More meat milk and eggs by and for the poor

CLEANED ex-ante environmental impact assessment of dairy production systems in Tanzania

Baseline validation workshop report

30-31 March 2021 | Arusha, Tanzania

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Maziwa Zaidi

More Milk in Tanzania

SNV Solidaridad CGIAR Research Program on Livestock

ILRI International Livestock Research Institute

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Citation:

Mangesho, W. Mukiri J., Ngunga, D, Nzogela, B., Ngoteya, G., Omore, A., Notenbaert, A., Paul, B.K.2021. CLEANED ex-ante environmental impact assessment of dairy production systems in Tanzania. Baseline validation workshop report. Alliance of Bioversity International and CIAT (International Center for Tropical Agriculture), Nairobi, Kenya.

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1. Introduction

Maziwa Zaidi II program under the CGIAR Research Program on Livestock aims to catalyze uptake of "proven" dairy technology packages that improve the livelihoods of small holder farmers. The Alliance of Bioversity International and International Center for Tropical Agriculture (Alliance of Bioversity and CIAT) and the International Livestock Research Institute (ILRI), together with their partners, are jointly working on Comprehensive Livestock Environmental Assessment for Improved Nutrition, a Secured Environment and Sustainable Development **(CLEANED)** Assessment of the dairy production systems, in Kilimanjaro and Tanga, in Tanzania.

The workshop was hosted by the Alliance, and ILRI in collaboration with their partners SNV and Solidaridad who are jointly working on promoting the environmental gains in the dairy sector in Tanzania.

This report presents the discussions and outputs of the CLEANED baseline validation workshop that took place at the SG hotel in Arusha from 30th to 31st March 2021. The workshop aimed to validate the environmental impacts quantified by CLEANED by dairy systems in Tanzania CLEANED runs were carried out for Hai and Muheza districts with key input data including farm inputs, herd composition, animal whereabouts with the model quantifying land use, water impacts, soil impacts, and greenhouse gas emissions (GHG). This is a first step in understanding environmental trade-offs thus designing systems that mitigate and enhance ecosystem services in pig production systems in Hai and Muheza.

The CLEANED baseline validation workshop objectives included:

1. **Share** and **discuss** preliminary model results
    - Representation of types (production/animal numbers)
    - Evaluation of distribution of types across locations
2. **Assess** the relevance of CLEANED results and **identify** key decision makers/experts
    - Which results are most interesting?
    - Who are the key decision makers to target?
3. **Develop** future scenarios for model implementation that reflect best-bet integrated intervention packages per system.
    - Which livestock production challenges are prominent in the different locations?
    - Which combination of interventions makes sense for the different types?

The event was led and facilitated by Mr. Walter Mangesho, a Senior Livestock Research Officer at Tanzania Livestock and Research Institute (TALIRI) currently a research consultant with The Alliance. This was a hybrid event with participants attending physically and virtually, and the full participants list can be found in Annex 1. The event agenda (Annex 2) guided the sequence of events.

The full presentation guiding through the workshop can be found **here.**

2. Knowledge, Attitude and Practices Survey (KAPS)

Before the workshop commenced a KAPS was given out. This survey aims to explore participants' understanding of the importance of livestock and environment.

Below is a summary of those results presented in Figures 1 to 3. Participants included a mix of professions including scientists, practitioners and policy makers. In regards to perceptions of the pork value chain, participants saw that dairy production is most important for livelihoods focusing on income generation. The stakeholder that would most benefit from the quantification of environmental impacts were policy makers.

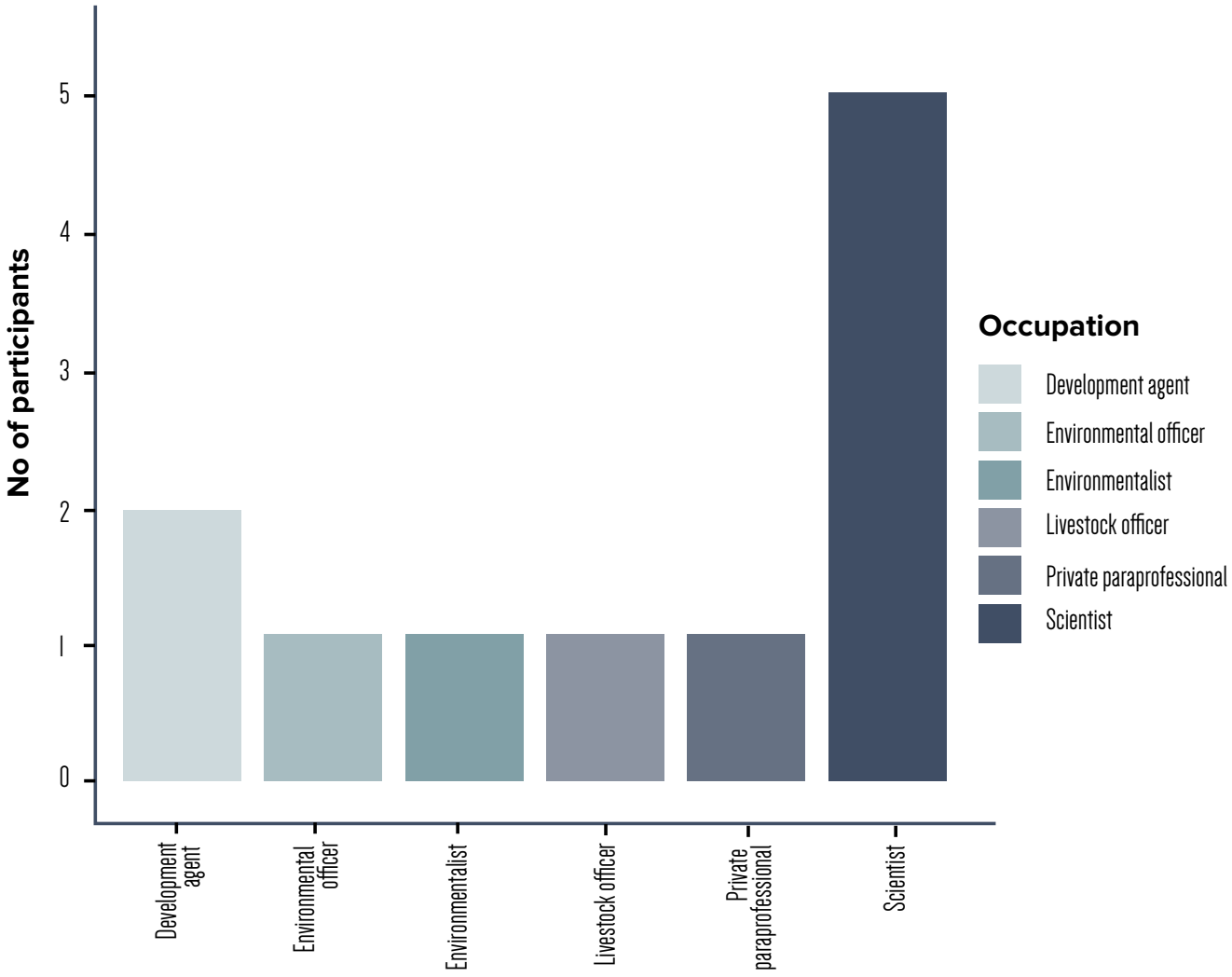


Figure 1 Participants' professions (KAPS survey)

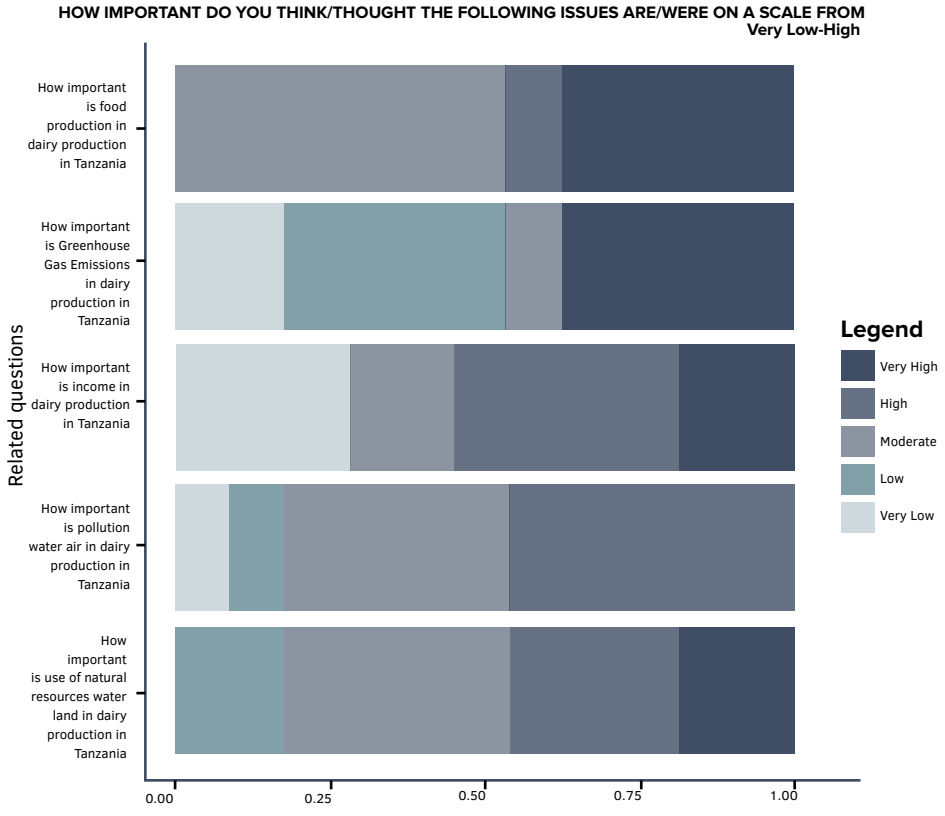


Figure 2 Participants ranking the importance of various impacts of dairy production in Tanzania before the workshop (KAPS survey)

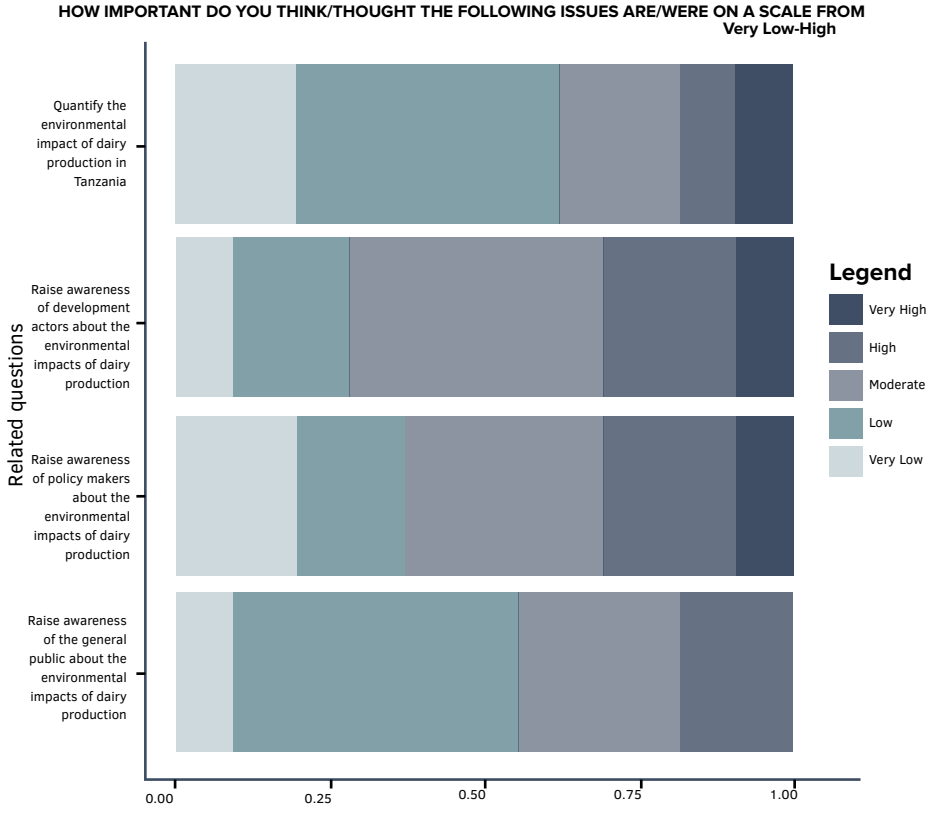


Figure 3 Participants ranking the importance of raising awareness of environmental impacts among different stakeholders before the workshop (KAPS survey)

3. Workshop sessions day 1

Opening Remarks

Mr. Lazaro Tango the Administrator at Alliance of Bioversity and CIAT Arusha, opened the workshop by welcoming the participants to the workshop. He then introduced Ms. Jessica Mukiri a Senior Research Associate with Tropical Forages Program part of the Alliance of Bioversity and CIAT to give a preliminary introduction of the participants and official opening of the session.

Summary Morning Presentations

Mr. Godfrey Ngoteya (Coordinator- ILRI) gave an overview of the Maziwa Zaidi II project in Tanzania. The gains of the first phase of the project and the focus on narrowing on promoting impactful interventions.

Ms. Jessica Mukiri, explained the goal of CLEANED workshop and pinpointed the key activities that ought to be carried within the two days. She defined the acronym of the word CLEANED as the Comprehensive Livestock Environmental Assessment for Improved Nutrition, a Secured Environment, and a Sustainable Development along Livestock Value Chains. She further explained that this is an ex-ante tool assesses the environmental impact of livestock systems and value chains, it evaluates land requirements, productivity, water use, soil health, economics, and Greenhouse Gas Emission. The tool was developed by CIAT, ILRI, and partners. She emphasized that the evaluation of these results will facilitating in furthering improving the tool.

Figure 4 Presentation of results by Walter Mangesho (left) and participants following the presentation (right)

Modeling methodology

Walter Mangesho presented the CLEANED modeling methodology used for in the assessment of the pig production systems particularly the interventions sites of Hai and Muheza as in seen in Table 1. These production systems were developed via literature and conversations with key experts in the regions.

The system of interest in this assessment were the intensive systems, as these were they systems being targeted within the Maziwa Zaidii II program. These dairy systems were representative of an intensive dairy system in each location. They were characterized by the management, breed type, average annual milk production per cow the herd composition the feeding system type and the feed diet of the animals.

Table 1 Dairy system types in Muheza and Hai

Site	Livestock systems	Season	Season Months	Management system	Breed type	Average. milk production (kg)/cow/ year	Type and No. of animals	Feeding system	Type of feed (%)
Muheza - Highland	Intensive	Long rains	April to June	Zero grazing	Cross breed	6100	Cows: 3 Heifers:2 Calves: 2	Cut & Carry	Improved Forages (47) Concentrates (1) Crop residues (2) Natural Pastures (50)
		Short rains	July, Oct to Dec						Improved Forages (24) Concentrates (1) Crop residues (5) Natural Pastures (70)
		Dry Season	Jan to March, Aug & Sep						Improved Forages (5) Concentrates (2) Crop residues (4) Natural Pastures (89)
Muheza - low land	Intensive	Long rains	April to June	Zero grazing	Cross breed	3660	Cows: 3 Heifers: 2 Calves: 2	Cut & Carry	Improved Forages (4) Concentrates (1) Crop residues (10) Natural Pastures (85)
		Short rains	July, Oct to Dec						Improved Forages (4) Concentrates (1) Crop residues (13) Natural Pastures (82)
		Dry Season	Jan to March, Aug & Sep						Improved Forages (1) Concentrates (2) Crop residues (13) Natural Pastures (84)

Site	Livestock systems	Season	Season Months	Management system	Breed type	Average. milk production (kg)/cow/ year	Type and No. of animals	Feeding system	Type of feed (%)
Hai	Intensive	Long rains	March to July	Zero grazing	Pure Breed	4650	Cows: 2 Heifers:1 Calves: 1	Cut & Carry	Improved Forages (15) Concentrates (5) Crop residues (30) Natural Pastures (50)
		Short rains	Mid Oct to Dec						Improved Forages (15) Concentrates (10) Crop residues (45) Natural Pastures (30)
		Dry Season	Sep to Mid Oct and Jan to Feb						Improved Forages (15) Concentrates (10) Crop residues (45) Natural Pastures (30)

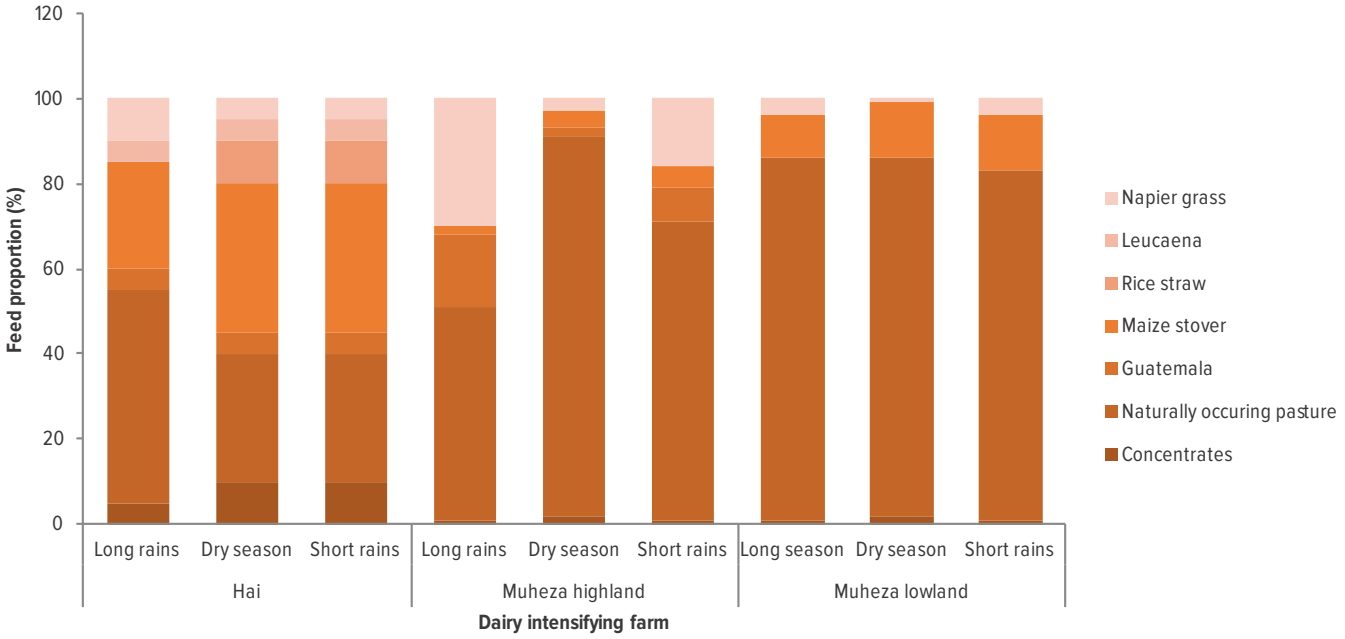


Figure 5 Typical feed baskets in Muheza and Hai regions

Baseline modeling results

Walter Mangesho presented the preliminary results for the modeled dairy production systems in the assessment areas. The results covered land requirements, soil impacts, water impacts, and GHG emissions, (Figures x – x), and complete results can be found in the presentation (here).

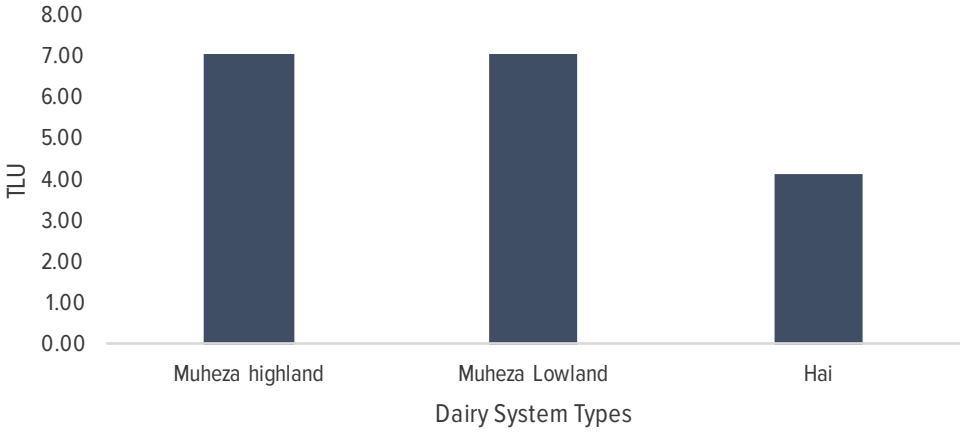


Figure 6 TLU (Tropical Livestock Units) quantification by CLEANED

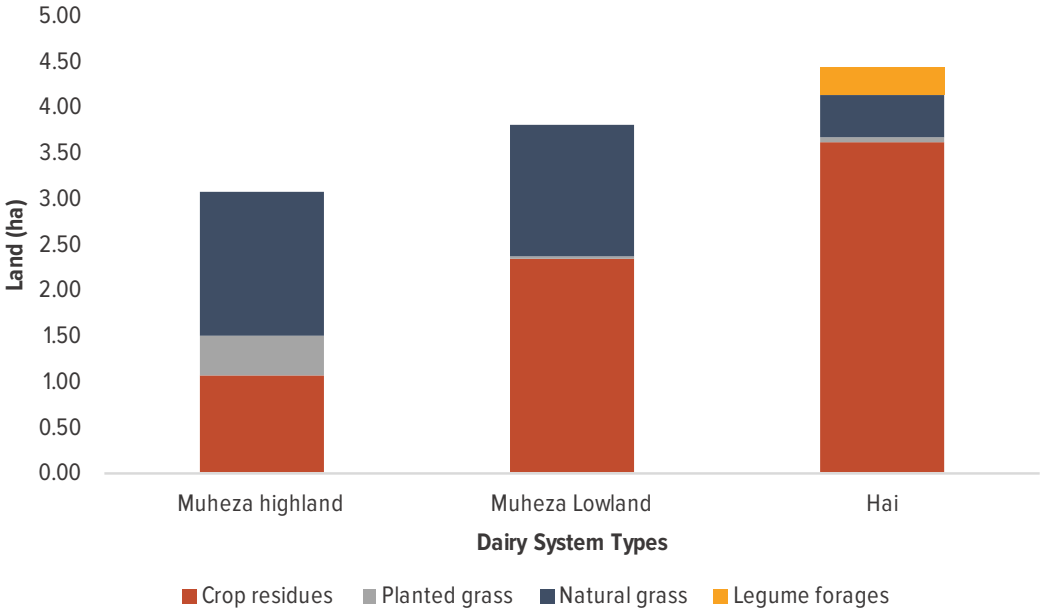


Figure 7 Land requirement for feed production quantification by CLEANED

- High dependence of crop residues in Hai than in Muheza therefore high land requirement
- Less usage of planted grass in Hai than Muheza
- High land footprint despite low TLU for Hai intensive system

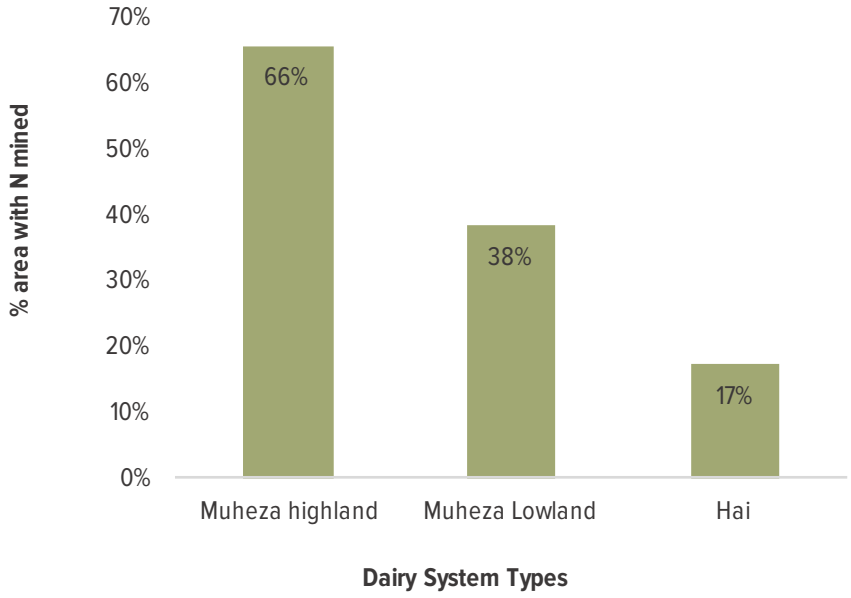


Figure 8 N mining as modelled by CLEANED

» Minimum N addition to the soil coupled with high crop cultivation leads to high N nutrient mining in Muheza

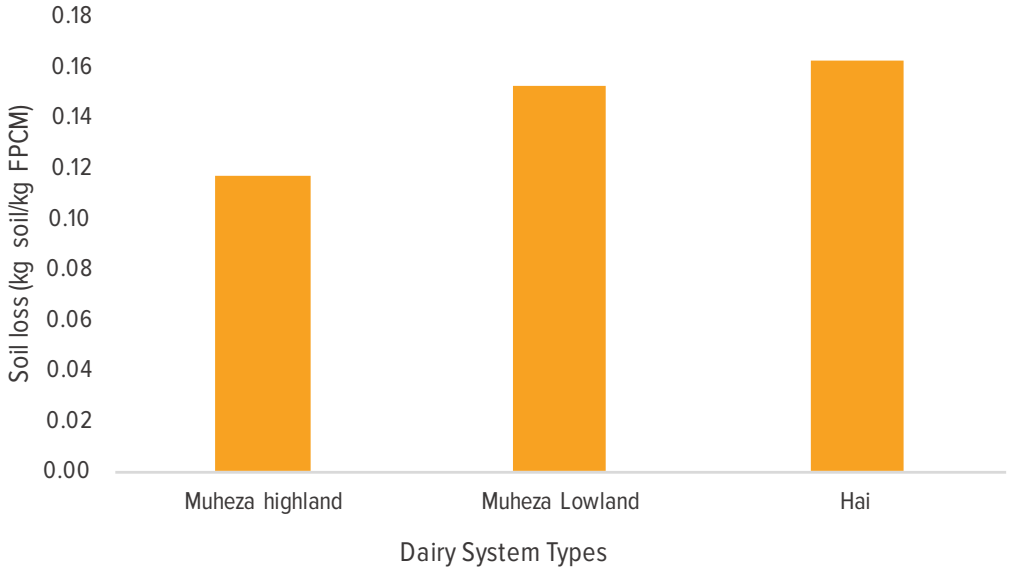


Figure 9 Soil erosion quantification as modelled by CLEANED

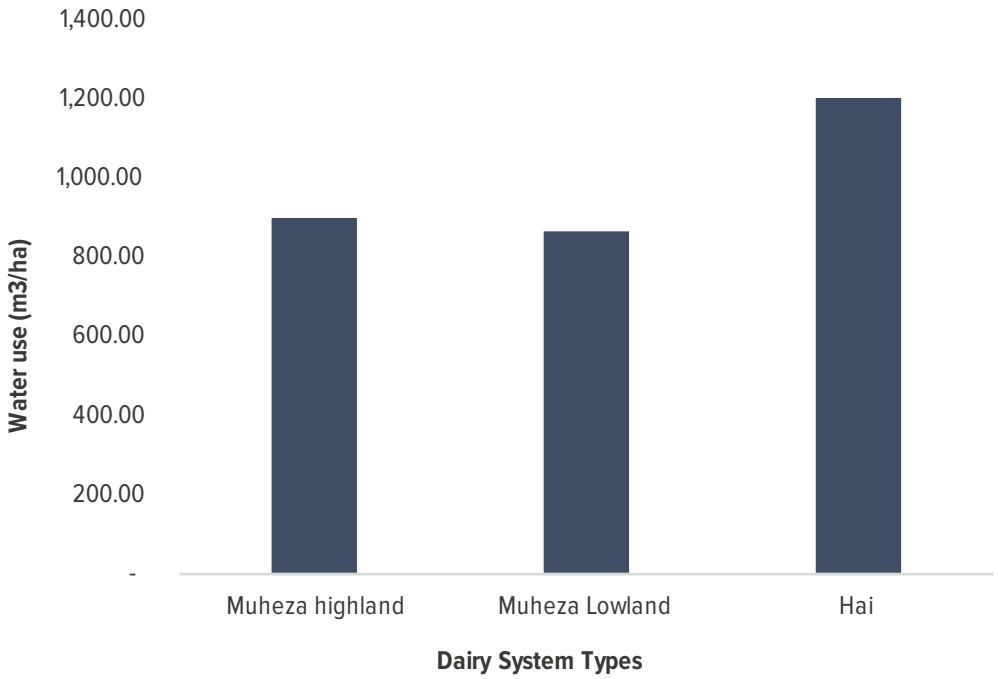


Figure 10 Total water use quantification as modelled by CLEANED

» Increase production of high-quality forage would reduce relative water resource use and improve efficiency of intensive dairy production system

» Feeding of crop residues explain high water use in Hai

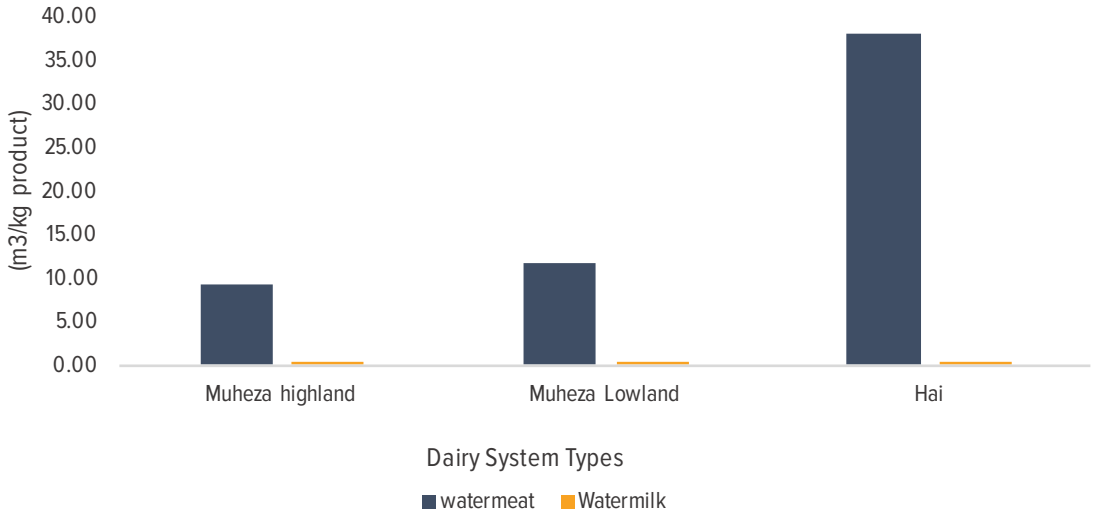


Figure 11 Total water use for meat and milk production quantified by CLEANED

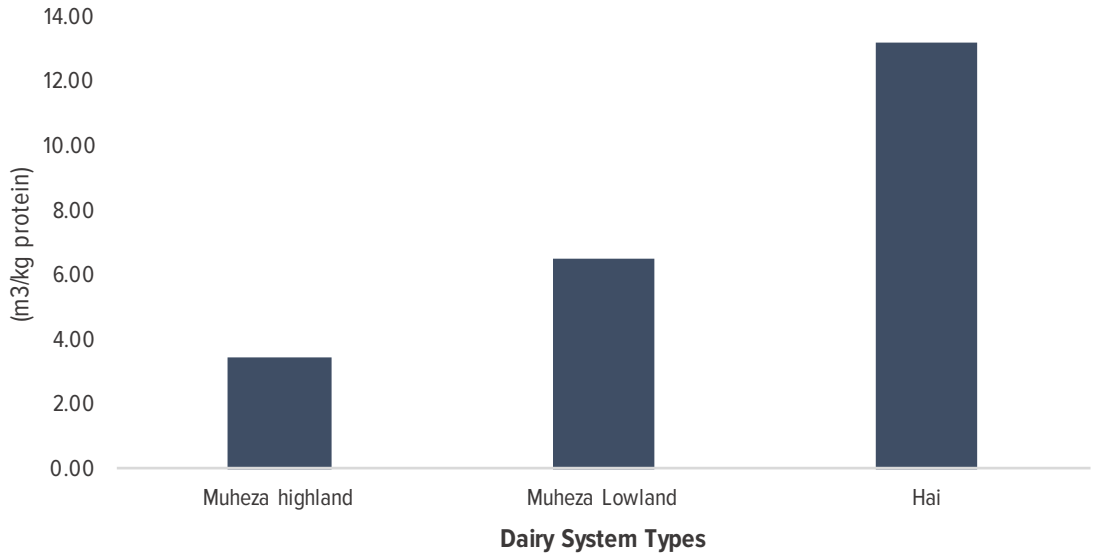


Figure 12 Total water use per kg protein production as modelled by CLEANED

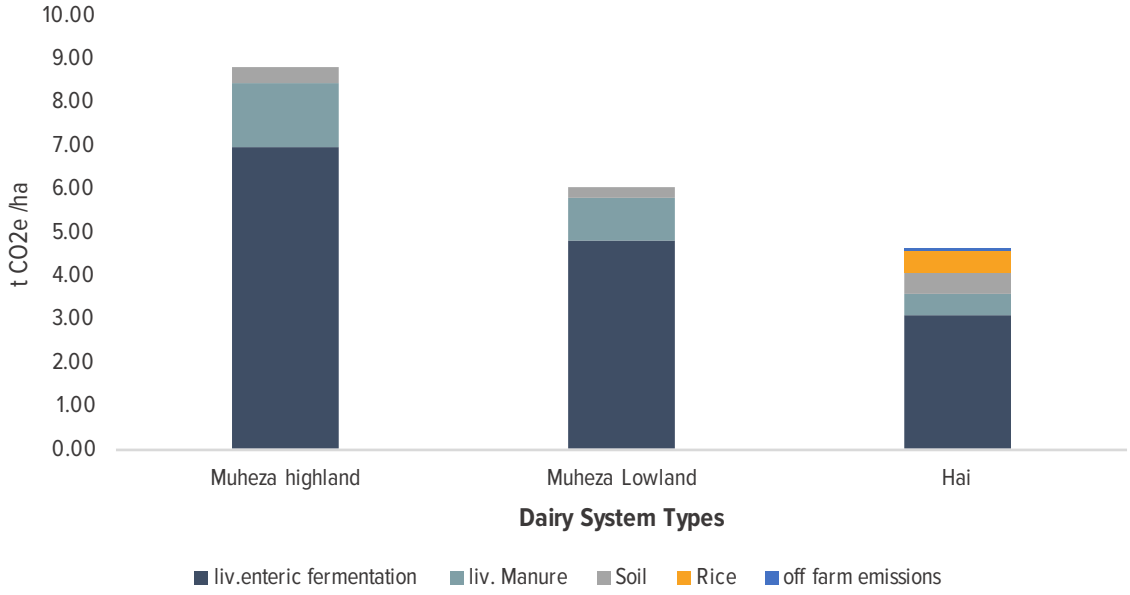


Figure 13 GHGe quantification as modelled with CLEANED

- High milk production correlates positively with enteric fermentation especially when low quality feeds are used
- Poor manure management also increases emissions
- Production and use of improved forages and proper manure management is highly recommended

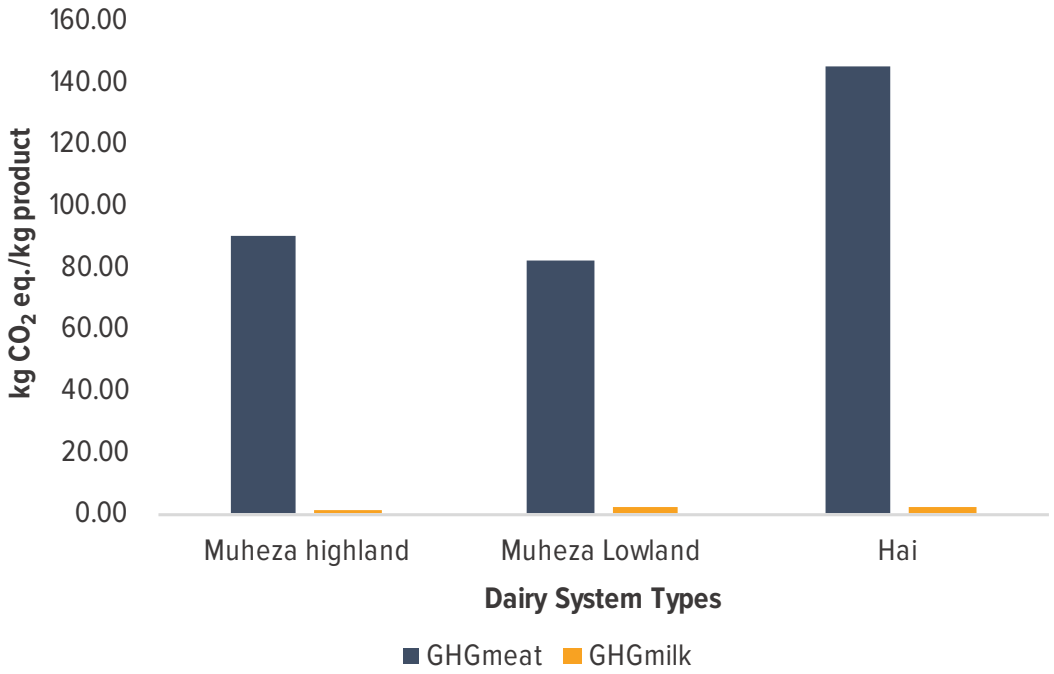


Figure 14 GHGe intensity per meat and milk as modelled with CLEANED

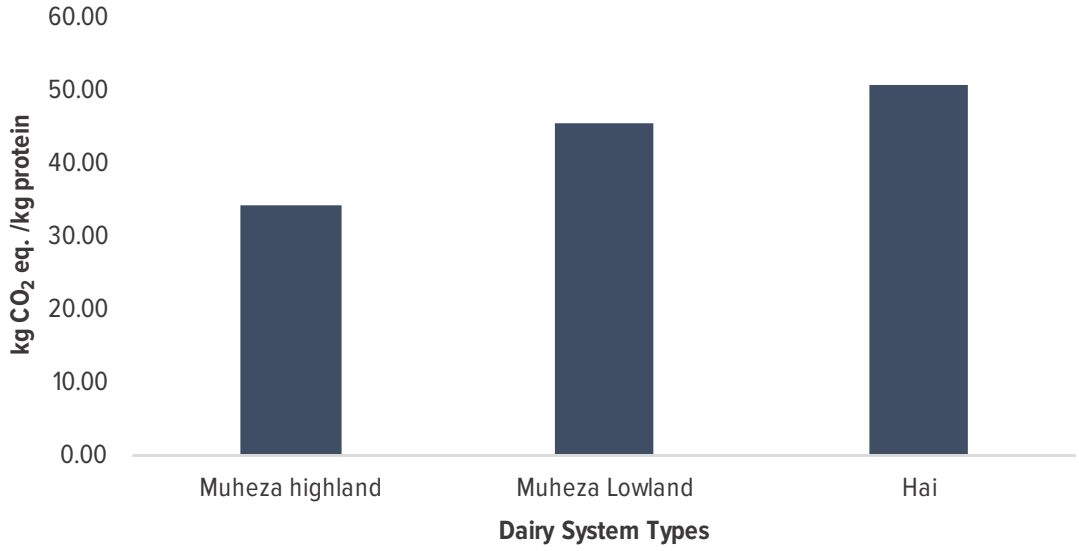


Figure 15 GHGe intensity per protein produced as modelled with CLEANED

- The Muheza highland systems is has the best intensities per kg protein
- Hai systems has the least intensities per kg product meat and milk

General comments

The presentation made by Mr. Walter gave rise to questions and comments. This was mainly regarding the study area and methodology used. This was briefly discussed and to be further validated in the group exercises

Dr. Eliamon Lyatuu asked about the methodology used to calculate soil erosion per ha and GHG emission intensity in the three study sites of Muheza Highlands and Muheza Lowlands of Tanga Region and Hai in Kilimanjaro Region. Mr. Walter commented that; the methodology and results were based on literature and expert input who had knowledge of the topic and study area. To have a better understanding of CLEANED calculations, participants were advised to look into the CLEANED manual.

Group work: system and result validation

The presentation was followed by group work where participants were required to verify the results by validating the environmental impacts; type; input and parameters.

This offered an opportunity to verify issues reported on livestock production systems, production seasons, management systems, breed type, Average milk production/cow/year, herd composition, feeding system and feed basket through the year. The participants placed into groups of three, based on the location they came from (Muheza Highland, Muheza lowland, Hai).

This section looks at the various results and input data verified, found above and in Annex 3.

i. Dairy Systems
ii. CLEANED results
iii. CLEANED inputs& parameters data

Dairy systems validation

This exercise is based on Table 1 on discussing the representativeness of the system.

Part of the validation on verification process was to verify the dairy systems modeled. Table 2 below gives a summary of the results participants gave regarding how the systems were developed.

Table 2 Verification of dairy system types Muheza and Hai

Type				Reasons for yes/no answer
	Yes	No	Percentage (%) Low / Medium / High (0 -29 / 30 -60 / 61 -100)	What information is needed to further verify the results
Muheza Highland	Yes		61-100	1. Topography, 2. Natural reserve limit grazing
Muheza Lowland	Yes		30-60	1. They do semi intensive
Hai	Yes		61-100	1. There are more dairy cattle, 2. there is scarcity of land

Participants from Hai reported that an intensive dairy production system is principally practiced in the district, the reason for this mode of production is the scarcity of land where a large part of the land is used for crop production.

Validation of baseline results

Modeling results for the selected production systems were assessed and validated by the different groups concerning what is considered to be the true reflection of the same on the ground, these were backed by justification.

Table 3 Verification of CLEANED results Lowland and Highland Muheza

Environmental Impact: CLEANED results	Validate	
	Is this what is expected on the ground	
	Yes	No
Total area under feed production	Yes	
N nutrient mining	Yes	
Soil erosion per ha	Yes	
Soil erosion per ha	Yes	
Total water Use m3/ha/yr	Yes	
Total water use meat	Yes	
Total water use to produce a kg of Protein	Yes	
Sources and Sinks of CO_2	Yes	
GHG emission intensity	Yes	
GHG emission intensity per kg protein	Yes	
GHG emission intensity per meat	Yes	

Participants were confident with the results generated by CLEANED. The total feed area needed reflects ground activities as there is an abundance of natural pasture in the agro-ecological zones. The use of cut-carry grasses from nearby natural reserves. As well as the introduction of improved forages has seen the shift in farmers planting varieties like Napier and Brachiaria grasses. Due to the topography and cropping cultivation results pertaining to soil erosion are reflective on what is happening on the ground.

Table 4 Verification of CLEANED results Hai

Environmental Impact: CLEANED results	Validate		Reasons for yes/no answer
	Is this what is expected on the ground		What information is needed to further verify the results
	Yes	No	
Total area under feed production	Yes		1. Scarcity of land
N nutrient mining	Yes		1. There is high application of inorganic fertilizers
Soil erosion per ha		No	1. This is contrary to the reality in the ground
Soil erosion per ha	Yes		1. They do soil conservation
Total water Use m3/ha/yr	Yes		1. There are prominent irrigation system and water harvesting facilities
Total water use meat	Yes		1. High use of water
Total water use to produce a kg of Protein	Yes		1. There is high use of water than the protein produced
Sources and Sinks of CO_2	Yes		
GHG emission intensity	Yes		1. Due to proper management of manure

Environmental Impact: CLEANED results	Validate		Reasons for yes/no answer
	Is this what is expected on the ground		What information is needed to further verify the results
	Yes	No	
GHG emission intensity per kg protein	Yes		1. They keep livestock mainly for dairy purposes
GHG emission intensity per meat	Yes		1. Protein produced is very low compared to the level of emission

Figure 16 Group discussion on results between participants from Muheza Lowland (left) and Highland (right)

Hai has a low nutrient mining of 17% compared to 38% and 66% of Muheza lowland and Muheza highland because farmers in Hai take back to the field the organic matter obtained from cow sheds (kraal manure) as part of the cleanness of the house and deposit into the farm. In this way, they tend to reduce Nutrient mining compared to Muheza high land and lowland where nutrient mining is exceedingly high because the area exercises two production system intensive and semi-intensive systems with little or no replenishing of nutrients. This was described to happen in Muheza because livestock keepers still have an opportunity of accessing forages (cut and carry or grazing their dairy animals in the vast land, reserve banks of the forest that don't require them to take back manure for restocking. In all study sites (Hai, Muheza lowland, and Muheza high land) 2 to 3 cross breed cows are kept by farmers depending on the availability of feeds, labor, and market of milk

Soil erosion per ha, is highly experienced in Muheza highland followed by Muheza lowland due to the topographical nature of the area. Total water use to produce a kg of protein is high in Hai (13m3/Kg protein) compared to Muheza lowland and Muheza highland 6 and 3 (m3/Kg protein) respectively due to high utilization of water in Hai districts for growing crops which in turn are fed to dairy cows as crop residues, where the other sites a little amount of water are required to produce forages for feeding dairy cows.

Greenhouse gas emission intensity; It was reported by group presenters that GHG emission intensity was observed to be high in Muheza highland compared to Muheza lowland and Hai, this was due to the high availability of livestock and poor management of manure produced by dairy animals. However, GHG emission intensity per product was high in Hai (150 kg CO2 eq./kg product) and averaged equal in Muheza highland and Muheza lowland respectively because Hai district revealed to have a high number of improved dairy cow that leads to high production of milk per year compared to the other sites.

During these discussions, it was reported that in Muheza lowland dairy animals are mainly fed on natural pastures (85%), with improved forages (1-4%) both in the wet and dry season.

In Muheza highland: Dairy animals are mainly fed on natural pastures (50-89%), the area was marked with high utilization of improved forage during long rains of about 47% and low during the dry season of the year. Hai district is characterized by high utilization of natural pastures averaged 36% where the main feed for dairy animals year-round is crop residues 40% on average. Hai is reported to have a high scarcity of land for the planting of improved forages, the

land is used for growing food crops like maize, and leguminous plants like beans which are become the big source of dairy feeds in the area (Figure 5).

Characterization of inputs and parameters

All the input and parameter that were used can be accessed in Annex 3. The participants agreed will all the values that were collected. The only disagreement was with the feed basket where *Musa spp* (banana) was an additional feed item missing.

Next users of CLEANED results

This section of the workshop was to discuss:

- Who is/will be using CLEANED, what are their professions?
- Where does it fit into their responsibilities?

From this the participants, we asked to list five stakeholders who could benefit from CLEANED and which of the graphs would be relevant to their occupation:

1. Farmers
2. Policy Makers
3. Researchers
4. Extension workers
5. Non-governmental organization

From the graph below, it is evident that certain results best fit different stakeholders. For instance, the for total area under feed production this is most important for farmers and extension workers. However, when it comes to GHG emission intensities and sources, the CLEANED results are most important to researchers and NGOs.

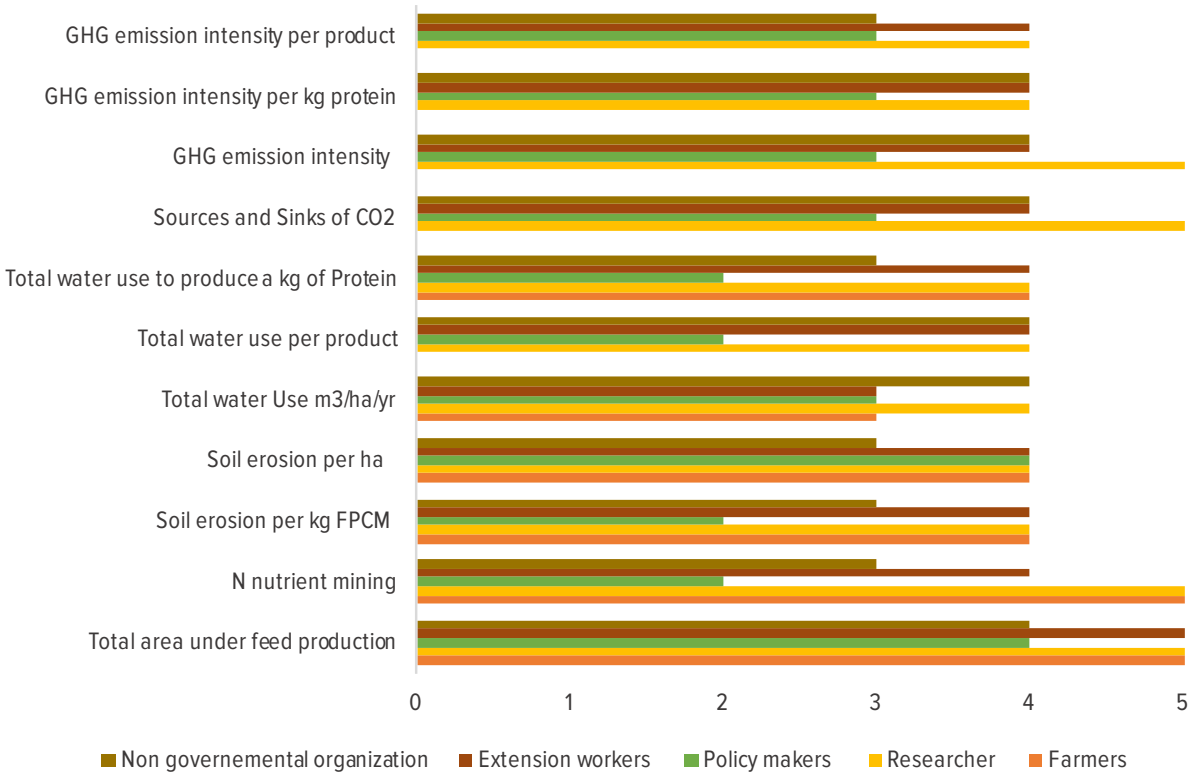


Figure 17 Showing relevance of CLEANED results to different stakeholders

4. Workshop sessions day 2

The same participants attended the second day of the workshop. The focus was on

i. Identifying the challenges facing dairy production in Muheza and Hai;

ii. Designing intervention packages based on the solutions being promoted by Maziwa Zaidi II

Challenges faced by the dairy value chain

Godfrey Ngoteya presented the challenges and interventions being promoted by Maziwa Zaidi-II. He pinpointed that Maziwa Zaidi II is focusing on agribusiness as an entry point in the dairy value chain and will specifically promote intervention packages that bundle and combine proven genetics, health, and feed technologies within institutional arrangements that not only have the potential to be profitably leveraged in various combinations by agribusinesses but also to farmers by allowing to utilize and benefit from these bundles. He further emphasized that Maziwa Zaidi II will test the following key assumptions:

a. Inclusive agribusiness approach that aimed to enhance the uptake of the technology packages.

b. Incubation/ acceleration/mentorship of agripreneurs for improved business performance.

c. Integrate technology packages for enhancing productivity, increasing income and consumption of safe milk and milk products.

He mentioned the delivery packages to be profitably leveraged by empowered agripreneurs targeted by the project that include; Brachiaria grass and other forage options, manure management and utilization, East Cost fever vaccine and Artificial Insemination (AI). Where all these services will be delivered through empowered agripreneurs and agribusinesses, using a digital platform for farmer profiling and e-extension, and capacity development supporting market access, safer products and effective collective actions. He then, introduced Mr. Adolf Jeremiah, ILRI Field Coordinator- from Dar Es Salaam who explained the objectives of the project and gave a brief synopsis of what is expected in the second phase of Maziwa Zaidi. He elaborated about the basket of technologies targeted by the project and the work that is currently performed on the ground.

The groups went back into groups to discuss these challenges, see the tables summarizing this activity.

Table 5 Challenges faced in Muheza Highland

Production challenges	Is the production challenge affecting your dairy type		If Yes How important is this production challenge in dairy type and location Percentage (%) Mildly important/ Important / Very Important	Reasons for answer
	Yes	No	(0 -29 / 30 -60 / 61 -100)	
Feeding			30-60	High dependency on natural pastures which are of low quality
Health			30-60	i. Poor accessibility of vaccines ii. Uncoordinated vaccination programs
Genetics			61-100	i. Accessibility of the service ii. Poor handling of AI process iii. Low conception rate
Environment/Manure mgmt.			0-29	Lack of enough knowledge on manure management

Table 6 Challenges faced in Muheza Lowland

Production Challenges	Is the production challenge affecting your dairy type		If Yes: How important is this production challenge in dairy type and location: Percentage (%): Mildly important/ Important / Very Important (0 -29 / 30 -60 / 61 -100)	Reasons for answer
	Yes	No		
Feeding			30-60	i. Low awareness of fodder harvesting and storage ii. Lack accessibility of varieties of improved forages
Health			61-100	i. Unavailability of different types of vaccines ii. Poor quality of veterinary drugs iii. Poor management practices e.g. dipping
Genetics			30-60	i. Poor semen handling and storage ii. Problems associated with heat detection and timing for insemination iii. Farmers awareness of the importance of AI
Environment/ Manure mgmt.			0-29	Lack of enough knowledge on manure management

Table 7 Challenges faced in Hai

Production Challenges	Is the production challenge affecting your dairy type		If Yes: How important is this production challenge in dairy type and location: Percentage (%): Mildly important/ Important / Very Important (0 -29 / 30 -60 / 61 -100)	Reasons for answer
	Yes	No		
Feeding			61-100	i. Low access to quality forage ii. Shortage of land for forage cultivation
Health			61-100	i. Poor dipping infrastructure facilities ii. No access to ECF vaccine
Genetics			0-29	Poor ethics to AI technicians
Environment/ Manure mgmt.			0-29	Lack of enough knowledge on manure management

Packages

Within the groups and based on the systems participants formulated different packages. In all the systems in Tanzania, the following package was formulated.

Program	Package
Herd health	East Coast Fever (ECF) Vaccine
Feeds and Forages	Brachiaria
Genetics	Artificial Insemination (AI)

It is envisaged that the package of intervention will bring substantial changes in livestock enterprise. The changes are such as;

- Increased milk production and weight gain of animals due to increased access to quality forages
- Reduced birth intervals due to efficient AI services

Generally, the package was said to not only have the potential to be profitably leveraged in various combinations but also will allow farmers to utilize and benefit from them through increased productivity, income, and consumption of safe milk.

5. Final remarks

The workshop highlighted a strong need for enhanced action for improving the CLEANED tool to help dairy producers, dairy experts, extension officers, policymakers, and researchers to be able to plan for sustainable dairy production.

The workshop was officially closed by Mr. Lazaro Tango. In his closing remarks, he appreciated the effort of The Alliance of Bioversity International and International Center for Tropical Agriculture (CIAT) and ILRI under Maziwa Zaidi II programme in organizing a very useful and much needed workshop.

6. Evaluation

At the end of the workshop participants were given the same KAPS questions to see if perceptions have changed, participants were rated questions mentioning dairy production and environment highly or very highly as opposed to earlier in the workshop. They also evaluated the workshop more results on these can be found in Annex 4.

In summary the participants were able to understand of the importance of assessing environmental impacts of pork production. They objectives of the workshop were achieved and some positives were the:

1. Interactions with different stakeholders, specially farmers being welcomed
2. Knowledge of the CLEANED model and its use

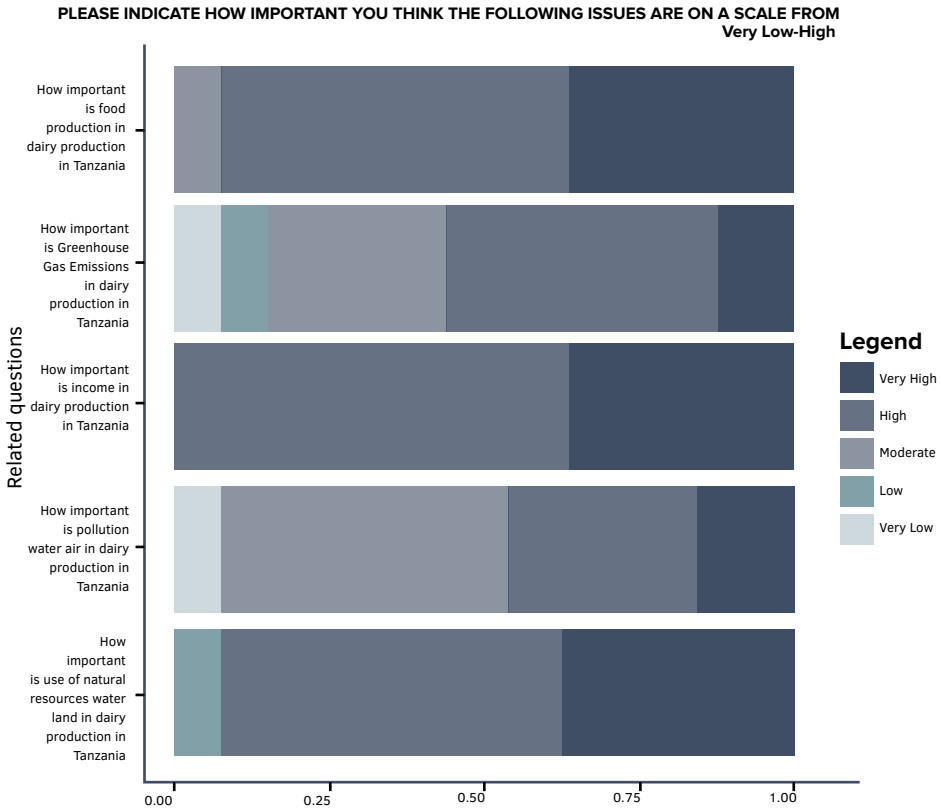


Figure 18 Participants ranking the importance of various impacts of dairy production in Tanzania after the workshop (KAPS survey)

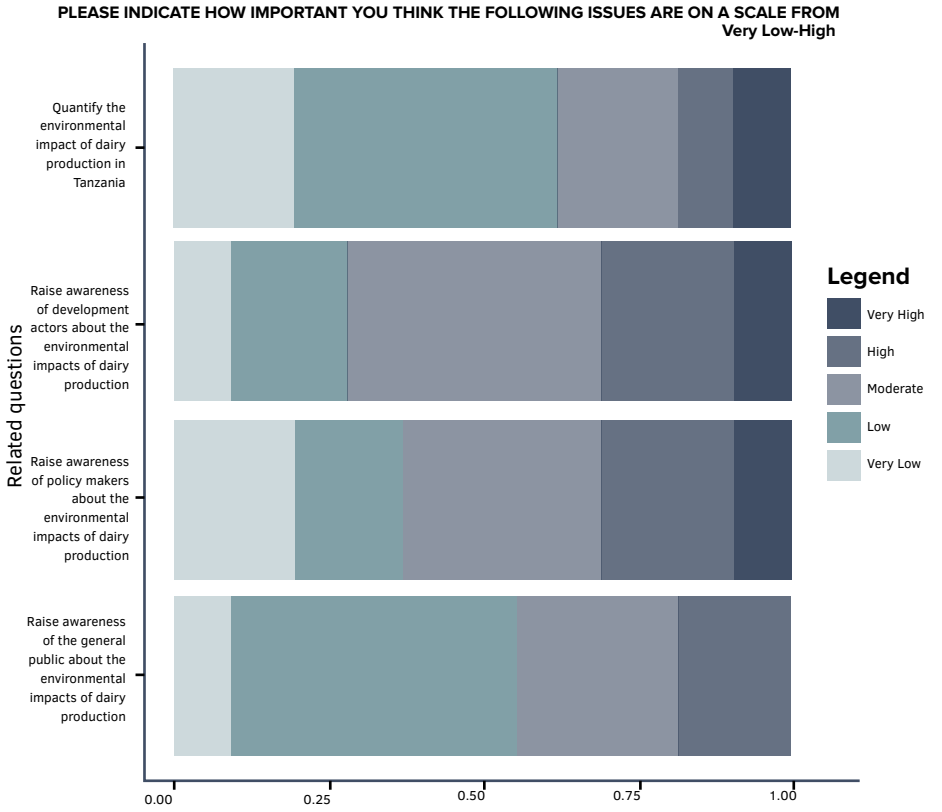


Figure 19 Participants ranking the importance of raising awareness of environmental impacts among different stakeholders after the workshop (KAPS survey)

Annex 1: Participants list

First Name	Last Name	Type of Expert	Institution	Email
Emmanuel	Mlay	Dairy	Hai District Council	emlay923@gmail.com
Alfred	Njegite	Environment	Hai District Council	njegite25@gmail.com
Pascal	Tekwi	Practitioner	SNV	ptekwi@snv.org
Chistopher	Sikombe	Dairy	Muheza District Council -Highland	sikombec@gmail.com
Cyprian	Mselem	Environment	Muheza District Council	cmsellemu@gmail.com
Jasmine	Mushi	Practitioner	Solidaridad	jasmine.mushi@solidaridadnetwork.org
Naomi	Paul	Dairy	Muheza District Council - Lowland	ummyzo93@gmail.com
Richard	Peter	Environment	Tanga City	richardmollel38@gmail.com
Samwel	Mkare	Practitioner	Solidaridad	samweli.mkare@solidaridadnetwork.com
Eliamoni	Lyatuu	Genetics	ILRI	E.Lyatuu@cgiar.org
Julie	Ojango	Genetics	ILRI	J.OJANGO@CGIAR.ORG
Solomon	Mwendia	Feeds and Foarages	CIAT	S.Mwendia@CGIAR.ORG
Henry	Kiara	Animal Health	ILRI	H.KIARA@CGIAR.ORG
James	Rao	Marketing	ILRI	J.Rao@cgiar.org
Walter	Mangesho	Consultant	TALIRI	wmangesho81@gmail.com
Godfery	Ngoteya	Coordinator	ILRI	G.Ngoteya@cgiar.org
David	Ngunga	Environment	CIAT	D.Ngunga@cgiar.org
Lazaro	Tango	Administrator	CIAT	L.Tango@CGIAR.ORG
Victor	Mwalwisi	Accountant	CIAT	V.Mwalwisi@CGIAR.ORG
Beatus	Nzogela	Researcher	CIAT	B.Nzogela@cgiar.org
Jeremiah	Adolf	Coordinator	CIAT	A.Jeremiah@cgiar.org
An	Notenbaert	Researcher	CIAT	a.notenbaert@cgiar.org
Jessica	Mukiri	Researcher	CIAT	j.mukiri@cgiar.org

Annex 2: Workshop Agenda

Stakeholder Workshop: CLEANED Assessment Dairy Value Chain Tanzania

30th and 31st March 2021, SG Hotel

Agenda

Objectives

1. **Share** and **discuss** preliminary model results
   a) Representation of types (Production/Animal Numbers)
   b) Evaluated the percentage of each type found in each location
2. To **assess** the relevance of CLEANED results and **identify** key decision makers/experts
   a) Which results are most interesting?
   b) Who are the key decision makers to target?
3. To **develop** future scenarios for model implementation that reflect best-bet integrated intervention packages per system
   a) Which livestock production challenges are prominent in the different locations?
   b) Which combination on interventions make sense for the different types?

Time	Activity	Responsible
DAY 1: Verifying Typologies + Results		
8:30 -9:00am | 30 minutes	Participants arrival and registration	**Alliance of Bioversity and CIAT Team**
9:00-9:20am | 20 minutes	Welcome and introductions	**Jessica Mukiri**
9:20-9:40am| 20 minutes	Overview of the project	**Godfrey Ngoteya**
9:40-10:00am| 20 minutes	Workshop objectives and activities	**Walter Mangesho, Jessica Mukiri**
10:00-10:30 am	***TEA BREAK***	
10.30 – 11:00am | 30 minutes	Plenary presentation on the CLEANED model + Methodology used Typology	**Jessica Mukiri, Walter Mangesho**
11:00 - 11.30am | 30 minutes	CLEANED results	**Walter Mangesho**
11:30 - 12.00 pm | 30 minutes	Group work on validating results Do the results make sense? Are the results of interest?	**Group Work**
12:00 - 1:00 pm	**LUNCH**	

Time	Activity	Responsible
1:00-1:30 pm| 30 minutes	Plenary presentation of group mapping of results and feedback from all participants	**Group Work**
1:30 - 2:15pm | 45 minutes	CLEANED characterization context + importance of each type A look at the typology and system/type characterization Parameters (yield - feeding basket, production – livestock parameters) Importance of the different systems/types Q&A – does this typology and how they are defined make sense? How to improve?	**Walter Mangesho**
2:00 - 2:30pm | 30 minutes	Plenary presentation of group characterization + importance of each type	**Group Work**
2:30 - 3:00pm | 30 minutes	Group work on mapping of results to key experts/ institutions	**Group Work**
3:00-3.30pm	***TEA BREAK***	
3:30-4:00 pm | 30 minutes	Plenary presentation of group mapping of key experts/ institution and feedback from all participants	**Group Work**
4:00-4:10pm | 10 minutes	Closing of the day	**Alliance of Biodiversity and CIAT Team**
DAY 2: Building the packages and Scenarios		
8:30-9:00am | 30 minutes	Recap of Day 1 and overview of Day 2	**Walter Mangesho, Jessica Mukiri**
9:00-9:20 am | 20 minutes	Plenary presentation Discussion production challenges of feeding systems/health/ genetics/markets – what are the packages and options given what is to be modelled?	**Godfrey Ngoteya**
9:20-10:00 am | 40 minutes	Group work on scenarios	**Group Work**
10:00-10:30 am	***TEA BREAK***	
10:30-11:00 am | 30 minutes	Group work on scenarios	**Group Work**
11:00-11:30 am | 30 minutes	Plenary presentation of scenarios and feedback from all participants	**Group Work**
11:30-11:50 am | 20 minutes	Evaluation of the workshop	**Alliance of Biodiversity and CIAT Team**
11:50 : 12:00pm| 10 minutes	Closing Remarks	**Alliance of Biodiversity and CIAT Team**
12:00 - 1:00 pm	**LUNCH**	

Annex 3 CLEANED Input Data

Muheza Highland

Table 8 Muheza Highland Data Inputs

Input/ Parameter	Value	Reference
Herd composition (nr) Cow	3	Farmers/Expert experience
Herd composition (nr) Heifer	2	Farmers/Expert experience
Herd composition (nr) Calves	2	Farmers/Expert experience
Average annual milk (kg)	6100	Farmers experience
Average annual growth per animal (kg)	130	Swai E S, Kyakaisho P and Ole-Kawanara M S 2007: Studies on the reproductive performance of crossbred dairy cows raised on smallholder farms in eastern Usambara mountains, Tanzania. *Livestock Research for Rural Development. Volume 19, Article #61.* Retrieved January 16, 2021, from http://www.lrrd.org/lrrd19/5/swai19061.htm
Average Body weight (kg) - Cow	345	Swai E S, Kyakaisho P and Ole-Kawanara M S 2007: Studies on the reproductive performance of crossbred dairy cows raised on smallholder farms in eastern Usambara mountains, Tanzania. *Livestock Research for Rural Development. Volume 19, Article #61.* Retrieved January 16, 2021, from http://www.lrrd.org/lrrd19/5/swai19061.htm
Average Body weight (kg)- Heifers	254	Swai E S, Kyakaisho P and Ole-Kawanara M S 2007: Studies on the reproductive performance of crossbred dairy cows raised on smallholder farms in eastern Usambara mountains, Tanzania. *Livestock Research for Rural Development. Volume 19, Article #61.* Retrieved January 16, 2021, from http://www.lrrd.org/lrrd19/5/swai19061.htm
Average Body weight (kg) - Calves	110	Swai E S, Kyakaisho P and Ole-Kawanara M S 2007: Studies on the reproductive performance of crossbred dairy cows raised on smallholder farms in eastern Usambara mountains, Tanzania. *Livestock Research for Rural Development. Volume 19, Article #61.* Retrieved January 16, 2021, from http://www.lrrd.org/lrrd19/5/swai19061.htm
Parturition interval (years)	1.2	Swai E S, Kyakaisho P and Ole-Kawanara M S 2007: Studies on the reproductive performance of crossbred dairy cows raised on smallholder farms in eastern Usambara mountains, Tanzania. *Livestock Research for Rural Development. Volume 19, Article #61.* Retrieved January 16, 2021, from http://www.lrrd.org/lrrd19/5/swai19061.htm
Natural pasture /DM Yield tonne/ha	13.05	Tropical forage Factsheets, (2019), Feedipedia(n.d), Expert data, Amdihun A. et. al,(2014)
Pennisetum purpureum/ DM Yield tonne/ha	30	Osele et.al, (2018), Tropical forages Factsheets, (2019), Expert data, Amdihun A. et. al,(2014)
Maize/DM Yield tonne/ha	1.3	Socio-economic survey data(Kenya, Tanzania and Rwanda), Expert data, Amdihun A. et. al,(2014)
Guatemala	19.8	Tropical forage Factsheets, (2019), Feedipedia(n.d), Expert data, Amdihun A. et. al,(2014)
Manure application tonne/ha	10	Farmers experience

Muheza Lowland

Table 9 Input data Muheza Lowland

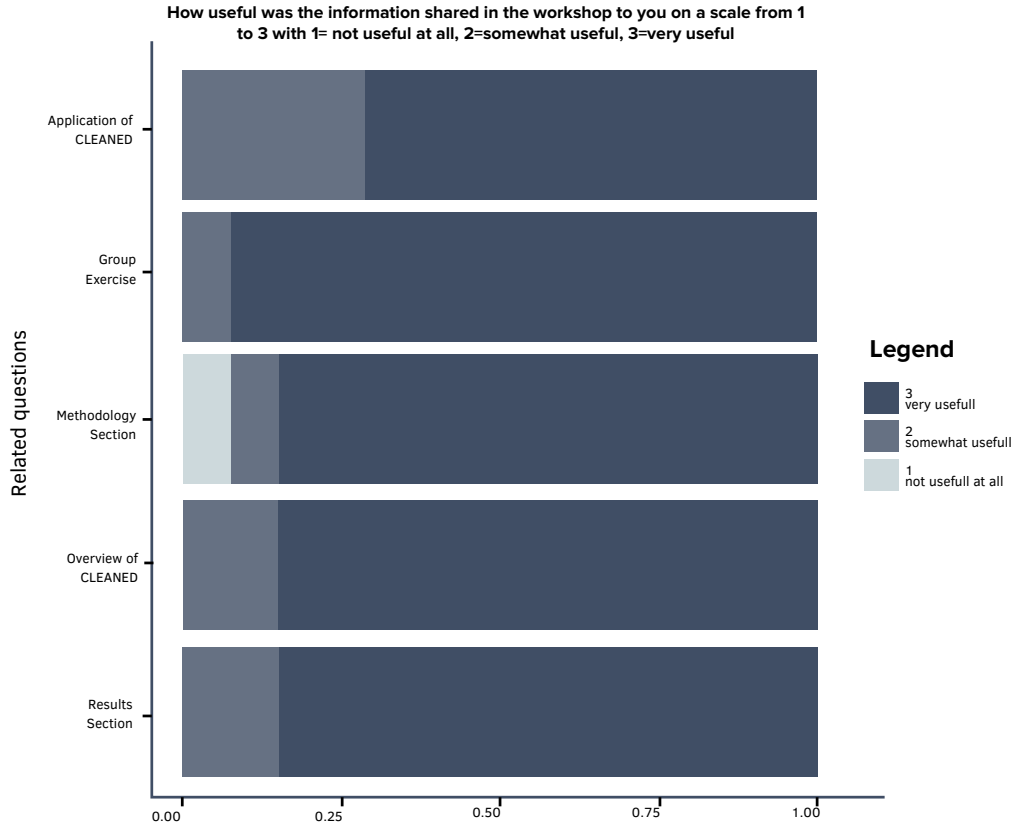
Input/ Parameter	Value	Reference
Herd composition (nr) Cow	3	Farmers/Expert experience
Herd composition (nr) Heifer	2	Farmers/Expert experience
Herd composition (nr) Calves	2	Farmers/Expert experience
Average annual milk (kg)	3660	Farmers experience
Average annual growth per animal (kg)	130	Swai E S, Kyakaisho P and Ole-Kawanara M S 2007: Studies on the reproductive performance of crossbred dairy cows raised on smallholder farms in eastern Usambara mountains, Tanzania. *Livestock Research for Rural Development. Volume 19, Article #61.* Retrieved January 16, 2021, from http://www.lrrd.org/lrrd19/5/swai19061.htm
Average Body weight (kg) - Cow	345	Swai E S, Kyakaisho P and Ole-Kawanara M S 2007: Studies on the reproductive performance of crossbred dairy cows raised on smallholder farms in eastern Usambara mountains, Tanzania. *Livestock Research for Rural Development. Volume 19, Article #61.* Retrieved January 16, 2021, from http://www.lrrd.org/lrrd19/5/swai19061.htm
Average Body weight (kg)- Heifers	254	Swai E S, Kyakaisho P and Ole-Kawanara M S 2007: Studies on the reproductive performance of crossbred dairy cows raised on smallholder farms in eastern Usambara mountains, *Tanzania. Livestock Research for Rural Development. Volume 19, Article #61.* Retrieved January 16, 2021, from http://www.lrrd.org/lrrd19/5/swai19061.htm
Average Body weight (kg) - Calves	110	Swai E S, Kyakaisho P and Ole-Kawanara M S 2007: Studies on the reproductive performance of crossbred dairy cows raised on smallholder farms in eastern Usambara mountains, *Tanzania. Livestock Research for Rural Development. Volume 19, Article #61.* Retrieved January 16, 2021, from http://www.lrrd.org/lrrd19/5/swai19061.htm
Parturition interval (years)	1.2	Swai E S, Kyakaisho P and Ole-Kawanara M S 2007: Studies on the reproductive performance of crossbred dairy cows raised on smallholder farms in eastern Usambara mountains, Tanzania. *Livestock Research for Rural Development. Volume 19, Article #61.* Retrieved January 16, 2021, from http://www.lrrd.org/lrrd19/5/swai19061.htm
Natural pasture /DM Yield tonne/ha	13.05	Tropical forage Factsheets, (2019), Feedipedia(n.d), Expert data, Amdihun A. et. al,(2014)
Pennisetum purpureum/ DM Yield tonne/ha	30	Osele et.al, (2018), Tropical forages Factsheets, (2019), Expert data, Amdihun A. et. al,(2014)
Maize/DM Yield tonne/ha	1.3	Socio-economic survey data(Kenya, Tanzania and Rwanda), Expert data, Amdihun A. et. al,(2014)
Leucaena	2.08	NRC, (1978), Feedipedia (n.d), expert data
Manure application tonne/ha	10	Farmers experience

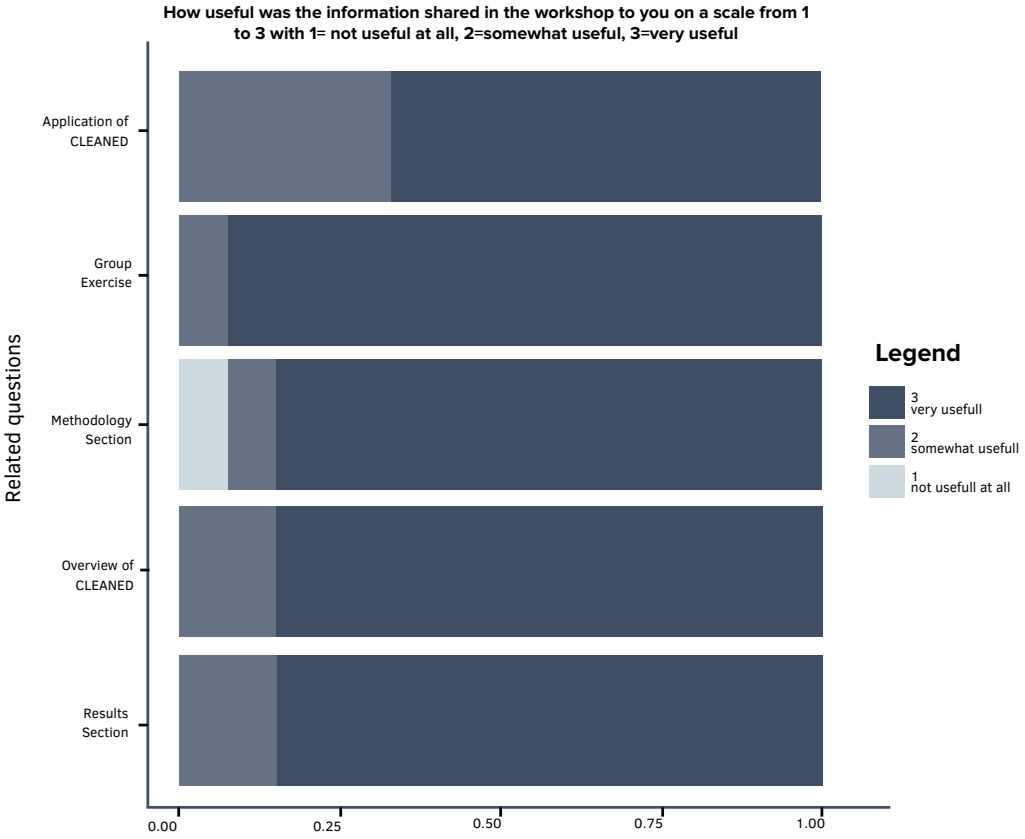
Hai

Table 10 Hai Input data

Input/ Parameter	Value	Reference
Herd composition (nr) Cow	2	Farmers/Expert experience
Herd composition (nr) Heifer	1	Farmers/Expert experience
Herd composition (nr) Calves	1	Farmers/Expert experience
Average annual milk (kg)	4650	Farmers experience
Average annual growth per animal (kg)	120	Swai E S, Mollel P and Malima A 2014: Some factors associated with poor reproductive performance in smallholder dairy cows: the case of Hai and Meru districts, northern Tanzania. *Livestock Research for Rural Development.* Volume 26, Article #105. Retrieved January 16, 2021, from http://www.lrrd.org/lrrd26/6/swai26105.htm
Average Body weight (kg) - Cow	340	Swai E S, Mollel P and Malima A 2014: Some factors associated with poor reproductive performance in smallholder dairy cows: the case of Hai and Meru districts, northern Tanzania. *Livestock Research for Rural Development. Volume 26, Article #105.* Retrieved January 16, 2021, from http://www.lrrd.org/lrrd26/6/swai26105.htm
Average Body weight (kg)- Heifers	249	Swai E S, Mollel P and Malima A 2014: Some factors associated with poor reproductive performance in smallholder dairy cows: the case of Hai and Meru districts, northern Tanzania. Livestock Research for Rural Development. Volume 26, Article #105. Retrieved January 16, 2021, from http://www.lrrd.org/lrrd26/6/swai26105.htm
Average Body weight (kg) - Calves	110	Swai E S, Mollel P and Malima A 2014: Some factors associated with poor reproductive performance in smallholder dairy cows: the case of Hai and Meru districts, northern Tanzania. *Livestock Research for Rural Development. Volume 26, Article #105*. Retrieved January 16, 2021, from http://www.lrrd.org/lrrd26/6/swai26105.htm
Parturition interval (years)	1.4	Swai E S, Mollel P and Malima A 2014: Some factors associated with poor reproductive performance in smallholder dairy cows: the case of Hai and Meru districts, northern Tanzania. *Livestock Research for Rural Development. Volume 26, Article #105.* Retrieved January 16, 2021, from http://www.lrrd.org/lrrd26/6/swai26105.htm
Natural pasture /DM Yield tonne/ ha	12.28	Tropical forage Factsheets, (2019), Feedipedia(n.d), Expert data, Amdihun A. et. al,(2014)
Pennisetum purpureum/ DM Yield tonne/ha	30	Osele et.al, (2018), Tropical forages Factsheets, (2019), Expert data, Amdihun A. et. al,(2014)
Maize/DM Yield tonne/ha	1.3	Socio-economic survey data(Kenya, Tanzania and Rwanda), Expert data, Amdihun A. et. al,(2014)
Guatemala	19.8	Tropical forage Factsheets, (2019), Feedipedia(n.d), Expert data, Amdihun A. et. al,(2014)
Manure application tonne/ha	10	Farmers experience

Annex 4 CLEANED Workshop Assessment





What did you like most about this workshop?	What should we have done differently?
I like how the facilitator managed to explain the work (CLEANED) performed and the questions/doubts raised by participants were answered and agreed to the skills given	Could have a professional meeting facilitator to lead the workshop. However, things went well
It raises the general awareness to the public about the environmental impacts associated with dairy production	To include more stakeholders like policy makers and farmers
The new knowledge on the CLEANED tool	More participants should be invited
The new knowledge on the CLEANED tool	Nothing
Validation of the results session and merging of the results vs results of the model	Share the references to show how currently the references are (how many years have already passed since the publication of the references)
What did you like most about this workshop?	**What should we have done differently?**
Flexibility and interaction	Farmers should have been invited to reflect the reality on the ground
Bundling technology and the CLEANED results	Bring into awareness the knowledge about the manure management
The whole idea of CLEANED, the research and results presented. it raised my understanding and awareness of dairy production and the environment	More stakeholders should be invited
Cooperation and meeting the objectives of the workshop	The agenda and objectives could have been sent earlier to the participants of the workshop

Was the format of the meeting suitable for you?	Reason for previous answer
Yes	The Objectives of the workshop was achieved
Yes	It was more involving and every participant was free to express his/her ideas
Yes	The time table was well followed
Yes	The format of the discussion
Yes	It allowed every participant to share their experiences
Yes	The plan/schedule was systematic
Yes	
Yes	The discussion was more open and involving
Yes	It was timely and participatory
Yes	The meeting was participatory
Yes	The workshop was well designed and the presentations were well presented

Photo: Kabir Dhanji/ILRI

Maziwa Zaidi

More Milk in Tanzania

ILRI INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE

CGIAR RESEARCH PROGRAM ON Livestock

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CGIAR RESEARCH PROGRAM ON Livestock

This report was conducted as part of the CGIAR Research Program on Livestock and is supported by contributors to the CGIAR Trust Fund. CGIAR is a global research partnership for a food-secure future. Its science is carried out by 15 Research Centers in close collaboration with hundreds of partners across the globe. www.cgiar.org/funders