exotic breed (E2) still guarantees production of more milk.

Before reaching an agreement of how many cows per selected vignette, two participants (male and female) wanted to have a scenario of 10,000 LBR, 15,000 C2 and 15,000E2 with an argument that there will be more milk production. However, because majority agreed to the first scenario, these two participants were asked to compromise with the majority and they were told their suggested scenario would have been tried the next day to see if its productivity output would be as they thought.

Evaluating the scenario

After agreeing on the vignettes and number of animals, the scenario was run in the CLEANED model and the tables below show the results, including reactions from group members on the productivity and environmental implications of the scenario (Table 35 and Table 36). Evaluating the productivity and environmental implications of the scenario went well. However, some women did not participate so well. They seemed to take longer to understand the numbers and their meaning, to be able to evaluate them. However, through more discussion with rest of the participants, a common understanding on the meaning of the numbers was created and agreement/consensus was made by all participants especially on the comments section.

Table 35: Farmer group 2 - Productivity score card

Scenario 1: LBR 10,000; C2 20,000; E2 10,000				
	% change	CLEANED score (High, Medium, Low)	Group evaluation (acceptable, ok, unacceptable)	Comment
Milk produced (litres)	+100%	High	Desirable	The aim of producing more milk has been achieved; Good life will be obtained through sales of milk (good health, education and increased income)
Maize produced (tons)	-45.5%	Med	Satisfactory	Maize will be grown for food purposes but not for selling purposes; There will be food security as sales from milk will enable households to buy food
Cropland required (ha)	-29%	Low	Satisfactory	Land is reduced but not much; Still production of crops will be high due to application of manure
Grazing land required (ha)	-51%	Med	Desirable	Intensive livestock keeping will leave more land for farming; Keeping animals indoor will lead to accumulation of more manure.
Import	-	-	-	

Table 36: Farmer group 2 - Environmental score card

Scenario 1: LBR 10,000; C2 20,000; E2 10,000				
Other indicators		% change	Group evaluation (acceptable, ok, unacceptable)	Comments
Water	Total (litre)	-41.9%	Satisfactory	Even if there will scarcity of water, production of milk will still be good; There will be good milk production throughout a year
	Litres water per animal	-41%		
	Litres water per kg milk	-70%		
Greenhouse gases	Total $CO2_{eq}$ (kg)	23%	Satisfactory	Production of more milk will not increase the production of CO2
	Total $CO2_{eq}$ (kg) per animal	+23.5%		
	Total $CO2_{eq}$ (kg) per kg milk	-38.2%		
Soil fertility	Nitrogen balance (N in minus N out)	-7.4%	Satisfactory	Availability of manure is high for agricultural activities; There is a high possibility of establishing biogas plant because of increased manure production
	Manure produced (tons)	+15.8%		
Biodiversity - # endangered species losing critical habitat		None		

11.3 Traders (Yellow group)

Table 37: Re-distribution of animals in the future for the Traders group

	Local breed	Cross breed	Mostly Exotic breed
Level 2 (2)	10,000	15,000	
Level 1 (1)			10,000
Current (BR)			
Starting scenario	25,000	15,000	0

The group discussed and designed their scenario as follows (Table 37).

i. Change from LBR (25,000) to L2 (10,000)

Members see it that if they are to achieve the good life indicators they eventually have to reduce the local breeds, reasons being:

- With an advanced systems, local breeds L2 are likely to produce more milk
- With an advanced systems, local breeds L2 are likely to produce more meat

The reason for keeping some local breed cows is that demand for local breeds in paying dowry and in funeral services will still be there.

ii. Change from CBR (15,000) to C2 (15,000)

The change of animal keeping system to the more advanced one i.e. from CBR to C2 will bring the following benefits:

- C2 are likely to produce more milk
- C2 are likely to produce more heathier calves. They gave an example of 3 months calf that a person was given an offer of Ths. 500,000. The value is attached the bigger body size of the calf.
- Local people can access C2 more easily due to the existence of the SECAP project that intended to supply more cross breeds. The SECAP started in 1976 and it phased out in 2000s. The same service is still offered by an investor who resides at Irente. One of participants from the District office explained that the investor owns Irente Farm and he is a long term investor. He does milk processing.

iii. Change from E (0) to E1 (10,000)

There is a change from 0 to 10,000 (E1), before there were none on the exotic breeds (EBR). The 10,000 animals were brought to E1 from the LBR category which previously had 25,000 animals. Reasons for the new scenario are:

- 10,000 exotic breeds are likely to produce more milk than 10,000 local breed cows
- In the future, there will no more open areas for cattle grazing. The system of keeping animals indoor may become the most suitable. This is further justified by the projected challenges of climate change. The group related climate change issues to reduction in amount of rains, reduction in natural vegetations/pasture, increase in temperature, increase in mosquitoes etc.
- There is now a by-law that charges Tshs. 50,000 per cow for individuals not controlling their animals in the highland areas where people are only allowed to keep animals indoor. Free animal grazing is still allowed in lowlands.

There is a decrease of animals by 5,000. The reasons for reducing animals by 5,000 is that people will have to sacrifice by selling some of their local breed animals (LBR) to raise cash for handling the exotic breed cows that are projected to require more costs. Some of the portion of income from selling the 5,000 LBR will be needed for educating children (one of the good life indicators) and buying land for pasture. The woman mentioned that the same money from selling animals will be also budgeted to ensure that domestic needs (food, oil, clothes) and repairing of houses are fulfilled.

Evaluating the scenario

After agreeing on the vignettes and number of animals, the scenario was run in the CLEANED model and the table below shows the results, including reactions from group members on the productivity and environmental implications of the scenario (Table 38 and Table 39).

Table 38: Traders group - Productivity score card

Scenario: L2 10,000; C2: 14,000; E1 3,000				
	% change	CLEANED score (High, Medium, Low)	Group evaluation (acceptable, ok, unacceptable)	Reactions to the scenarios
Milk produced (litres)	+56	Medium	Unacceptable	Members agree that with +56% milk productions, it won't be possible to achieve good life. They now decide that will be a need to add more exotic breeds while reducing cross breeds. They propose the final numbers to be 7,500 for cross breeds and exotic to be 17,500 because the feeds that are used by crossbreeds CB2 are more or less of the same like what exotic E1 will eat. The numbers for LB2 will still remain 10,000.
Maize produced (tons)	-46	Low	Acceptable	This result did not seem to shock members. When asked why reduction of maize production is no surprise they gave the following reasons: That even, as of now maize production is low. It takes to up to 6 months for maize for mature That with more milk they can purchase food They concluded that since 2008 more land that was used for maize production has been on sale. So it is of no surprise that maize production is low. Nobody will hesitate to changing land from maize production to other uses. They now largely depend on production of vegetables on lowlands
Cropland required (ha)	-46	Low	Acceptable	They agree that this is acceptable because if someone needs more fodder they will have to automatically reduce land for cropping. A decision on the change of the available land use will have to be made.
Grazing land required (ha)	-45	Low	Acceptable	Members altogether agree that this is acceptable because animals are now kept indoor. More fodder can be bought by those in need. The available land can be cleverly used by planting good species like elephant grass
Import	0			

Table 39: Traders group - Environmental score card

Scenario: L2 10,000; C2: 14,000; E1 3,000				
Other indicators		% change	Group evaluation (acceptable, ok, unacceptable)	Reactions to the scenarios
Water	Total (litre)	-51	Acceptable	Group members agree with the situation and they mention that: The available water will now be cleverly used for animal drinking and other domestic uses Animals will not go to water sources and destroy them
	Litres water per animal	-27		
	Litres water per kg milk	-61		
Greenhouse gases	Total $CO2_{eq}$ (kg)	-17.2	Acceptable	Members argue that a modern way of animal keeping will allow use of biogas. Zero grazing will also allow for little environmental destruction. The existing bylaws does not allow for tree cutting without a formal approval
	Total $CO2_{eq}$ (kg) per animal	+22.6		
	Total $CO2_{eq}$ (kg) per kg milk	-34.1		
Soil fertility	Nitrogen balance (N in minus N out)	-28.1	Acceptable	Members argue that the remaining 72% is enough for farm use. It will not be a big problem as with reduction of maize planting, manure is less needed. Fodder does not need much manure
	Manure produced (tons)	-25		
Biodiversity - # endangered species losing critical habitat		-		

There were differences of opinion in choosing the type of animals. Some members had proposed to shift all local breed animals (LBR) and distribute them equally to CBR and Exotic breeds. The group decided to shift from CBR (15,000) to C2, skipping C1 because for them they want to have breeds that will immediately produce more milk. Others were of the view that traditions cannot be swept away that easily.

There was a long discussion about dropping local breeds altogether. Some of the group raised a concern that we must not quickly forget that however much we change, local breeds will still be needed for things like dowry payment and funeral services.

During discussions, members were reminded that every decision that we make in terms of development will need willingness to change style or total direction on how we do things. Stage by stage, the group went each final vignette and tried to mention what they lose/incur. Below is the summary of possible costs of change (Table 40).

Table 40: Possible trade-offs in the Traders scenario

S/N	Vignette	Possible costs
1	L2	More costs in terms of acquiring land for fodder, veterinary services, supplementary foods
2	C2	Higher costs than in L2 that will require people to sell some pieces of land they do not use to raise funds for their animals
3	E1	Higher costs than in C2 that will require people to access loans to raise funds for their animals

Although it is a collective decision, people will be differently impacted. The reasons are, people own different sizes of land. Those who have bigger land have an upper hand in terms of selling some part in attempts to raise income for improved breeds raising. Also, people in this category will find it easier to access planted fodder. Some of them will inherit improved breeds from their relatives; these will need no income for buying calves.

Overall, members were so excited about the future but they accept that raising exotic breeds is not going to be easy.

11.4 Local administrators and experts (Green group)

Designing the scenario

To create the future scenario, the group considered how the current dairy cattle population would evolve (Table 41). They concluded that the current animals (25,000 local breed, 15,000 cross breeds and 0 or less than 1,000 mostly exotic breed) would be re-distributed as follows, to a final population of 37,000 animals.

- 5,000 local breed animals would remain as they are currently (LBR)
- 10,000 local breed animals would be selectively bred and better managed to reach L2 (LBR to L2)
- 7,000 local breed animals would be bred with exotics to create Level 2 cross breeds (LBR to C2)
- 5,000 current cross breed animals would be further bred with exotics to improve to C2 (CBR to C2)
- 5,000 current cross breed animals would remain as they are currently (CBR)
- 3,000 local breed animals would be sold to buy E1 animals instead (LBR to E1)
- 2,000 E1 animals would come in from other sources (new E1)

Table 41: Re-distribution of animals in the future for the policy-makers group

	Local breed	Cross breed	Mostly Exotic breed
Level 2 (2)	10,000 from LBR	7,000 from LBR 5,000 from CBR	
Level 1 (1)			3,000 from LBR 2,000 from elsewhere
Current (BR)	5,000 remain	5,000 remain	
Starting scenario	25,000	15,000	0

The group decided that they should keep some local breed animals as they are today (5,000 LBR) to keep the gene. The LBR have delicious milk and meat, can withstand harsh local environment, and are used in traditional rituals and functions such as paying for bride price and offerings. Because of their size, it was also suggested it is a more ideal cattle breed to slaughter for family and societal functions.

To improve productivity of milk, 10,000 LBR were proposed to be moved to L2. The group looked at L1 and L2 as somewhat weaker in tolerance and more demanding compared to LBR, but stronger than cross breeds (C) and exotic breeds (E). The group also considered the current cross breeds (CBR) as less demanding and more tolerant to environment and diseases as compared to C1, C2 and E breeds. This is why the group also suggested to keep 5,000 CBR. The moves to C2 and E1 were cautiously made to increase milk production, but also not to be overstretched by costs of managing the C2 and E2 animals. For example, the group did not want to move to E2 for the same reasons. Another reason not to move to E2 was that participants felt that the time for projection (12 years) might not be sufficient to have developed pure exotic breeds.

Another reason for moving from local breeds was the size of land needed for keeping them. Improved breeds were selected because they need a smaller area than the LBR.

This scenario describes more complexity in the animal distribution than the CLEANED tool can represent. Only one vignette per category can be chosen for CLEANED, to represent what the majority of animals will be in that category. Therefore, to be input into CLEANED, the scenario was adjusted to 12,000 L2 animals to count 10,000 L2 + 5,000 LBR, 12,000 C2 animals and 5,000 E1 animals.

The scenario might impact people differently, mainly because levels of livestock keeping knowledge might not be the same and access to capital/breeds/extension service may differ. The group wanted to keep different classes of the same breed (eg LBR and L2), to cater for low inputs and high inputs.

Evaluating the scenario

The group was disappointed by the results of the new scenario (Table 42 and Table 43). The milk productivity increase of only 18% was not as high as they had anticipated, and they considered that the financial income would be too low to support a good life. The group realized it did not research well before deciding on the vignettes and numbers of cattle, and felt they had invested too much in the local breed which have low milk production. They felt a need to review the scenario to be able to fulfil the indicators by 2030.

The decrease in maize production was ranked as low, but not desirable. Group thought this may lead to food insecurity because the population of Lushoto is also increasing. Thus, demand for food will be higher. Based on the same argument of food security and population increase, the decrease in area for crop production was ranked as high and not undesirable. The decrease in area used for livestock keeping was ranked as medium and desirable. The reason was mentioned as land will be available for other uses such as crop production and infrastructure development.

Table 42: Policy-makers - Productivity score card

Scenario 1 – Green Group – L2: 12,000; C2: 12,000; E1: 5,000			
	% change	CLEANED score (High, Medium, Low)	Group evaluation (acceptable, ok, unacceptable)
Milk produced (litres)	+18%	Low	Unacceptable
Maize produced (tons)	-51%	Low	Unacceptable
Cropland required (ha)	-49.9%	High	Unacceptable
Grazing land required (ha)	-51%	Medium	Acceptable
Import	-	-	-

The group was happy about most of the environmental scores. The amount of water used was decreasing, attributed to the reduction in the number of cows. The group also were concerned that the reduction in water could reduce milk production. The change in greenhouse gas emissions would also decrease which the group felt was reasonable according to international level. However, the amount of manure produced was decreasing giving a negative balance in soil fertility. The animals will be taking more of soil nutrients than they add in the soil. This was ranked medium and undesirable.

Table 43: Policy-makers - Environmental score card

Scenario 1 – Green Group – L2: 12,000; C2: 12,000; E1: 5,000				
Other indicators		% change	CLEANED score (High, Medium, Low)	Group evaluation (acceptable, ok, unacceptable)
Water	Total (litre)	-54.8%	Medium	Acceptable
	Litres water per animal	-27%	Medium	? Unacceptable?
	Litres water per kg milk	-61.9%	Medium	? Unacceptable?
Greenhouse gases	Total $CO2_{eq}$ (kg)	-23%	High	Acceptable
	Total $CO2_{eq}$ (kg) per animal	+22.5%		
	Total $CO2_{eq}$ (kg) per kg milk	-35.5%	High	Acceptable
Soil fertility	Nitrogen balance (N in minus N out)	-28.8%	Medium	Unacceptable
	Manure produced (tons)	-29.5%		OK
Biodiversity - # endangered species losing critical habitat		-	-	-

12 APPENDIX F - Participant feedback

At the end of the workshop, participants were invited to fill in an evaluation form, including two free text questions:

i) Did you change your point of view about something following the discussions in the workshop? If so, what changed, and what prompted the change of view?
ii) Did anything surprise you in the workshop? If so, what was it?

The dominant feedback, both in terms of changing their opinion and being surprised, was to learn knowledge to help them improve their production methods, or that there are improved breeds and improved methods that can lead to high production of meat and milk. Participants said their change of view was that:

"To have so many livestock, it can give you improved life and you can have improved livestock and it gives you extra good life and improve your life"

"yes, I have understood that if you have a good cow, and you are very good with the management it can give good productivity"

"I had keeping local livestock without a shelter, I was just keeping locally and I had also local cattle. For this workshop it has changed me quite a lot"

"because he has learnt that if we keep pure livestock we will get an improvement for his life"

"I have changed through livestock from local livestock keeping to pure livestock keeping which can bring productivity"

"he has increased his awareness from this workshop that he has increased understanding on livestock activities in Lushoto"

Participants were surprised about:

"the employment and productivity that can get from keeping fewer cows which are exotic or kisasa"

"how to get improved pure / cross-breeds, and through getting training and also he learned how to increase milk and thank you for the workshop because you get training"

"you can know types of improved cows"

"difference between cross-breeds and pure breeds"

"A livestock keeper who has 20 cows can not have enough a good life through the type of livestock he keeps you cannot compare with the one who has 2 cows who can have enough money to have a good house and send children to school through selecting types of livestock" [you] can get more from 2 good cows than from 20 low-yielding cows]

"to have little land with high products"

"to see cows with hump or local they have not enough milk compared to a kisasa"

"the type of livestock they have used to – it was not good, that which is good is pure livestock"

"wow, if you keep livestock through receiving training from expert people, you will change from one step to another and you will improve your life and your family"

The second most common feedback was a new appreciation of the value of planning and thinking ahead:

"yes: Livestock keeping must have something that you can see and you must take care of the environment"

"Milk business is good if you dare to do it."

"To have a good plan before you start any activity or any business and to think beyond the box and to evaluate on how effective in animals and the environment"

"yes I have agreed on my own perception that nothing can not be done in the livestock sector if we are meaning to do that"

"he has been surprised to see he can change the lifestyle of individuals and also Lushoto community by increasing income and training"

There was also a reminder that there is a lot of work being done on agriculture and livestock in Tanzania:

"understanding of livestock is up and there are other activities which are being implemented by other institutes, and this institute/ workshop is helping other institutes to reach their objectives. So this workshop, it had very good results and what we have been told it will help economically"