



Comprehensive Livestock Environmental Assessment for Improved Nutrition, a Secured Environment and Sustainable Development along Livestock and Aquaculture Value Chains Project

PGIS Workshops' Summary Reports

**Workshop 1: 30 June – 1 July 2014; Workshop 2: 3 July 2014;
Edema Conference Centre, Morogoro, Tanzania**

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Edema Conference Centre, Morogoro, Tanzania**

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EXECUTIVE SUMMARY

This report describes the results of a multi-stakeholder workshop organised in the Morogoro region of Tanzania, with the aim of developing an overview of small-scale dairy systems in the Kilosa and Mvomero districts. The workshop focused primarily on livestock keeping, feed production and support infrastructure and services for small-scale dairy production, as well as the environmental context supporting such systems. Together, the information provided a basis for discussion of the common impacts on the environmental context associated with livestock keeping for dairy production. The data were captured using participatory mapping (PGIS, Cinderby et al. 2011, Elwood 2006) by small group discussions during the workshop. These groups yielded a wealth of relevant information describing the state of dairy production and natural resources in June-July 2014 (summarised in Table 1), which was especially useful because it was developed by the stakeholders who know and operate in the landscape, and who manage the associated natural resource base through their activities. The results will complement the secondary data, household-level information and expert knowledge gathered as inputs into a proof-of-concept implementation of an *ex-ante* environmental assessment using the Comprehensive Livestock Environmental Assessment for Improved Nutrition, a Secured Environment and Sustainable Development along Livestock and Aquaculture Value Chains (CLEANED-VCs, Lannerstad et al. manuscript). For more information on CLEANED-VCs, visit the project website at: <http://sei-international.org/projects?prid=2057>.

Table 1: Summary of the information compiled by participants in the workshop

Livestock systems	Characteristics
Extensive system variants:	
Nomadic farming	The livestock keepers travel long distances from their home looking for pasture in communal areas. They can spend the entire rainy or dry season away with the livestock, continually moving and camping each night wherever they are at dusk.
Transhumance/ seasonal movement	Livestock graze in local communal areas in the rainy season until the grass, and then the crop residues, are finished. In the dry season, the young men travel 20–30 km with the livestock in search of pasture, and set up thick thorn enclosures in which to camp at night rather than return home.
Semi-intensive system variants:	
Semi-intensive grazing with no supplementary feed	Livestock graze locally in communal spaces all day and are brought back to the homestead each night. This is only found in a few places, due to competition with crop farmers for land. However, some communities have set aside part of their communal land for this type of farming.
Semi-intensive grazing with supplementary feed (e.g. agro-or silvo-pastoralism)	Mixed farming with both crop production and livestock keeping, where livestock graze locally during the day and are brought back to the homestead at night. In the dry season they are fed in the homestead with crop residues. Many different crop-growing practices are included in this type of system.
Intensive system variants:	
Tethering	Livestock are tied to a peg or tree in private or communal areas to graze the tethered radius, then transferred to a different location once the grass has been exhausted. This is a form of intensive grazing usually practiced by those with only a few cattle and/or no labour to take care of their livestock.
Semi-zero grazing (a modern practice, typically on private land)	A mixture of zero-grazing and free ranging, where livestock are kept in a shed part of the time and feed (collected or bought) is provided in situ. The rest of the time, the livestock are let out of the shed to graze on the farm.

Zero-grazing (a modern practice)	Livestock are kept in a shed all the time and all food and water is brought to them. The feed is collected or cultivated locally ('cut and carry') or bought.
Feed types	Species and production/source
Natural forage	Grasses: Napier/elephant grass (<i>Pennisetum purpureum</i>), <i>Brachiaria</i> spp, <i>Calliandra calothyrsus</i> , <i>Cynodon</i> spp, <i>Panicum</i> spp; Weeds; Legumes: cowpea (<i>Vigna triloba</i> ^a), <i>Mucuna</i> spp, Blue pea spp; Trees: <i>Leucaena leucocephala</i> , <i>Sesbania</i> spp, <i>Acacia</i> spp. Production: Collected from roadside, verges; grazed from communal areas or owners' private land
Cultivated forage (hay and improved pastures)	Digitaria, Guatemala grass, Napier/Elephant grass, Buffalo grass (<i>Cenchrus ciliaris</i>) Production: Individual or group initiatives to improve pasture Demo plots: Maziwa Zaidi programme ^b – <i>C. ciliaris</i> ; Heifer programme ^c – <i>Desmodium</i> , Mulato (<i>Brachiaria</i> hybrid cultivar)
Crop residues	Maize, wheat, paddy rice, beans, sweet potato Production/Source: Collected from own or nearby fields for cows in sheds and/or grazed in-field
Concentrates	Sunflower cake (<i>mashudu</i>), maize bran, rice bran/pollard, molasses, minerals, cotton cake (<i>mpumba</i>) Production/Source: Sugar cane and sunflower by-products processed in local mills, other concentrates bought from local agro-dealers
Management practices	
Crop rotation	Cereals are rotated with beans; rice is rotated with horticulture crops such as tomato, eggplant (aubergine), cabbage and hot pepper. Intercropping, although not strictly allowed, is practiced due to lack of space: typically cowpeas and maize, lima beans and maize or sunflower and maize.
Fertiliser and pesticide use	Commercial fertilisers such as urea used for crops where such investment would yield higher returns: cereals (maize, rice) and other cash crops, which in this area include vegetables such as tomatoes, aubergine, cabbage and hot pepper. These crops are also sprayed with herbicides (most commonly Rindomil®; not with beans) and insecticides (such as Celtron® water concentrates).
Manure use	Manure is used on vegetable gardens, sourced within farm from chickens, pigs, goats and cows, and applied immediately/daily.

a A synonym for *Vigna unguiculata* (L.) Walp. subsp. *stenophylla* (Harv.) Maréchal et al., <http://www.ars-grin.gov/cgi-bin/npgs/html/taxon.pl?41641>.

b <http://moremilkit.wikispaces.com/home>

c <http://www.heifer.org>

Key natural resources	Status	Opportunities and risks
Land	Some areas are under high pressure from competing users, especially crop farmers and livestock keepers, for example around rivers and in dry season grazing areas. Some areas are under no pressure as they are seen as completely degraded.	There may be opportunities for integrating fodder production into crop farming. Risk of conflict remains where crop farmers occupy fertile pasture land. The extent of grazing land is being reduced through encroachment by bushland, cropland, national parks and other land uses.
Water	Water scarcity is a problem in the dry season. Water sources other than rivers are small dams, shallow and deep wells and rivers. However, one key river, Mkata, which used to be permanent is now seasonal. Water quality is sufficient for livestock, except where rivers pass through human settlements or the industrial area of Morogoro town.	There are opportunities for rainwater harvesting and building further wells and dams. Certain areas flood each year, which makes them inaccessible in the rainy season, but provides dry-season grazing. There is a risk of reduced access to water for livestock, if more land along the river is bought and fenced off, blocking access to the river.
Soil	Soils are fertile along the main cropping and grazing corridor from Mikumi to Kilosa to Turiani. In some areas, where the land is used for both crop farming and livestock keeping, soil fertility is now low.	Crop rotation using legumes and manure helps to maintain soil fertility. Areas with high volumes of livestock, such as markets and migration routes, suffer soil compaction and therefore low levels of fertility. Some erosion occurs, associated with charcoal production and hill-slope farming.
Vegetation	Two kinds of burning occur: early phase, which is good for clearing excess vegetation early in the season and encouraging growth; and late phase, which is destructive because it burns all vegetation including trees, and contributes to land degradation.	Early burning is used in some national parks and may be requested on overgrown grazing lands. Late-phase burning is known to regularly occur on the Nguru wa Ndege hills near Morogoro.

1. INTRODUCTION

This report describes the results of an assessment of small-scale dairy production systems in the Morogoro region of Tanzania. The work is part of the ILRI project on **Comprehensive Livestock Environmental Assessment for Improved Nutrition, a Secured Environment and Sustainable Development along Livestock and Aquaculture Value Chains (CLEANED-VCs)**, which contributes to the Maziwa Zaidi project¹ by assessing the impact of dairy interventions on surrounding environmental resources. The Maziwa Zaidi project is working in Tanzania to improve livelihoods by improving milk production (ILRI 2014a), and ensuring that it is environmentally, socially and economically sustainable. Short-term improvements in dairy-related livelihoods are less beneficial if local environmental resources cannot sustain such improvements, or if other livelihood activities are negatively affected by environmental degradation.

Assessment workshop process

The assessment, conducted in two workshops in June–July 2014, asked local experts to describe and map all dairy livestock and feed production systems across the district, and assess the distribution of production in relation to available resources. The workshops focused on the Kilosa and Mvomero districts of Morogoro.²

In addition, the experts explored several scenarios for interventions to alter the production systems and discussed the associated environmental impacts. Participating experts came from the Kilosa, Mvomero and Morogoro districts (Table 2). The participants represented a number of different stakeholder groups: farmers, regional policymakers and decision makers, such as livestock officers, wildlife experts, milk traders and researchers.

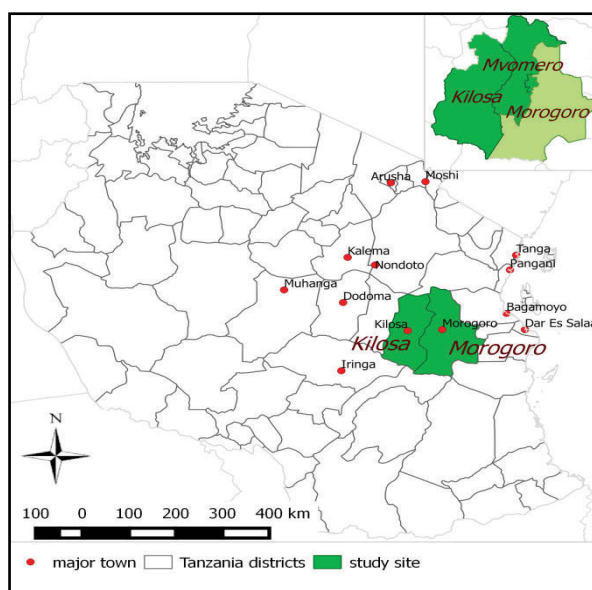


Figure 1: Location of the study districts across the Morogoro Region of Tanzania. Inset shows the new district boundaries, as of 2012 Source: FAO Geonetwork, National Statistics Agency

1 <http://moremilkit.wikispaces.com/home>

2 The boundaries used in the workshop's base map are out of date, and include Mvomero as part of Morogoro district. The inset shows the correct, current boundaries, which are used in the rest of the report.

Table 2: Organisations and actors represented at the workshop

Organisation/occupation	Male participants	Female participants	Total participants
Workshop 1:	12	5	17
District livestock officer	4	0	4
District veterinary officer	0	1	1
District agricultural extension officer	1	1	2
Wildlife/natural resources officer	2	0	2
Chairperson of dairy farmer group	1	1	2
Farmer/ livestock keeper	1	1	2
Milk collector ^a or collection point agent	2	1	3
Input provider	1	0	1
Workshop 2:	4	3	7
University lecturer	2	2	4
District livestock/crop officer	1	1	2
Regional secretariat	1	0	1

a These are milk traders/ vendors who collect and buy fresh milk from farmers and sell it either locally or to milk collection centres and other outlets.

1.1. Methodology

The data were gathered using Participatory GIS workshops: a set of structured discussions, the results of which are mapped by the local stakeholders. In this way, the knowledge produced is rooted in the participants' understanding and in a spatially explicit framework (Cinderby et al. 2011, Elwood 2006). For a technical description of how to conduct a Participatory GIS workshop see Appendix of TBD (2015).

The first expert workshop consisted of several PGIS sessions held over two days. This was followed by a one-day workshop with a different set of participants. In the first workshop, the discussions focused on:

- the common categories of **dairy livestock keeping and feed production**;
- landscape **environmental resources**; and
- **scenarios for dairy development**.

The second workshop explored in greater depth some of the key implications of the scenarios for dairy development developed in the first workshop.

The expert conversations in the first workshop were conducted mainly in Swahili, with some translation to or from English where necessary. The second workshop was conducted mainly in English, with some translation and internal discussion in Swahili. The expert conversations were documented primarily on the maps drawn by the participants, although these were complemented by notes taken on flipcharts. The mapping was carried out using permanent coloured markers on layers of acetate, which were fixed over the base map of district boundaries, roads, rivers, key towns and land cover (Figure 2). This method enabled several new maps showing features from the different discussions to be drawn over the base map, with each new set of features on a fresh sheet of acetate. The acetates were blank, except for the major road network and towns which were used as georeference points so that they could be digitised using GIS-based software and geo-referenced to the base map after the workshop (see section 1.2. Information processing).

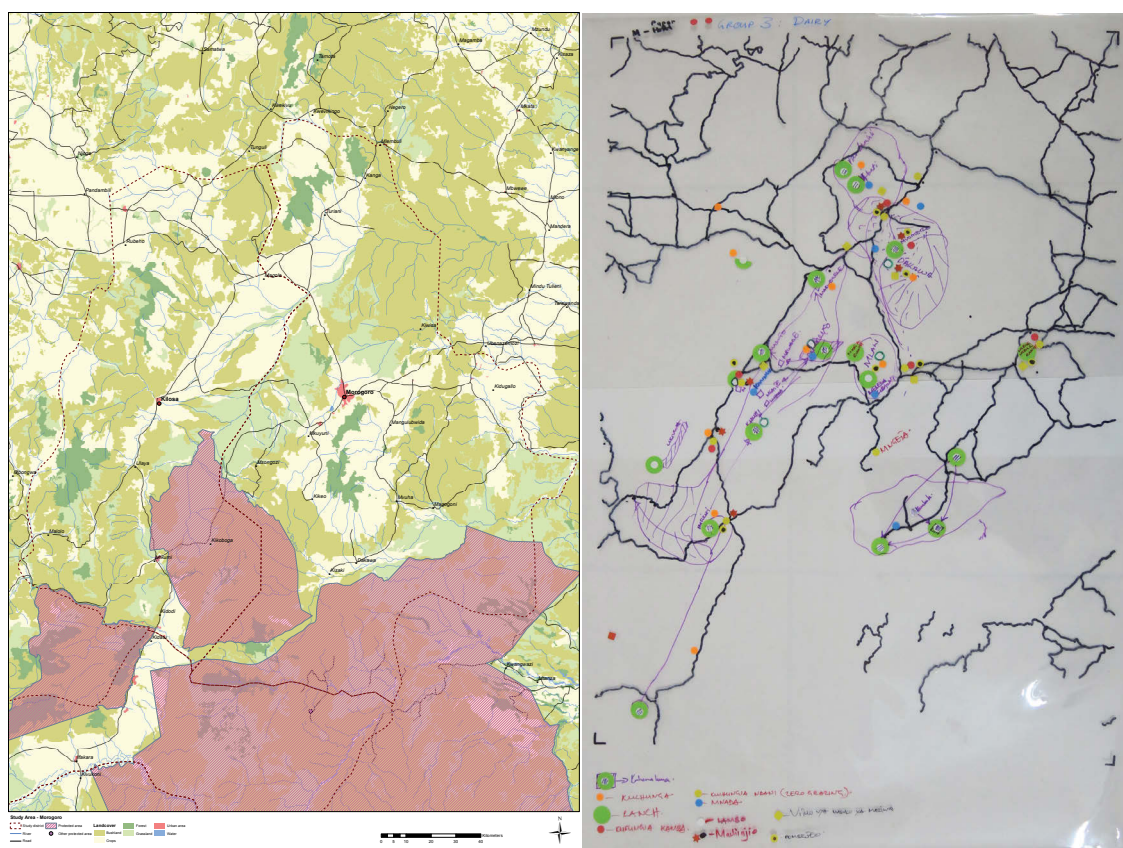


Figure 2: Base map used in the workshop, showing Kilosa and Morogoro districts, roads, towns and land cover (left), and an example of participants' mapping on to an acetate that would have been fixed over the base map

(Data sources: Valuing the Arc landcover, Swetnam et al. 2011; districts, roads, towns, FAO Geonetwork).

It should be noted that Tanzania’s administrative boundaries were changed in 2012, dividing the regions into new districts. The base maps, which used FAO Geonetwork boundaries from 2002, were therefore out of date. The town and road layers were also incomplete, as some towns or roads were either incorrectly located or missing. As a result, some time was spent correcting faults and errors in the maps before the mapping of livestock keeping and feed production could begin. Some participants struggled to locate areas they knew because the map did not have the right information. When describing the distribution of livestock systems, for example, the participants identified areas in Kilosa, Mvomero or Morogoro districts by village or ward.

All the proceedings were recorded and subsequently transcribed and translated into English, in order to provide context for the mapping where required. All the flipchart notes and maps drawn were photographed at the end of each day. This workshop report reflects the voices of the participants, unless otherwise stated, and is based on the English transcriptions, flipchart notes, digitised maps and team reflections. This methodology is illustrated in Figure 3.

Following the first workshop, the team participated in field visits to Kilosa and Mvomero led by the local livestock officer for each district, visiting milk collection points, examples of small- and large-scale intensive, large-scale semi-intensive and extensive dairy production, as well as feed and milk processing facilities.

Preparation

Prior to the workshops, key literature and data sources on the study area were reviewed, including village-level data and household-level data. The household data were collected in earlier surveys of over 1000 households across the Morogoro and Tanga regions of Tanzania (Silvestri et al. 2014, ILRI 2014b, Fraval et al. 2013). The surveys collected various data on dairy production and feed crop production, such as herd size, milk yield, fodder types and ratios, and fertiliser use in crop production. Selected summary statistics from the data collected (Table 3) were used to inform initial descriptions of common types of dairy livestock keeping in the study area, and comparisons with the wider region.

Table 3: Production system traits in Tanzania nationally, and by region/district

Source: ImpactLite dataset, ILRI/CCAFS 2012; MoreMilkIT baseline, CGIAR, 2013; Dairy in western highlands of Kenya, ILRI, 2013.

Dairy farm characteristics	Eldoret, Kenya Mean/max (n)	Tanzania ^c Mean/max (n)	Mvomero Mean/ max (n)	Kilosa Mean/ max (n)
Herd size	8/47 (n=194)	43/678 ^a (n=818)	76/618 (n=173)	88/678 ^a (n=105)
Exotic cattle (% of herd)	94/100 (n=194)	34/100 (n=818)	18/100 (n=172)	8/100 (n=106)
Land size (ha)	3/36 (n=194)	16/1000 (n=818)	32/1000 (n=172)	18/300 (n=106)
Average milk yield (l/ year) ^b	1818/6620 (n=194)	433/2950 (n=515)	420/2190 (n=124)	354/2920 (n=92)
Concentrates fed (kg/ year)	349/3345 (n=194)	115/3600 ^a (n=814)	181/3600 ^a (n=172)	30/972 (n=106)
Feed Crop residue (%)	88	58	47	30
Feed fodder (%)	73	21	2	2
Purchased feed (%)	54	10	5	3

a Outlier removed, for example, where data were deemed inconsistent with the context

b Annual milk yield estimated using milk at calving, and 'yesterday's yield' averaged over the milking herd

c Tanzania, limited to Lushoto, Handeni, Mvomero and Kilosa

Secondary studies also provided valuable insights into the study area, such as FEAST reports (Wassena et al. 2013a,b, Mangesho et al. 2013), village level assessments and peer-reviewed studies (Wickama et al. 2014).

1.2. Information processing

The maps were digitised into Q-GIS (open-source GIS software, www.qgis.org) by first georeferencing the photographs of the map layers drawn by the participants and then tracing and classifying the features on to individual layers in the digital database. Initial analysis of the data included synthesising maps on the same topic drawn by different groups, and merging the information into single layers. Conflicts in the data were resolved based on the transcripts of the plenary discussions, notes on individual group discussions, and discussion within the team where necessary. Generally, points in quite close proximity (i.e. the same town) were merged, but otherwise all points were kept.

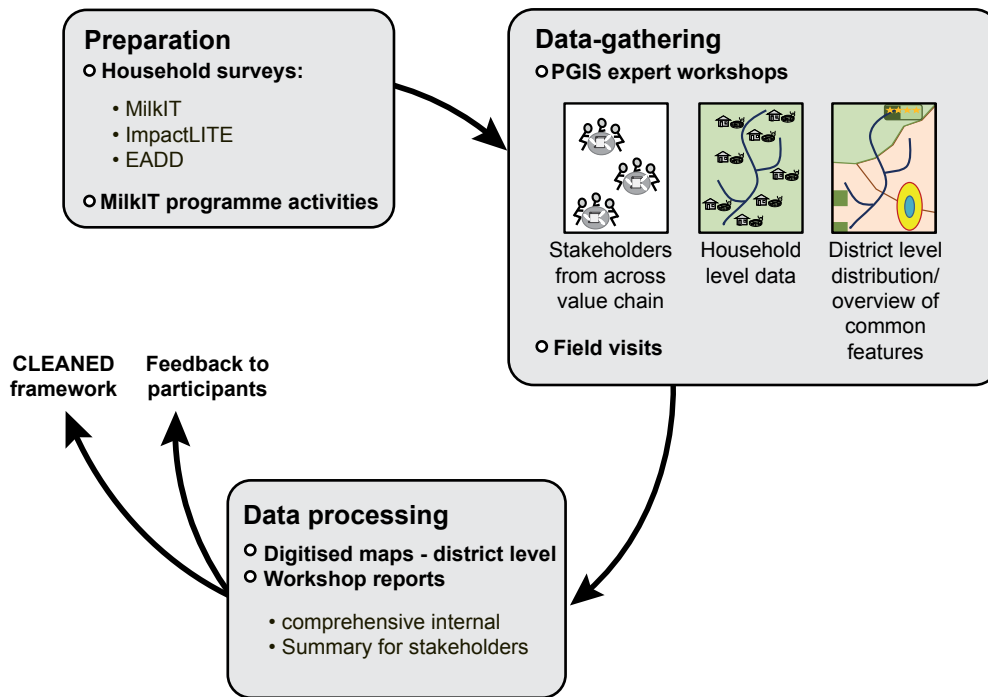


Figure 3: Methodology for the participatory GIS sessions and the outputs produced for the CLEANED-VCs framework

2. WORKSHOP 1: INITIAL BASELINE ASSESSMENT AND SCENARIOS



Participants in Workshop 1: 30 June–1 July 2014, Edema Conference Centre, Morogoro, Tanzania

2.1 Distribution of dairy farming: milk production systems

Traditional livestock keeping practices were found to fall into three broad categories, based on the proportion of time which livestock spend grazing: 100% grazing on communal land (extensive); part grazing communally and part kept and fed indoors (semi-intensive); and 100% kept and fed indoors (intensive). Participants described two variants within each category (see below and Figure 4). A small number of farmers, typically those on private land, are considered to be using modern, intensive or semi-intensive farming methods, which require higher use of inputs and possibly also the use of some machinery.

Extensive grazing

- *Nomadic farming*: livestock keepers travel far from home looking for pasture. They can spend the entire rainy or dry season away with the livestock, continually on the move, camping each night wherever they find themselves at dusk. Figure 4 shows some of the well-known migration paths.
- *Transhumance/seasonal movement*: livestock graze local communal areas in the rainy season until first the grass, and then the crop residues are exhausted. In the dry season, the young men travel 20 or 30 km with the livestock in search of pasture, and set up bomas – thick thorny fenced enclosures – in which to camp at night, rather than return home.

Semi-intensive grazing

- *Semi-intensive with no supplementary feed*: livestock graze locally in communal spaces all day, and are brought back to the homestead each night. This is only found in a few

places, due to the competition for land with crop farmers. However, some communities have set aside part of their communal land for this type of farming.

- *Semi-intensive with supplementary feeding (e.g. agro-pastoralism, silvo-pastoralism)*: mixed farming with both crop production and livestock keeping, where livestock graze locally during the day and are brought back to the homestead at night. In the dry season, they are fed in the homestead on crop residues. Many different crop-growing practices are included in this type of system.

Intensive livestock keeping

- *Tethering*: livestock are tied to a peg or tree to graze the tethered radius, then transferred to a different location once the grass there is exhausted. This is a form of intensive grazing, usually practiced by those who have only a few cattle and/or no labour to take care of their livestock.
- *Semi-zero grazing (private farms/ranches)*: a mixture of zero-grazing and free ranging, where livestock are kept in a shed and fed hay or grass, or whatever feed is collected or bought, and then released to graze on the farm (a modern practice).
- *Zero-grazing*: livestock are kept in a shed all the time and all their food and water are brought to them, either 'cut and carry' feed which is collected/cultivated locally or bought feed (a modern practice).

The practice of buying cattle for fattening to sell at a profit was discussed. This was said to be a more modern beef farming practice.

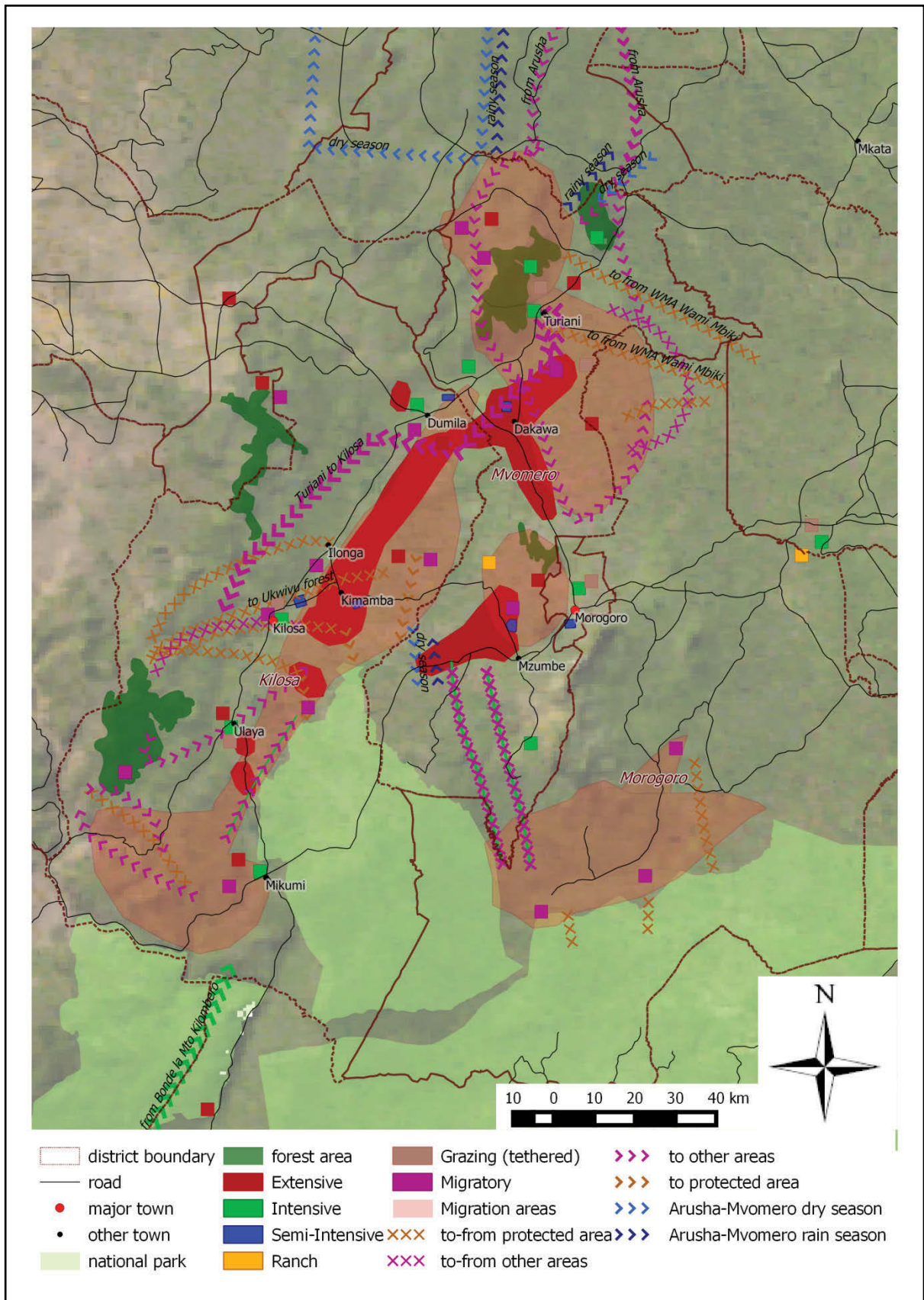


Figure 4: Location of dairy livestock keeping systems across the Kilosa and Mvomero districts

Source: expert consultation discussions and PGIS maps, June/July 2014.

Other Value Chain components

The components of a livestock industry infrastructure are: livestock markets, milk marketing channels, cattle dips, veterinary health centres and input suppliers (see Table 4 and Figure 5).

Table 4: Infrastructure available in the Kilosa, Mvomero and Morogoro districts

Source: workshop discussions and PGIS maps, June/July 2014

	Inputs		Animal health	Outputs	
	Livestock markets	Agrovet/ feed supplier	Cattle dips and spray races	Abattoir	Milk marketing
Kilosa	6	5	4 dips 2 spray races	3	2
Mvomero	4	8	3 dips	3	3
Morogoro	1	2			2

It is notable that no veterinary health centres were identified in any of the districts.

Farmers generally consume milk at home as fresh or sour, and the surplus supply is sold. Milk marketing channels include collection centres, cooling facilities and processors. Four collection centres with cooling plants were identified: Kambala, Dakawa (5000 litres), Dumila and Kimamba (2000 litres), and Turiani; as well as one collection centre without cooling at Kidudwe. Two collection points were identified in Morogoro district: Morogoro town and Ngerengere. However farmers also sell milk locally to vendors, restaurants and individuals.

No processors were identified within Kilosa or Mvomero districts. The Tanga Fresh & Tanga Dairy Cooperative Union, located in Tanga town, 330 km from Morogoro town, is the closest large processor. It processes 60 000 litres per day in the wet season, mainly from collection points across Tanga region and a few in Morogoro region. Tanga Fresh also produces yoghurt and butter, and excess milk is processed into mozzarella.

It was noted that some livestock keepers migrate further away from urban centres during the dry season. This migration pattern presents challenges for marketing milk, as farmers have to travel longer distances to access markets. This situation can be exacerbated by the closure of milk collection centres in the dry season, when the scarcity of supply makes it not viable to keep the cooling plants running. The higher prices achieved at these times can, in part, act to incentivize the long distance delivery of milk, but this is still perceived as uneconomic by some milk producers.

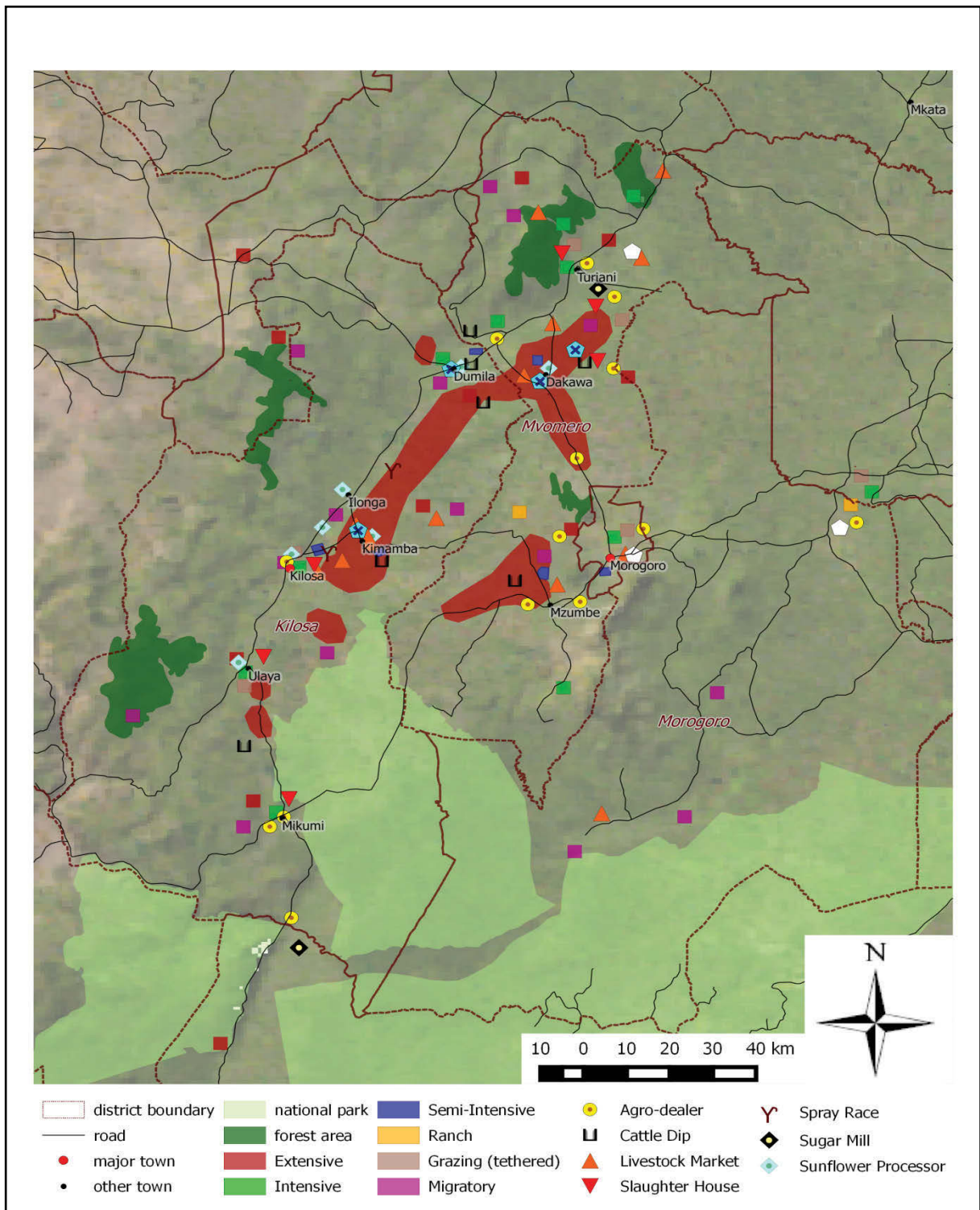


Figure 5: Support infrastructure and services for dairy livestock systems

Source: expert consultation discussions and PGIS maps, June/July 2014.

2.2 Distribution of dairy farming: feed production systems

Participants agreed that most feed in the study area was grazed or collected, rather than purchased. The main sources were natural and planted forages (grasses, legumes and weeds), crop residues, and commercial feeds and concentrates. A summary of common feed sources is given in Table 5, and their spatial distribution is illustrated in Figure 6.

Table 5: Common feed types and sources for dairy livestock in Kilosa and Mvomero, Tanzania

Feeds used	Sources	Category of livestock keeping that uses it
Natural forage: Grasses: Napier/elephant grass (<i>Penisetum purpureum</i>), <i>Brachiaria</i> spp, <i>Calliandra calothyrsus</i> , <i>Cynodon</i> spp, <i>Panicum</i> spp; weeds; Legumes: cowpea (<i>Vigna triloba</i> ^a), <i>Mucuna</i> spp, Blue pea spp; Trees: <i>Leucaena leucocephala</i> , <i>Sesbania</i> spp, <i>Acacia</i> spp	Collected from roadside, verges; grazed from communal areas or owners' private land	All
Cultivated fodder: Hay and improved pastures: <i>Digitaria</i> spp, Guatemala grass (<i>Tripsacum andersonii</i>), Napier/Elephant grass, Buffalo grass (<i>Cenchrus ciliaris</i>)	Individual or group initiatives to improve pasture; Demo farms: Maziwa Zaidi programme ^b – <i>C. ciliaris</i> ; Heifer programme ^c – <i>Desmodium</i> , Mulato (<i>Brachiaria</i> hybrid cultivar)	Extensive (few); semi-intensive; intensive
Crop residues: Maize, wheat, paddy rice, beans	Grazed in-field and/or collected from own or nearby farms to take to livestock in their sheds	Extensive; semi-intensive; intensive
Concentrates: Sunflower cake, maize bran, rice bran, molasses, minerals, cotton cake, sunflower cake	Sugar mills, local sunflower processors, local agro-dealers	Not confirmed

a A synonym for *Vigna unguiculata* (L.) Walp. subsp. *stenophylla* (Harv.) Maréchal et al., <http://www.ars-grin.gov/cgi-bin/npgs/html/taxon.pl?41641>.

b <http://moremilkkit.wikispaces.com/home>

c <http://www.heifer.org>

Participants made the following comments on each feed source, relevant to one or more of the livestock systems:

Grazing: across both districts, cattle in pastoralist systems graze natural pastures, shrubs, natural trees in communal areas and farm residues when allowed. Specific dry season grazing areas were also highlighted. Agro-pastoralists use the same grazing areas as the pastoralists, but stay within a short radius of their farm; they primarily use farm residues to supplement feed.

Crop residues: in general, after harvesting the crop, such as maize, rice, beans or wheat, the residues are left in the field and cattle are allowed into the fields to eat them at no charge to the livestock keeper.

Cultivated fodder: Hay is currently grown at three locations: in Dakawa and Bustani (Melela); by a large single farmer producing hay from his own pastures at Wami Sokoine (Shamba Kubwa); and in Mandela village. Participants identified rice-growing areas as potential areas for making

hay, although natural grass can also be collected around Mgeta and Turiani in Mvomero and Twatwatwa in Kilosa. Other improved pasture species, such as *Desmodium*, *Cenchrus ciliaris* and *mulato grass*, are being demonstrated on demo farms in Wami Sokoine, Dakawa, as well as Kimamba and Ulaya. Cultivated fodder may be grown as dedicated pasture or in buffer strips surrounding crop fields.

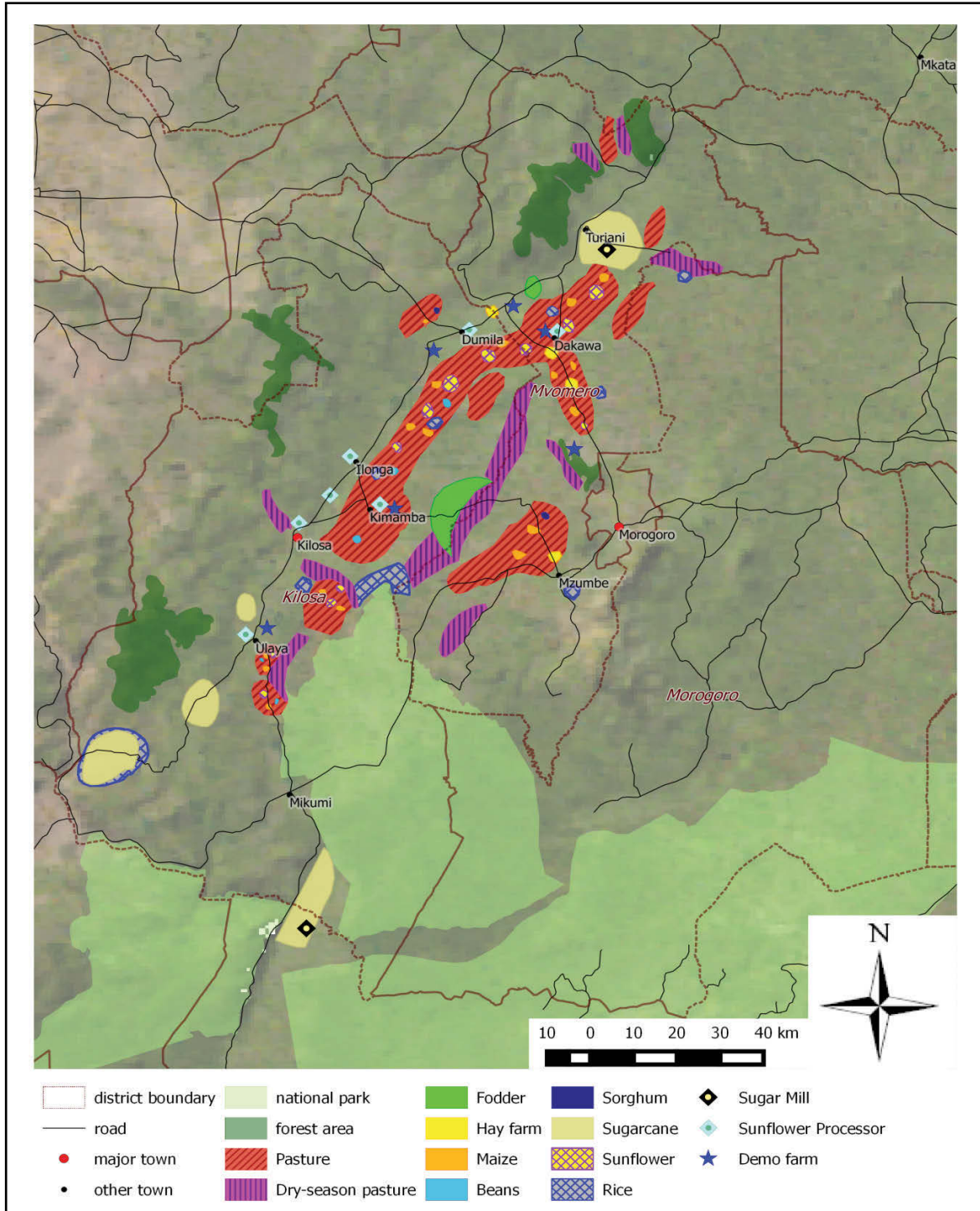


Figure 6: Feed types and sources for dairy production

Source: expert consultation discussions and PGIS maps, June/July 2014.

Concentrates (including rice bran, sunflower cake and molasses): Livestock keepers use molasses from the sugar mills to improve feed palatability and alter rumen function. Sugar cane is

grown on two large estates run by the Illovo Sugar Company (Kilombero) and the Mtibwa Sugar Company (Turiani). Each has a sugar mill to process the sugar cane. Small farmers surrounding the estates also produce sugar cane as outgrowers, selling directly to the sugar companies.

Sunflower is grown between Turiani and Ilonga, either on its own or intercropped with maize. The sunflower is processed at seven mills (Ilonga, Kimamba, Ulaya, Kilosa, Kondo, Dakawa and Dumila) to produce sunflower oil, and the compressed husks form sunflower cake (*mashuru*) which livestock keepers use as a concentrate.

Other concentrates, such as minerals, maize bran and cotton cake (*mpumba*), are bought from local agro-dealers, but imported from outside the districts.

2.3. Environmental resources: status and risks

The major natural resources required for dairy and crop production were identified and rated with respect to their importance. The categories were: (i) natural vegetation, such as grasses, shrubs, forests and bush land; (ii) water bodies, such as rivers, dams, natural ponds/pans and springs as well as rainfall; (iii) soil; (iv) established vegetation, such as forests and pasture; (v) wildlife; (vi) livestock species; and (vii) mountains/valleys.

1. Land use and vegetation

Encroachment on grazing land was repeatedly raised as a concern, for several reasons (see also Figure 7):

- By bushland (e.g. Acacia species), which it was suggested was encouraged by livestock spreading seeds while grazing, and as a result of long-term overgrazing of grasses. The Parakuyo, Mbwade and Mkata ranches were given as examples.
- By crop farming moving into specific grazing lands, in areas such as Mfumo, Mabwegere and many parts of Ngaite, which were initially zoned as livestock keeping areas, but later sectioned off for rice and other crop farming when they were found to be fertile and good for farming – thereby reducing the land available for livestock. Animal-crop conflicts were mentioned in relation to these locations.
- The designation of new protected areas, such as a new National Park north-east of Morogoro town which used to be grazing land.
- Grazing is now banned in forests, which were once accessible for grazing but have now been secured and preserved due to their importance to the ecosystem. It should be noted that this was generally viewed as a good thing, in order to protect the forests as water sources (see the discussion on water below).
- By reforestation or other land use changes: examples were given of grazing land now used to grow teak tree and thus no longer accessible to farmers; and the sisal fields along the Dumila-Kilosa road. Farmers used to graze the latter when the sisal factory was operational, but the land is now neglected and the forest is re-establishing leaving only a narrow strip of sisal fields – although some farmers still go there in search of pasture.

Burning was highlighted as an issue that can be both good and bad. ‘Early phase’ burning is allowed in some places, before the vegetation gets too dry and while the fires can burn slowly and are controllable. ‘Late phase’ burning is prohibited, however, because once vegetation has dried out, trees will burn as well as grass and the fires become uncontrollable and destructive. Early burning has been used in national parks to promote fresh growth for the animals, and to prevent larger fires later. Similarly, early fires have been permitted on overgrown grazing lands, to clear

the excess vegetation and promote new growth. However, it was noted that the Nguru wa Ndege were regularly burned in the 'late phase', which has hampered the growth of good grass for animals. These hills contain a 'catchment' forest that is protected for its importance to water retention, where burning is not allowed.³

Pastoralists were concerned about the clearing of whole hillsides by other parties for charcoal production, for example in Kimamba (see map), as they valued the trees for fodder and other uses or functions. However, they felt that they did not have the power or means to prevent it. Biodiversity was also perceived to have reduced. An example was given of a bird that would indicate when the rains were coming. It used to be abundant in the area, but the removal of the trees that provided its key habitat means that it is now rarely seen. Similarly, certain native species of herbs and flowers are known to be high quality animal fodder, but these are now rare and have been replaced by grasses of poorer quality.

³ Two other reasons were given for burning: (i) the traditional belief that if you start a fire and it burns for a long time and over a great distance, you will live a long time; and (ii) the setting of fires while hunting ndezi, a small animal prized for its sweet meat.

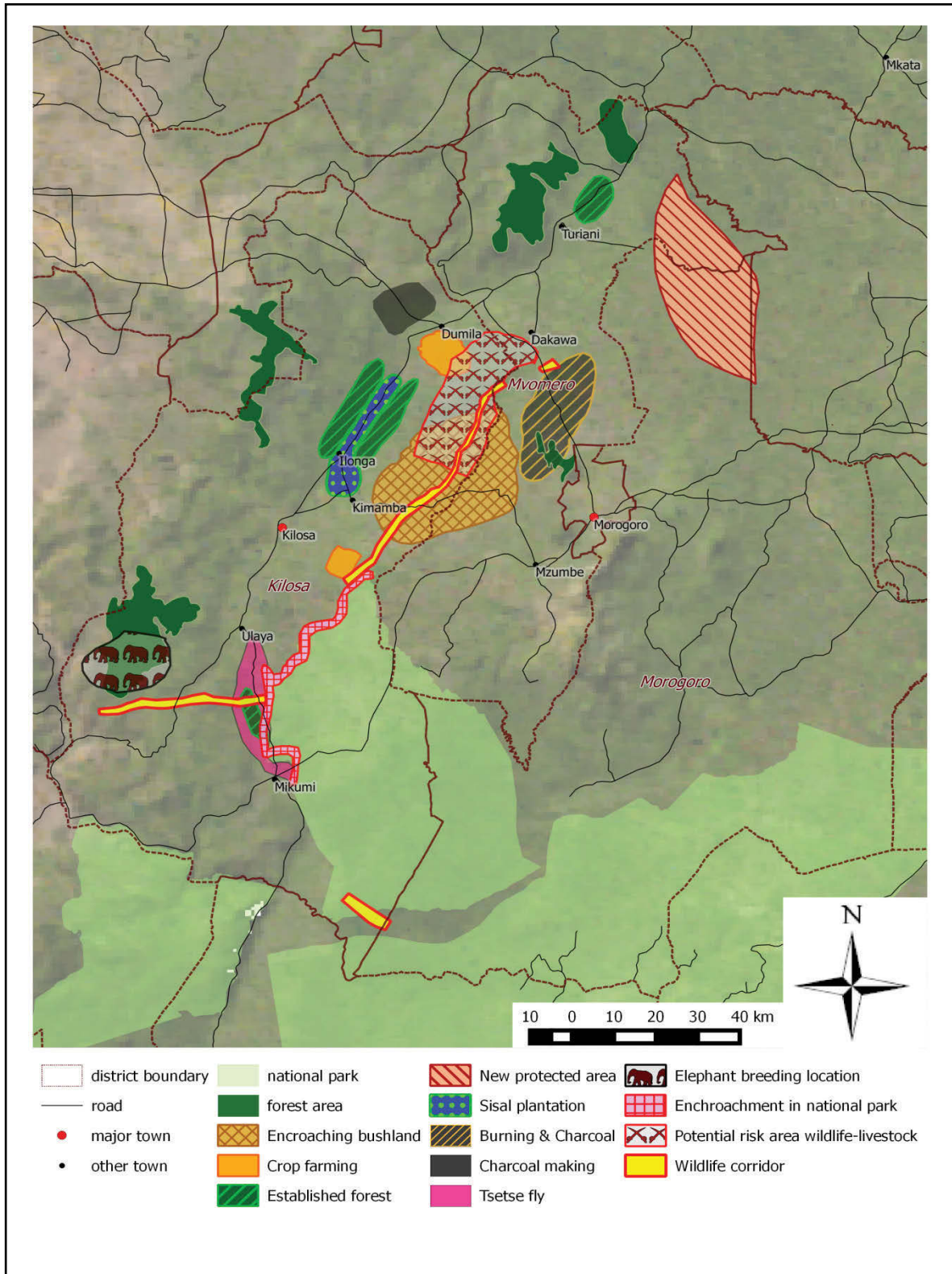


Figure 7: Environmental resources: Vegetation and other issues

Source: expert consultation discussions and PGIS maps, June/July 2014.

2. *Water availability*

Water scarcity was highlighted as a problem in the dry season, which runs from February to June. The major sources of water were categorized as: (i) key rivers in Mvomero (Mjonga from Kibati, and the rivers Divue, Mkindo, Wame, Magore and Mvomero) and Kilosa (the rivers Ruaha, Rwabi, Msimba, Miombo, Wami, Mkondoa, Mduku, Mkata and Mvumi); (ii) dams, dykes and ponds/pools; (iii) boreholes, shallow wells and springs; and (iv) rainwater (see Figure 8).

Three issues concerning water resources were highlighted by the participants:

i) A reduction in the amount of water in rivers has caused *permanent rivers to become seasonal*,⁴ for example, the River Mkata near an area encroached with acacia. Suggested contributory factors were:

- water being abstracted for irrigation by crop farmers settled along several rivers in Handeni and Mvomero, which affects water availability;
- human activity such as farming silting the rivers, for example, the river Magore, near Kitetu;
- climate change, which has reduced rainfall.

ii) *Flooding* was highlighted as a risk in certain areas, and participants linked it to the diversion of rivers. Participants also noted that flooded areas are good for grazing in the *dry season* because no grass can grow there in the rainy season, so no animals can graze there. These areas include: Mabwegere, Mgongoto and Ngaite; as well as Kampara, Lukenge and Kigugu.

iii) Water quality was, in general, judged to be of acceptable or even good standard for animal use, because of natural sedimentation. Quality problems can arise, however, when rivers pass through human settlements – and also where there are mineral mines. Water from wells is generally safe, but this mostly depends on the depth of the well. Rainwater is safe if it is harvested in tanks, but not so safe when stored in pools.

3. *Soil quality*

The area between Sokoine and Dakawa was identified as having good soil fertility. Similarly, the corridor from Turiani to Kilosa and down to Mikumi was considered fertile and to achieve high yields. In these areas, little or no added manure was required in order to maintain fertility.

In some areas, fertilisers and other inputs were known to be used, such as:

- *manure* for vegetable farming, sourced from within farms, from chickens, pigs and goats, and applied immediately on a daily basis. Particularly in the Mgeta, Chenzema and Nyan-dira areas, it was noted that there are very few cattle, so very little cattle manure can be used. In Mbeya and Rukwa farmers do not have access to industrial fertilisers, and only use manure.
- *commercial fertilisers* such as urea are used for cereals (maize, rice and other cash crops). These crops are also sprayed with herbicides (most commonly Rindomil©, although not with beans) and insecticides (such as Celtron© water concentrates).

4 The river now only flows in the rainy season.

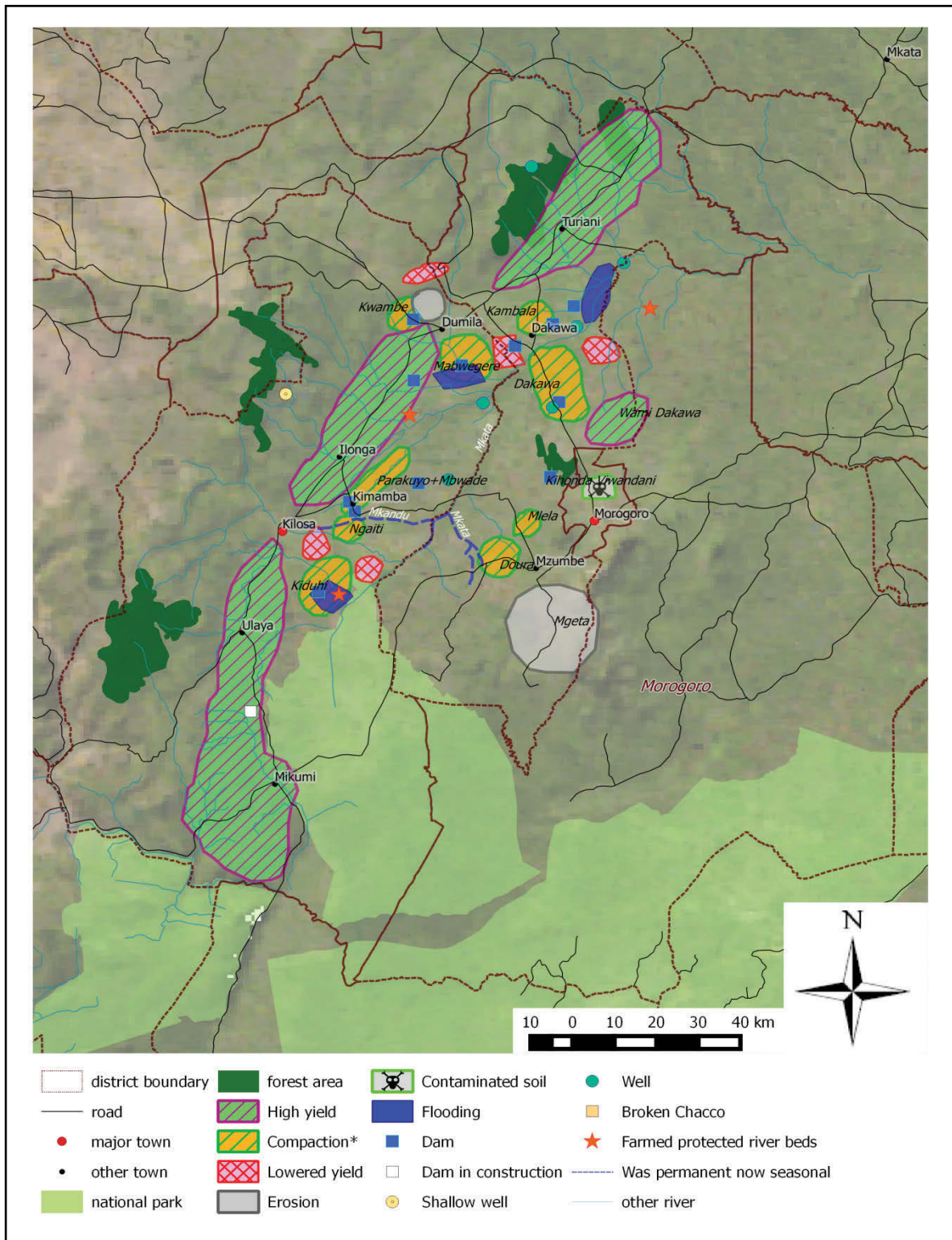


Figure 8: Environmental resources: Water resources and soil condition

Source: expert consultation discussions and PGIS maps, June/July 2014. *Compaction as a result of sharing land between cropping and livestock.

Intercropping, although not strictly allowed, was known to be practiced due to lack of space: typically cowpeas and maize, lima beans and maize or sunflower and maize. However, sunflower was known to negatively affect the yield of one or two of the other crops. It was explained that sunflower takes up all the top-soil nutrients. Therefore, maize should be planted 10 days before

so that by the time sunflower starts taking up the nutrients it needs, the maize can be supported by using added fertiliser.

The use of crop rotation was also noted, in order to maintain soil fertility. In most cases, cereals are rotated with legumes. Leaving land fallow was another technique mentioned, although this is not widely practiced because the amount of arable land available per farmer was said to be so limited that they sometimes even plough up the forests.

Risks to soil quality

Risks such as soil pollution were mostly associated with the industrial pollution from the Kihonda Industrial area in Morogoro Town.

Locations such as Mabwegere, Kambala, Kiduhi, Ngaiti, Parakuyo and Mbwade were identified as practicing both crop and animal farming on the same land due to space constraints. Here, compaction was said to occur and the yields from both crops and animals were compromised.

Soil compaction was also noted in the areas which cattle pass through while grazing, for example the migration routes through Mvomero (Figure 4), and livestock markets (Figure 5). These areas were also said to give low yields.

Soil erosion was identified in some places, linked to either natural causes or human activities. For example, in Kwame charcoal burning has depleted the forest cover, thus exposing the soil cover to erosion. In Nyandira and Mgeta surface soil has been lost from higher areas, where farmers plant on the fertile hill slopes. The erosion is not necessarily widespread over the entire area, but dispersed within the shaded areas.

4. Other issues

Tsetse flies were noted as present all over Kilosa, but particularly problematic in Mfiris (Figure 7).

In the shadow of the national parks, participants noted that both livestock and crop farmers have come into conflict with wildlife and highlighted certain areas of particular tension (Figure 7):

- the migration corridors for elephants between breeding grounds and national parks;
- the borders of the park, where farmers have been known to encroach into the park;
- a dispersal area between Kimamba and Dakawa, where wildlife often come out of the park, to the convergence of the tributaries of the Wami River for water; the large rice irrigation area in Tindiga also attracts wildlife because there is water all year round.

2.4. Scenarios for increasing milk yield

On the second day, the three groups were each given a target to increase milk production and asked to develop scenarios for how to achieve their target. The targets were:

- To maintain yields at a constant level throughout the year
- To increase milk production from 300–1200 litres per month to 1500–2500 litres by 2020
- To increase milk production to the current highest yield in the area and stabilise it at that level all year, by moving from free range to semi-zero grazing

The requirements for the scenarios to be achieved were similar across the three cases discussed, and revolved around: (i) improving feed quality and quantity, to provide more nutrition for higher milk yields and improve feed availability in the dry season; (ii) improving farmers' education

on several issues, such as growing fodder, herd management and animal health; (iii) improving animal breeds for higher productivity; (iv) improving support services and infrastructure; and (v) improving water availability and access. These are described in more detail in Box 1, and illustrated in Figures 9–11.

The locations for these planned scenarios were: Twatwatwa, Parakuyo, Melela, Malolo, Kiduhi, Dakawa, Ngaiti, Mfilisi, Gwade, Mwobeshi, Ngesi, Mabwegere, Kilosa, Tuyali, Kibati and Turi-ani, as well as Kumba Tanga.

Additional issues arising from the scenario discussions

Although the land issue is a sensitive one,⁵ the participants stated that pastoralists would be willing to grow improved pastures, but not on the communal land. Ideally, they would like a small private plot but to still have some communal land for small amounts of grazing. Some pastoralists already plant cow peas, Napier grass and Buffalo grass (*Cenchrus ciliaris*, locally called suguda), and some already add manure and plant improved seed in order to improve their pasture. Participants recalled that there used to be some form of rotational grazing on a large scale; the pastoralists would move far away in the wet season, and leave the areas close to home for the dry season. However, more recently, while the pastoralists were away, crop farmers found the ‘abandoned’ settlements with good land and took them over. The pastoralists would return home in the dry season to find their ‘conserved’ pasture ploughed and converted to farmland. This experience has discouraged them from conserving pasture in this way. Enclosing the land would protect their right to keep it, and also protect against people from outside being given large parcels of land, which disrupts the grazing pattern. Examples were given of paths to water that had been cut off after a large area of land was bought and fenced off.

An interesting concept was developed: *Kuvuna mifugo*, the harvesting of cattle. To tell pastoralists to reduce their cattle numbers is an insult, because keeping animals is their tradition and the more animals a livestock keeper has, the better. It was also noted that for many pastoralists, their cattle are a form of bank. It was suggested that the word ‘*kuvuna*’ (harvest) should be used, as a parallel with crop farming. Farmers harvest when the crops are at their best. Thus, why should pastoralists not ‘harvest’ their animals when they are in their prime?

5 Participants explained that there has often been conflict, sometimes even violent, between crop farmers and livestock keepers. Where the livestock keepers rely on communal land for grazing to meet a significant proportion of their feed requirements, crop farming fairly permanently reduces the amount of land available for livestock to move around freely. Migratory livestock keepers in particular have felt challenged by the difficulty in laying claim to communal land, which may look ‘unused’ when the herds are in a different area for part of the year. Livestock keepers therefore resent the crop farmers for permanently settling on a piece of land which is then difficult to retrieve for grazing, while crop farmers accuse livestock keepers of allowing the livestock into crop fields and eating their crops, causing the loss of a harvest. See, for example, selected studies on the issue, ranging in intensity of conflict (Kajembe et al. 2003; Malley et al. 2008; Benjaminsen et al. 2009).

Box 1: Strategies to increase and stabilise milk production year round

1) Improved feed (Figure 9)

- Promote the growing of more fodder grasses and legumes
- Improve the fodder grown: grow drought-resistant varieties and high-yielding varieties (e.g. Desmodium, blue pea and Mulato grass)
- Supplement feeds with concentrates and supplements (e.g. brans, oil-seed cakes, salt licks, molasses), and use more crop residues (maize stover, wheat chuffs, rice straw)
- Improve feed availability – clear pastures of weeds, preserve feeds for the dry season (hay, residues, silage), irrigate pastures in dry season

2) Improved education on (Figure 10):

- the best feed varieties and ratios, practices
- growing fodder and proper land use practices (e.g. setting land aside for pasture, growing leguminous trees around edges)
- herd management – appropriate cattle numbers ('kuvuna mifugo': harvesting of cattle rather than reducing), and managing calving time so that it coincides with the time of the year when the local breeds produce most milk
- selective breeding and Artificial Insemination (AI); know when a cow is on heat so that AI is done at the right time, and how to administer AI (e.g. the wrong way might scare the cow and reduce the success rate)
- keeping livestock healthy
- agri-business; livestock keeping, especially for dairy, should be viewed as an enterprise

3) Improved breeding (Figure 10)

- improve the breeds – using either selective breeding with superior bulls, particularly specific indigenous bulls that have equal potential to modern breeds, or AI
- promote AI and build new centres to support it

4) Improved services (Figure 10)

- provide new and modify/repair existing extension personnel, medical facilities, AI/breeding centres, cattle dips and dams
- subsidise veterinary services
- increase access to market by providing new milk collection centres and processing units

5) Improved water availability (Figure 11)

- Improve access to water in dry season using boreholes, rainwater harvesting, and so on
- Secure water availability in the dry season, for example, by digging deeper boreholes
- Explore the possibilities of irrigating pasture in conjunction with existing rice irrigation areas
- Increase the harvesting of water, both individually and large scale (by building dams)

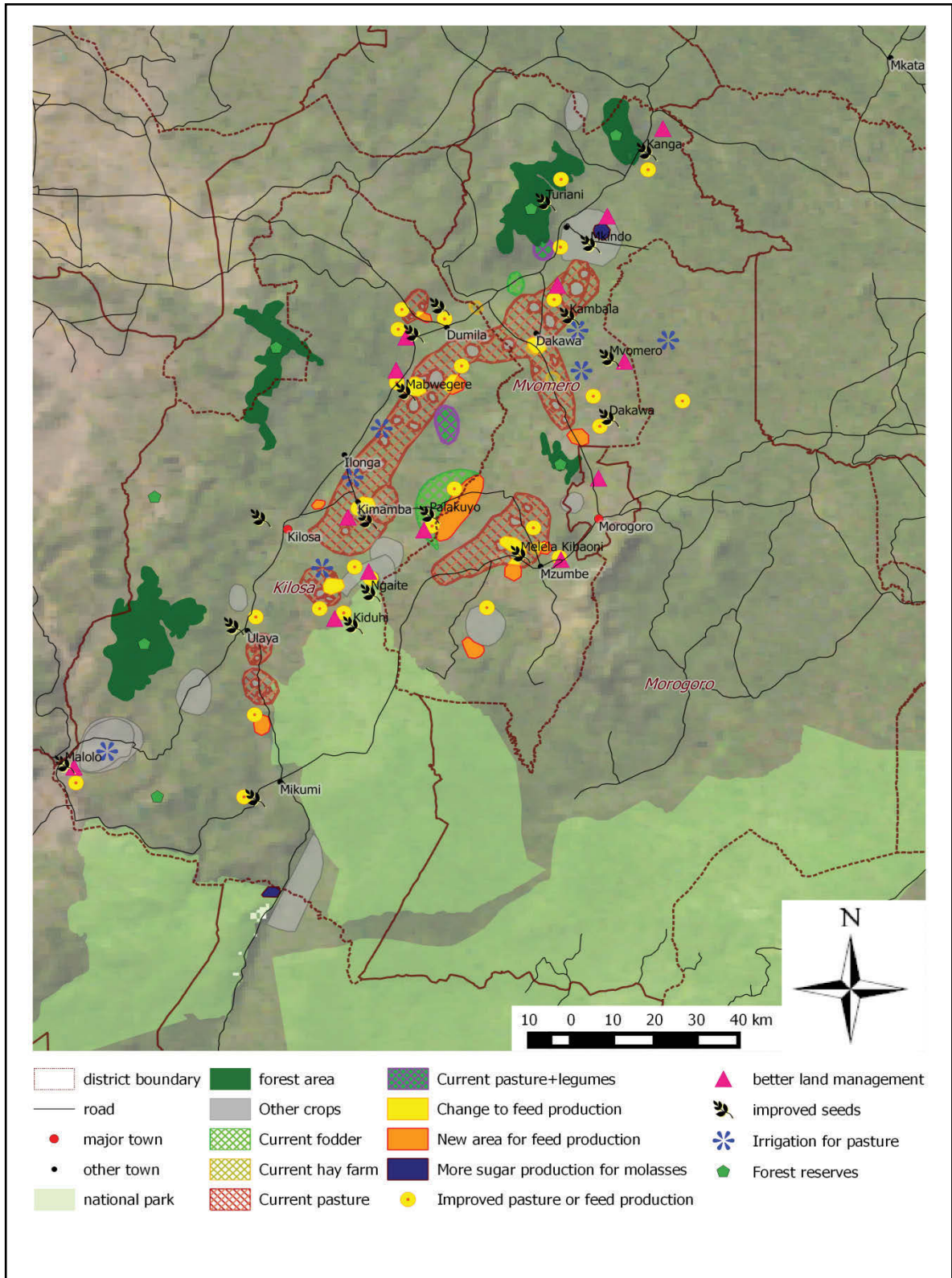


Figure 9: Suggested improvements to feed production

Source: expert consultation discussions and PGIS maps, June/July 2014.

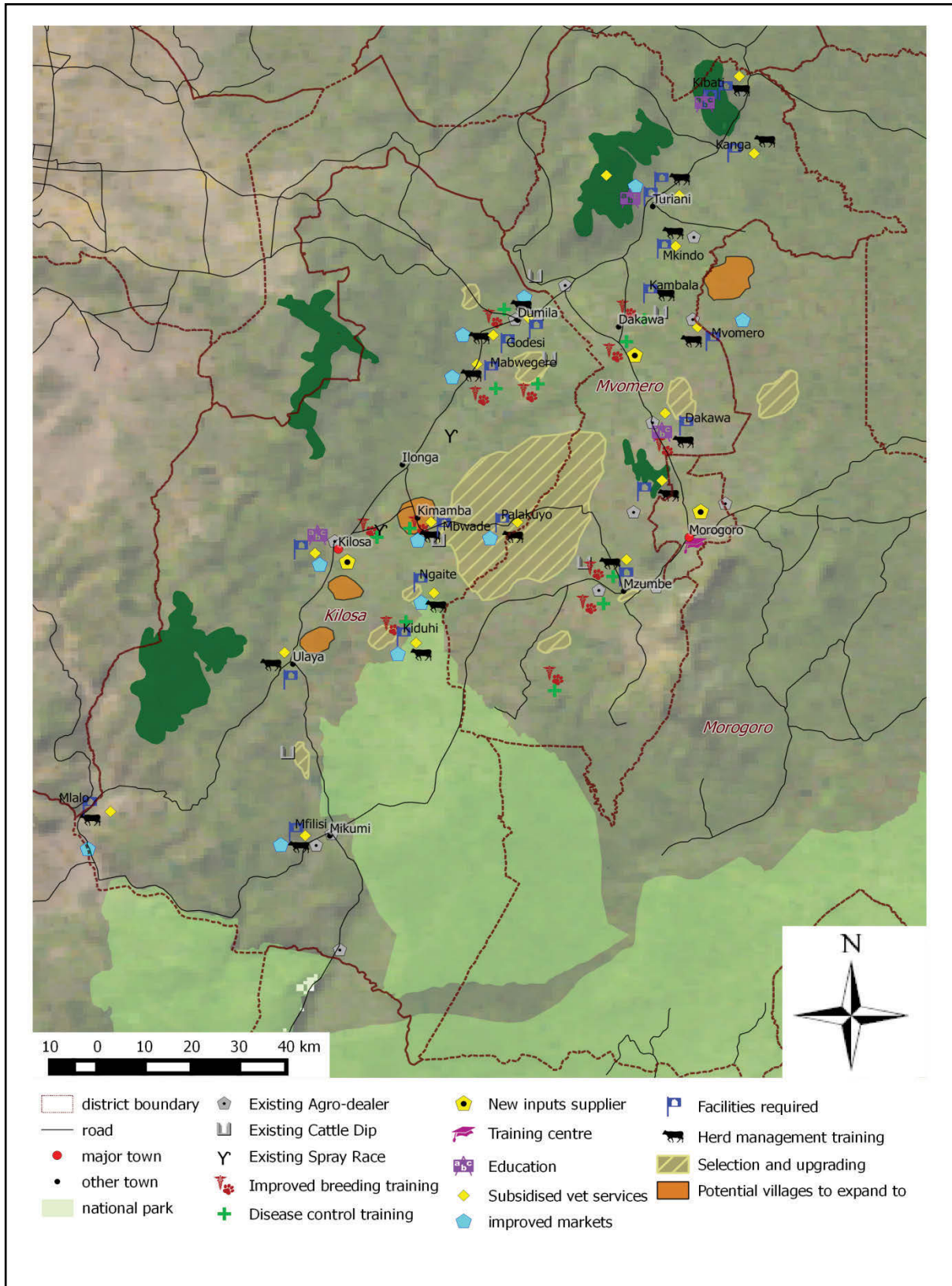


Figure 10: Suggested improvements to support infrastructure and services

Source: expert consultation discussions and PGIS maps, June/July 2014.

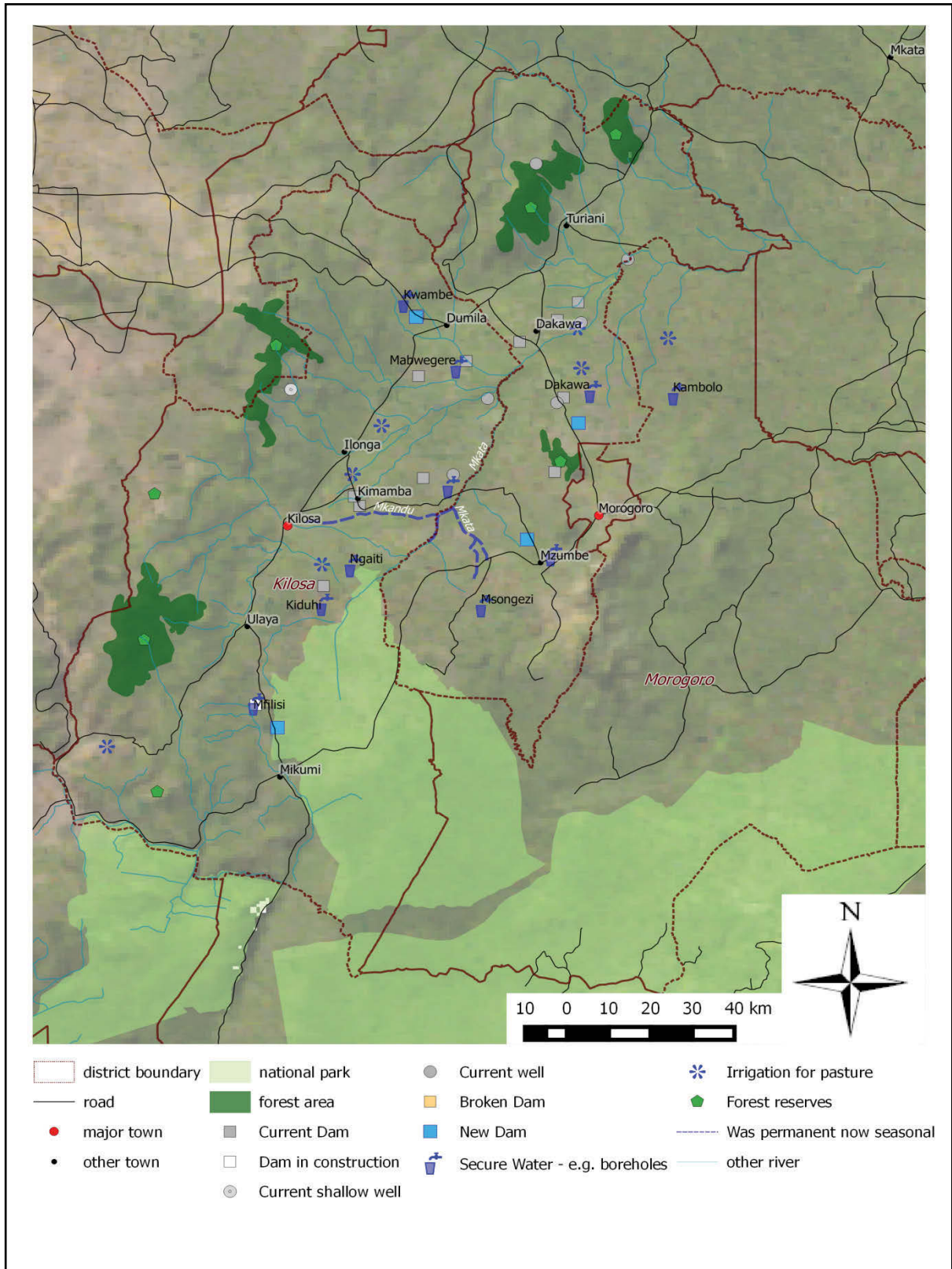


Figure 11: Suggested improvements to water access

Source: expert consultation discussions and PGIS maps, June/July 2014.

3. WORKSHOP 2: A MORE DETAILED LOOK AT THE IMPLICATIONS OF THE SCENARIOS



Participants at Workshop 2: 3 July, Edema Conference Centre, Morogoro, Tanzania

The maps produced in Workshop 1 (see above) were briefly presented at the beginning of the day. Participants discussed the scenarios developed in Workshop 1, and their implications for three aspects of water: protecting water catchments, using groundwater and irrigating pasture. This was followed by a discussion on the implications of expanding fodder production.

3.1 Water access

“Maziwa ni maji” – without water, no milk!

Protecting water catchment areas

A key point drawn out by the participants was that the water catchment areas (typically forests) should be protected (Figure 12). Various water sources were mentioned, including mountains, forests, swamps, wetlands and highlands; and the main areas for potential protection emerged – the Kanga hills, Nguru wa Ndege hill, Mkindo swamp, Mkondoa, Ukaguru and Ngulu mountains. It was noted in particular that Nguru wa Ndege hill was unprotected, but should be protected.

Competing uses

Protection had many different meanings to the participants, and could be achieved in different ways. For example, by banning cropping or regulating water use. In discussing what protection might mean in practice, it emerged that the catchment areas are already used by various stakeholders, including for charcoal production (e.g. on Nguru wa Ndege hill), timber-harvesting (Uluguru and Nguu mountains areas) and mining of yellow gold and green lead (in Kibati, Uluguru

and Nguu mountains⁶), as well as for livestock keeping and crop farming, for example, in the large rice growing area in Mkindo swamp.

Mitigation

Conservation activities and initiatives were mentioned in a few catchment areas, in particular the Ukaguru and Uluguru areas. These included: a sustainable charcoal production project which will later move on to sustainable timber harvesting, initiated by the Tanzania forestry conservation; mining restrictions; educational programmes on deforestation; and programmes on environmentally friendly agriculture by the government and the community. There were also some projects on conservation and sustainable harvesting run by Care International.

Condition of the resources

Where known, the status of the catchment areas was rated as good, moderate or bad. In some areas, it was noted that severe degradation is visibly identifiable, for example where charcoal production has cleared all vegetation, leaving the mountain bare. High pressure for land was noted in the rice growing areas, for example around Tindiga, creating competition between rice growing and livestock rearing, and conflicts had often been reported. Examples were noted of areas with less pressure, where pastoralists tend to move from the mountains to the wetlands in search of pasture. Nguru wa Ndege hill was said to be no longer experiencing any pressure as it was already completely degraded and in need of restoration.

⁶ It was noted that there were immigrants from Sukuma land in these areas, who practiced both farming and grazing.

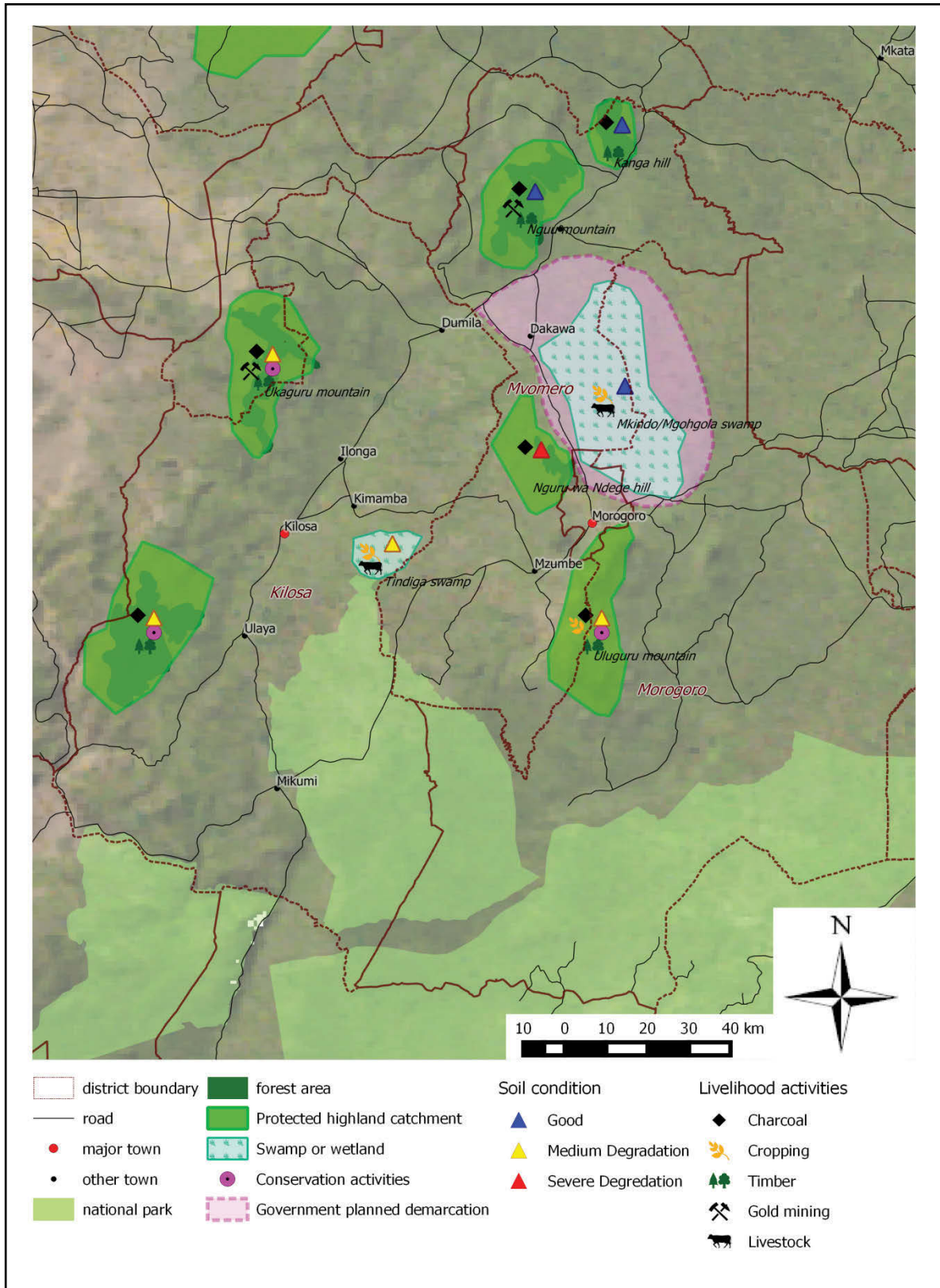


Figure 12: Water catchment areas to be protected, competing users and resource condition

Source: expert consultation discussions and PGIS maps, June/July 2014.

Challenges to mitigation and protection

No alternatives to using charcoal as fuel were identified. Hydropower is the main power source in Tanzania, but participants agreed that its price is too high for most people in the area to afford.⁷ Despite the fact that deforestation linked to charcoal production is illegal, even senior officials were said to have been seen carrying charcoal on the roof of their cars. This highlights the issue of deforestation as a result of an unwillingness to enforce the law on charcoal production.

Some alternative energy sources are being trialled. These include: biogas from manure in Jombe and Iringa (Sokoine University of Agriculture, SUA); the use of goat manure in Mgeta, even though goats produce very little manure; solar cooking; and attempts to make charcoal from recycled paper, although this was found to burn too quickly. A company designing biogas cookers in Arusha was mentioned, but biogas was said to present challenges for pastoralists as it requires water to operate well, and water is a major problem.

Risks

Flooding was mentioned as a common major risk as far as water conservation was concerned. Participants referred to a bridge that had been washed away in Tetu.

Using groundwater

Participants agreed that the use of groundwater was becoming more common, but that this depended on the depth at which it was found. This varies a lot, making it difficult to identify large areas with the same supply. Some examples were given. In Dodoma, where the water table level is high, municipal water is supplied from 11 deep wells at high pressure, although participants noted that only two were currently in use. Kagulu has plenty of ground water compared to other areas. There was a permanent well water source on the way to Dumila, created accidentally by road contractors. Wami Dakawa has groundwater at a shallow depth, and the Shamba Kubwa farm near Wami Sokoine has an 80 m borehole. In areas suitable for rice growing/ paddy farming the water table was noted to be high. It was suggested that the Matala area needs a borehole as there is a lot of livestock there, and that the Makuyu area was the livestock entry point.

Using irrigation water for pastures

This scenario suggestion sparked a debate: What would be the source of the water? How would diversion be managed? What would be the management practice for the application of herbicides, pesticides and fertilizer in rice growing areas? Would water be allowed to evaporate from the pasture before harvesting, or would it just be released into the environment? Existing irrigation schemes may already be using the water all year round. In Kilombero, for example, farmers follow the rice harvest with peas.

Rice paddies had earlier been identified and located on the map (Figure 6, Figure 13). Most irrigation schemes were said to be diverting water from rivers to the fields and then back to the rivers again.

Challenges identified

Participants highlighted the fact that irrigation schemes belong to the government, community groups or donor-funded projects, which all have their own objectives. They also stated that the rivers in the Rufiji river basin have laws prohibiting cultivation within 60 metres of the river banks. Conflicts have occurred when farmers divert water to their crop fields, leading to the de-

⁷ The level of household access to electricity was not discussed but, according to World Bank statistics for the whole of Tanzania, only 3.7% of the rural population had access to electricity in 2010 (World Bank, 2010).

marcation of farmers' and pastoralists' areas. Pastoralists would not therefore be allowed to move closer to farmers' land.

Furthermore, pasture is not a common crop in Tanzania, and approximately 90 per cent of pastoralists do not manage the pastures. The pastoralists assume that the pastures will always be there, so they have no need to grow any pasture. As livestock keepers have no ownership of land, but instead use communal land, convincing donors to run projects with them is difficult. However, it was also thought likely to be difficult to persuade the livestock keeping communities, especially the Maasai and Sukuma communities, about land demarcation and adapting to intensive cattle keeping.

Mitigation options suggested

- Livestock farmers to be given their own land, and help to understand that the overuse of grazing land is a problem as well as how to improve pastures and use them sustainably. To achieve this, they would have to remain in certain areas permanently. Farmers' groups or cooperatives should always be involved, in order to increase the chance of adoption. It was agreed that on-farm trials, showing real cases and learning from farmers' farms would be the best approach. In Mvomero, the government, through the Ministry of Land and Settlement, had set up an initiative that demarcated 100 acres of land each to about 50 farmers as a pilot in land use planning (Figure 12). Its main aim was to improve pasture by discouraging communal grazing, by addressing the barrier of lack of ownership.
- Pastoralists could use water first to irrigate their pastures before diverting it for crop growing. This would decrease the need to enter the rice fields at times of drought in search of pasture and water. Diverting water to pasture before it is channelled to the fields would also avoid contamination with fertilizers and other chemicals, which can harm livestock. This could become a multipurpose water source, as it could have a feeding canal for washing clothes and to provide drinking water for livestock.

3.2 Expanding fodder production

Existing livestock feed production

Participants identified hay and pasture cultivation in a small number of locations, most notably involving farms producing hay as a business to sell to livestock keepers. There is a large demonstration project run by SUA and the Livestock Research Centre in Masini, which seeks to encourage farmers to produce for livestock keepers. In Kambala, a farmer makes hay from rice husks. Participants found that farmers were not planting much Napier grass, and that the farmers seemed to be unaware of its importance.

Crop residues from food crops such as sorghum, maize and rice are used in Tindiga, Wami ranch, Dibamba and Pemba (Figure 13). For example, after the rice harvest in Tindiga, livestock are allowed on to the fields to graze the residues. It was noted that farmers practiced both crop farming and livestock keeping together in Mbwade and Kimambila.

Proposed feed production

Areas were identified where intensive pasture production could be introduced: Wami Sokoine ranch, Mkata ranch, Mela, Twatwatwa, Msongozi and Dibamba. However, it was noted that potential fodder-growing areas were currently being used as grassland and crop land. It was also mentioned that farmers growing tomatoes (in rotation with rice) were being encouraged to plant grasses or pasture at the edges of their farms in order to reduce or control wind damage.

Legumes were discussed as a multi-purpose improvement for several reasons: to introduce protein fodder, which is good for livestock; to improve soil fertility when grown in rotation with crops or together with pasture; and to improve soil moisture conservation/retention. Areas where legumes could be grown were identified as Dibamba, Wami Sokoine, Kimambila and Pemba – any maize and rice-growing areas. Kiduhi would have the potential to grow grass-legume mixed pastures. Some legumes are particularly water-use efficient. Cowpeas were identified as able to survive in dry areas.

Many fodders, such as *Sesbania* and Lucerne, among others, were mentioned as suitable for improved pastures, even though they belong to different ecological zones. Extension officers would need to offer the right advice. It was noted that there is a government pasture seeds' multiplication centre in Mkuge, and other seed farms like Mabuki, Mkwapa, Gikuge and Kogwe have emerged. Participants had encountered a shortage of good quality seeds. A few farms had tried to propagate seeds, but they did not grow – possibly because they were from different ecological zones, or due to seed quality, storage, harvesting method or maturing and planting issues.

Likelihood of adoption

However, in terms of adoption, participants estimated only about 10 per cent of farmers would take up improved fodder production. It was highlighted that farmers grow crops that have a market and a value, such as tomatoes and peas. The demand, and therefore the market, for improved fodder, hay and legumes would only develop if farmers with a small number of livestock were to start rearing their cattle specifically for dairy and meat, that is, as a business. Fodder sales, which were not common at the time of the workshop, would have to be economically comparable to other alternatives. For comparison, the average price for vegetables ranged between Tsh 500 and Tsh 1000 per kg. It was noted that high-pressure areas would be the most appropriate to introduce on-farm legume/fodder trials, as pastoralists were working in stressed conditions and would be eager to see the performance of legumes/fodder before adopting them.

On crop management, crop rotation was identified in rice-growing areas, rotating rice with horticulture crops such as tomatoes, eggplant (aubergine), cabbage and hot pepper. Similarly, fertilisers were used more commonly on horticultural crops, where investments would provide higher returns, rather than on staple food crops such as maize and beans. Vegetable farming was ranked as a cash crop in these areas.

Pasture as a buffer to the National Park

There was a lot of debate about the potential for planting pasture along a buffer zone on the eastern edge of the Mikumi National Park, based on experience in Doma where farmers were planting pasture which is not attractive to wildlife, surrounded by crops such as hot pepper that scare and keep away elephants. The use of buffer zones was suggested because farmers tend to crop some distance from the protected land, in order to minimise destruction of crops by wildlife.⁸ However, it was concluded that there are no livestock in that area, and thus no market for the hay produced, so there would be no reason to grow pasture there.

⁸ Farmers are not allowed to plant too close to the edge, and will not be compensated for any loss if they are within 500m of the boundary.

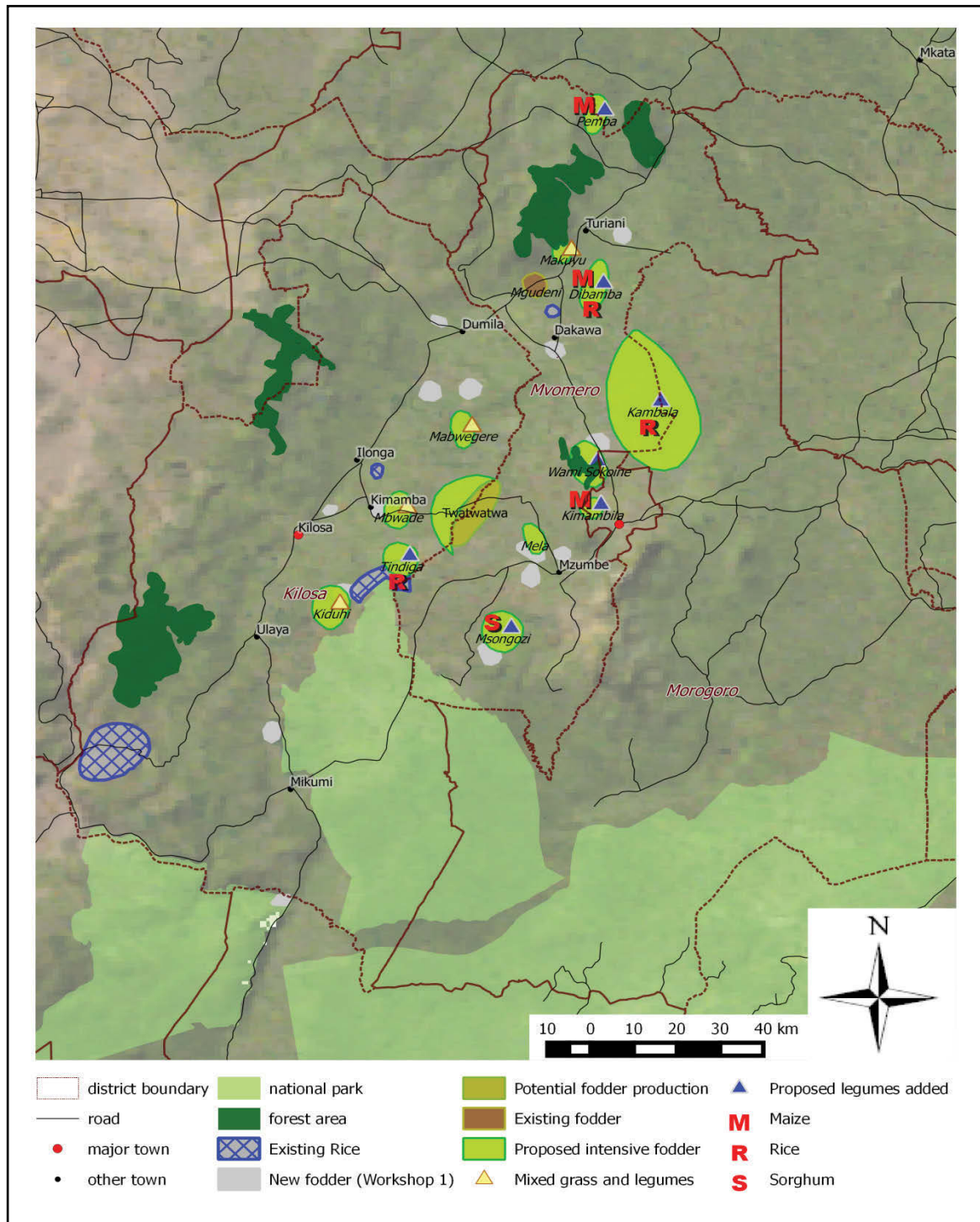


Figure 13: Opportunities for expanding fodder production

Source: expert consultation discussions and PGIS maps, June/July 2014.

4. PARTICIPANTS' REFLECTIONS

To conclude the day, participants reflected briefly on two questions about the future of dairy production in Mvomero and Kilosa, in the light of the discussions in the workshop. Everyone placed themselves along a line across the room, representing where they thought the answer to each question would lie, on a scale of low-to-high/bad-to-good.

1) *Would the improvements discussed to fodder production and water management be put in place?*



Figure 14: Approximate location on the continuum of individual responses to the question: Would these scenario activities be put in place?

(positions not recorded on the day)

Everyone had a chance to briefly elaborate on their positions:

- There would be obstacles as farmers would not adopt straight away, and changing the behaviour of pastoralists would be the major challenge
- Some participants did not think the changes in management would happen
- It would work as it was always good to stretch higher
- It would not work right away as there was not enough feed, but it would work given enough time
- Areas with mountains, timber and charcoal faced high levels of competition

2) *If the improvements were put in place, would there be an impact on the environment? Would it be good or bad?*

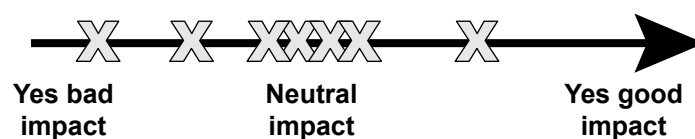


Figure 15: Approximate location on the continuum of individual responses to the question: Would there be an associated impact on the environment?

(positions not recorded on the day)

- Participants were not sure as there were so many issues to factor in.
- Farmers were not always receptive where adapting to new technologies was concerned, for instance, in the case of artificial insemination, proper selection from indigenous native breeds which could adapt to current climate change was preferred to importing new breeds.

- Growing fodder would reduce the need for both humans and livestock to walk long distances in search of pasture, thereby controlling animal movements and pasture/crop land conflicts among communities.
- Educating farmers about pasture/fodder, and how to improve their herd by switching from zebu to boran would automatically result in reduced livestock numbers. This would be assisted by government restrictions on animal movements.
- In the Kilosa area, where conflicts occur between pastoralists and farmers over land use, marginalized land that is no good for crops and also far from water sources has been set aside and allocated to pastoralists. Nonetheless, farmers continue to identify fertile areas to cultivate and pastoralists still roam everywhere during droughts looking for grass, even if it is on crop land.

Other observations:

- Education needs to be provided for everyone, as it is the major need; training on sustainability is required for users and actors.
- Any research or survey must have a continuing impact and share its results, while working to rectify problems. Farmers are starting to feel that there is too much research, much of which does not lead to any change, which in turn provides no incentive for them to change.
- Farmers know a lot and have their own way of doing things, hence the need to involve them in any trials or in introducing new ideas.
- Cattle numbers are important to pastoralists as 'It is the only bank they know'.
- When crop farmers increase their production they receive praise from the government, but when livestock farmers increase their herds they are told to reduce them.

5. CONCLUSIONS

The dairy production systems, infrastructure and environmental baseline in Kilosa, Mvomero and Morogoro districts were mapped and discussed in two workshops, using a participatory GIS process. The primary aims of undertaking these activities were to identify the environmental impacts of the changes required to increase milk yields, and to contribute context-specific data to the proof-of-concept *ex-ante* environmental assessment framework, CLEANED-VCs. The secondary aims of conducting this mapping exercise were to provide an opportunity for dairy industry proponents to think through the industry's needs into the future, and to provide resources that can be built on and communicated with. The results of this report relate to the data collected that can be used for these purposes.

The process also ascertained what changes across the districts would need to be put in place in order to realise the ambition of Maziwa Zaidi – to reduce poverty and vulnerability among dairy-dependent livelihoods in selected rural areas in Tanzania, by enabling rural dairy farmers to secure more income through enhanced access to demand-led dairy market business services and viable organizational options.

Dairy production systems and dairy-related infrastructure were mapped across the Kilosa, Mvomero and Morogoro districts. This included a number of intensive and semi-intensive farms as well as the locations of milk collection centres, cattle dips and livestock markets.

The feed resources that these dairy producers rely on were also mapped, consisting of pastures, various crop residues and legumes. Sunflower cake and molasses were widely available in the area due to the existence of an active processing industry.

Interactions with environmental resources in the area were quite complex. There were areas of direct interaction for livestock keepers, including soil compaction, erosion, conflict with wildlife and the sedimentation of waterways. External interactions were also transforming the landscape and exacerbating livestock impacts, most notably charcoal making.

Workshop participants assessed the scenario of increasing milk yields from 1–2 litres per day to 5–8 litres per day in extensive systems, and from 4–8 litres per day to 10–15 litres per day in more intensive systems. Working through the scenario, water and feed resources were highlighted, along with many interventions that would be required to educate and service the industry, including on herd management and breeding, improved fodder production and conservation, and strengthening the extension support and dairy marketing chains.

Further exploration of the implications of the scenarios highlighted that protecting the water catchments would be an important step in securing water access for livestock, but that these catchments are already used by one or more stakeholders, so protection will require a process of negotiation among all stakeholders. In addition, there are opportunities for improving pasture and fodder production, often in areas already used for crop farming. Options for integrating livestock production into crop farming systems included planting buffer strips of forage grasses or legumes around fields, or incorporating pasture into the crop rotation. However, an essential requirement would be to establish a market for fodder (e.g. hay).

Overall, the overview of smallholder dairy livestock keeping, fodder production and environmental context built during the workshops suggests that the smallholder dairy industry is still in an early stage of development, and that the impact on the environment that can be directly attributed to dairy production is not yet a cause for concern locally. The discussions on scenarios for dairy sector development suggest that much of the increase in milk yield could be brought about through education on how to improve production efficiency by using the existing resources more effectively, rather than by using more resources.

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APPENDIX

Agenda: Workshop 1

Agenda Day 1: Morogoro, 30 June 2014	
09:00–09:30	Registration and Introduction
09:30–10:30	Discussion and mapping: Gr 1 & 2: Feed sources and production Gr 3 & 2: Dairy production distribution
10:30–10:45	–TEA–
10:45–12:30	Discussion and mapping: Gr 1 & 2: Feed sources and production Gr 3 & 2: Dairy production distribution
12:30–13:00	Plenary discussion
13:00–13:50	–LUNCH–
13:50–14:00	Recap and energiser
14:00–15:00	Discussion and mapping: Environmental resources
15:00–16:00	Plenary discussion
16:00–16:15	–TEA–
16:15–16:30	Wrap up
Agenda Day 2: Morogoro, 1 July 2014	
09:00–09:30	Arrival and welcome
09:30–10:30	Introduction, re-cap of Day 1; Introduction to scenarios
10:30–11:00	–TEA–
11:00–13:00	Discuss, develop scenario (in groups)
13:00–13:50	–LUNCH–
13:50–14:00	Recap and energiser
14:00–15:00	Plenary session
15:00–15:30	Wrap up

Agenda: Workshop 2

Agenda: Morogoro, 3 July 2014	
09:00–09:30	Arrival and welcome
09:30–10:30	Introduction, Overview of results from Workshop 1 – Dairy livestock systems, feed production systems, environmental resources, scenarios of development
10:30–11:00	–TEA–
11:00–13:00	Discussion: key impact 1* (Protecting the water catchments)
13:00–13:50	–LUNCH–
13:50–14:00	Recap and energiser
14:00–15:00	Discussion: key impact 2* (Expanding fodder production)
15:00–15:30	Wrap up

* The topics for discussion were guided by which impacts the participants saw as most important.

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