IRC

Water Master Plan
Kalemgorok and Katilu sub-locations Turkana

Kenya Arid Lands Disaster Risk Reduction (KALDRR-WASH) program

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Supporting water sanitation
and hygiene services for life

World Vision

Millennium Water Alliance

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Acronyms and abreviations

AfDB	African Development Bank
CG	County Government
FBO	Faith-Based Organisation
FGD	Focus Group Discussion
FH	Food for the Hungry
GoK	Government of Kenya
HH	Household
IP	Implementing Partners
KALDRR	Kenya Arid Land Disaster Risk Reduction
KALR	Kenya Arid Land Region
KWS	Kenya Wildlife Service
LU	Livestock Unit
MUS	Multiple Use water Services
MWA	Millennium WASH Alliance
MWI	Ministry of Water and Irrigation
NGO	Non-Governmental Organisation
O&M	Operation and Maintenance
RIDA	Resources – Infrastructures – Demand - Access
WASH	Water Sanitation Hygiene
WC	Water Committee
WMP	Water Master Plan
WRMA	Water Resource Management Authority
WRUA	Water Resource User Association
WUA	Water User Association
WVI	World Vision International
3R	Recharge Retention Re-use

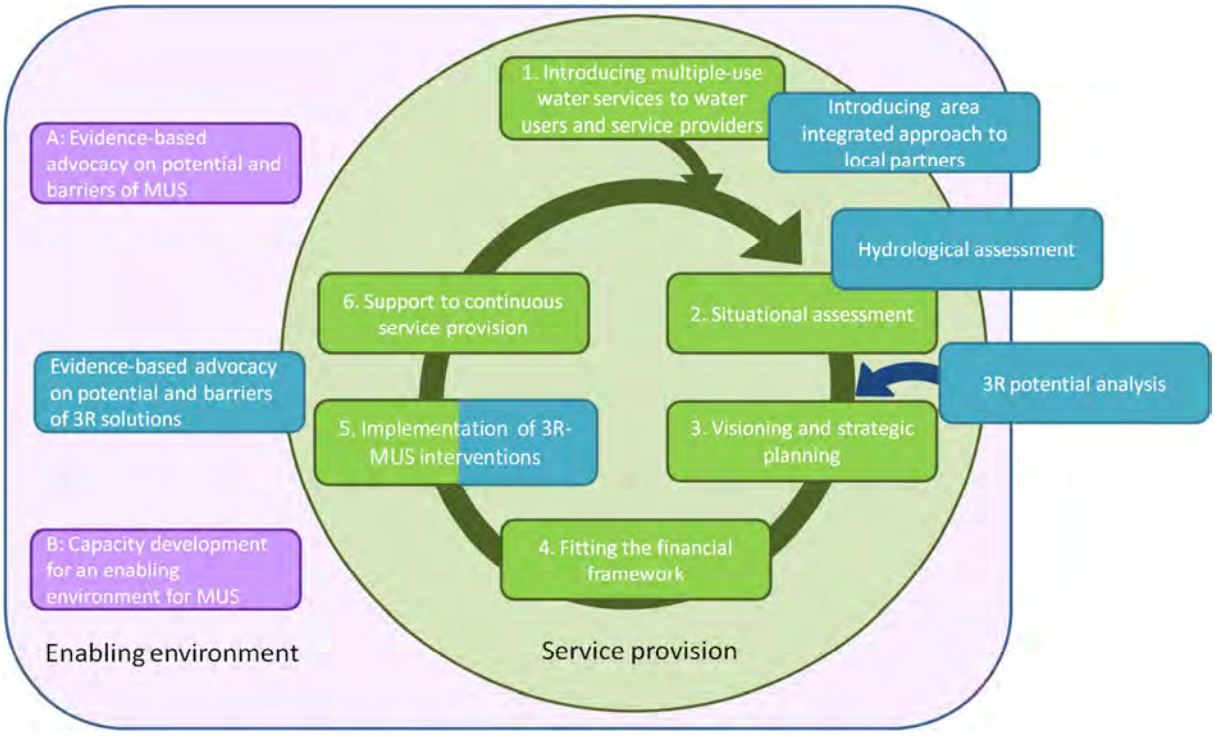
1 Introduction

1.1 Background

This report illustrates the third step of the 2-years KALDRR-WASH programme (2013-2014) of the Millennium Water Alliance (MWA), which aims at conducting water master plans in four pilot areas in the Kenya Arid Lands Regions (KALR), in partnership with MWA local implementing partners (IP)[1]. The final objective of the programme is to improve resilience of the communities to recurrent drought events by improving the overall management of water supply and use of water resources in the pilot areas.

The figure below (a combination of MUS guidelines[2] and the 3R approach) summarizes the steps of the process; the KALDR-WASH programme focus till present has been on steps 1, 2 (situational assessment) and 3 (visioning and strategic planning through the setting-up of a Water Master Plan).

Figure 1: Process cycle for the water master planning in the KALDRR-WASH pilot areas



Source: Acacia, IRC, 2013

The situational assessment for Turkana was conducted in June 2013 in targeted sub-locations by IRC and Acacia Water. This assessment methodology was based upon the RIDA framework (Resources – Infrastructures – Demand – Access) and included presentation of the MUS (Multiple Use of water Services) and 3R (Recharge, Retention, Re-use) principles to the IPs, field

[1] The implementing partners are FH (Food for the Hungry) in Marsabit, CRS (Catholic Relief Service) in Wajir, World Vision in Turkana and CARE in Moyale.
[2] Adank (2012). Guidelines for Planning and Providing Multiple-Use Water Services, Adank et al., MUSGROUP, IRC and IWMI, 2012.

visits to the communities, analysis of the multiple use of water and an in-depth hydrological analysis of the area using the 3R approach. Field visits where followed by a one-day stakeholder meeting to work on a vision for the area (full report of the situational assessment available on IRC website[3]).

A Water Master Plan workshop, organised in March 2014 by World Vision (WV) and IRC, brought together 43 participants representing at least 12 groups of stakeholders. These include community and local government representatives as well as civil society organizations active in the area. **Annex 1** presents the full list of participants. Based on the workshop discussions, IRC and WV have drafted the Water Master Plan for endorsement and implementation by Turkana stakeholders.

The Kalemgorok and Katilu Water Master Plan is an important milestone in the planning process for sustainable water management in the area. The KALDRR-WASH program will support the stakeholders in 2014 to start implementation of (elements of) the water master plan by developing (1) a financing strategy and (2) an implementation plan for 2014.

1.2 Purpose of the Water Master Plan (WMP)

The purpose of a local WMP is to achieve an effective, equitable and efficient use of water at the local level that will build resilience of the population against droughts.

The goal is to delegate planning and management to the local level, to ensure that water resources are used rationally and shared equitably and fairly among the communities in a sustainable way considering all different needs.

During the workshop the following objectives of the WMP were discussed:

- Plan and guide implementation of water related infrastructure and water services for all types of water uses.
- Address priorities for potential water related activities.
- Achieve long-term investment and develop projects in the water sector.
- Promote conservation of water and natural resources.

It is recognized that the water planning process for the Kalemgorok and Katilu areas need to link up with the on-going decentralization processes and contribute to overall rural development in the area.

1.3 Water Master Plan workshop objectives and methodology

The WMP workshop, which took place in March 2014 in Lodwar, had five main objectives:

1. Bring stakeholders together in a planning forum to enable a joint search for solutions to the water gap in Kalemgorok and Katilu areas, including agreeing assumptions for arriving at conclusions.
2. Agree to develop and implement a Water Master Plan for the Kalemgorok and Katilu area.

[3] "Towards a better balance between water demand and supply: The Local Water Resource and Service Management approach applied to the pilot area of Kalemgorok-Katilu in Turkana"(ACACIA, IRC, 2013), http://www.ircwash.org/resources/towards-better-balance-between-water-demand-and-supply.

3. Identify and agree on the strategic building blocks for the water master plan for the Kalemgorok and Katilu area.
4. Enable stakeholders understand and own the water balance analysis.
5. Agree on planning for actions based on the water master plan for the Kalemgorok and Katilu area.

The workshop consisted mostly of plenary sessions and one working group session. Plenary sessions enabled participants to have a shared understanding of the issues under discussions in order to reach common agreements and conclusions. This was important especially for community members who could only participate actively through interpretation of discussions. Working group sessions enabled participants, working in small groups, to focus on key issues of governance, water service management and capacity building with a view to identifying challenges and suggesting areas of improvement. Working group findings were presented and discussed in plenary.

2 Description and problem analysis of the Kalemgorok and the Katilu area

2.1 Turkana County

This zone lies under a hot climate and a bimodal, erratic and unreliable rainfall. The short rains (April-July) and the long rain season (October-November) average 300mm-400mm of rainfall yearly. The rain falls in brief, violent storms resulting in floods. The surface runoff and potential evaporation rates are high.

As in other counties of the Kenya Arid Land region (KALR), the majority of the inhabitants (95%) are nomads, while 3% are internally displaced persons and 2% fully settled (see full report on FEWS.NET[4] website), the households mainly engage in livestock husbandry, trade, hunting and gathering for food and cash income. The overall pastoralist population can be broken down into the following wealth groups:

Table 1: Wealth groups of pastoralist population in Northern Kenya

	Rich	Middle	Poor	Very poor	Sedentary
% of population	10-20	25-40	30-40	5-25	<5
Shoats/HH	80-15	50-80	25-40	15-25	8-15
Camels/HH	10-20	1-5	0-1	0	0
Cattle/HH	50-100	0-10	0	0	0

Source: FEWS.NET website

For pastoralists, most of the food commodities consumed by the households are sourced from the markets. The most common food purchased is maize. Livestock and livestock products are the main source of income for the better off. The middle and poorer households sell bush products (charcoal, poles, etc.) and rely on social support for income.

On the other hand, communities along the Turkwell river have a different lifestyle: about half of the inhabitants are fully settled, 40% are nomadic and 10% migrant labourers. The majority of

[4] http://www.fews.net/sites/default/files/documents/reports/KE_livelihood_profiles.pdf.

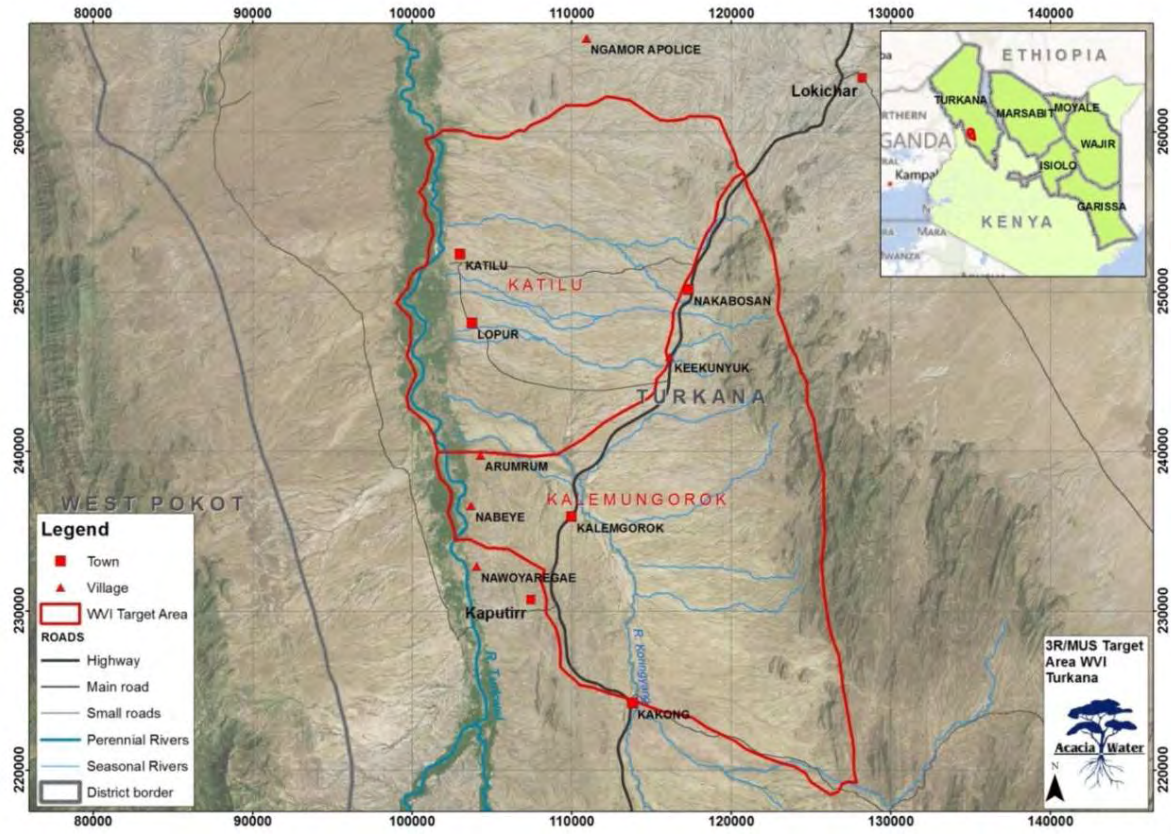
the inhabitants engage in food crop production, livestock production and firewood collection and/or charcoal production for income. Households consume their own produce including sorghum, maize, vegetables and dairy products. Crops are cultivated under rain-fed and irrigated conditions during both rainy seasons. However, local production is not adequate for all year consumption and households have to rely on markets for food purchases which are poorly distributed and often difficult to access. Food crop production contributes to up to 40% of household income, while livestock production contributes about 25%, followed by firewood collection/charcoal production, small businesses and other self-employment activities.

According to a report of the Social Analysis Study undertaken by the Arid Lands Resource Management Project in Kenya in 2004, migration in search of water and pasture is the first coping strategy among pastoralist communities in northern Kenya. In case of extreme drought conditions, the people turn to slaughtering their animals in order to preserve the meat; milk animals, especially goat, are lent out by the comparatively better off households to the poorer households to enable the latter have at least some milk for the family. There is high insecurity and conflict incidences with neighbouring communities occur frequently: herds are stolen, people killed and essential dry season grazing lands in the north are inaccessible. Other elements such as low education and skill level and dependency culture to NGO and government support are significant elements hampering development activities in the area.

In terms of water access, rain, overland flow, gully flow, seasonal rivers, groundwater and springs are the resources from which water can be harvested and stored; along the Turkwel river, water is available all year long. In Turkana, water is used mainly for livestock and domestic consumption, while it is mainly used for irrigation along the Turkwel river. Within the county, movement of livestock are common between the dry and rainy season, to ensure access to grazing land and provision of sufficient water for the cattle. Agriculture, present at large scale along the Turkwel river, is visible only at small scale (household level) for food crop in other parts of the county.

2.2 Kalemgorok and Katilu sub-locations

Figure 2: Target area: Kalemgorok and Katilu sub-locations



Source: Acacia, 2013

During the 3R/MUS situational assessment conducted in May 2013, the selected area for the local inventory consisted of Kalemgorok and Katily sub-locations in turjana south district (red area on the map). The area is located between Kainuk and Lokichar, along the Turkwel river on the West and the mountain range on the East.

In the framework of the Water Master plan, it was decided to keep the same pilot area. The census 2009 population indicates a total population of 26,217 persons (17,686 for Katilu sub-location and 8,531 for Kalemgorok sub-location); an estimated annual growth rate of 3% and an average household size of 8 people will be assumed for future estimations.
During the workshop, eight clusters were identified (see 4.2.1), spread along the Turkwel river and the highway. Some clusters do not have permanent settlements and are used for livestock mainly.
The list of water points available was entirely reviewed with the stakeholders during the workshop conducted in March 2014, based on the preliminary assessment from June 2013.

Detailed descriptions about water resources, infrastructure, water demand and access for the area can be found in the report 'Towards a better balance between water demand and supply: The Local Water Resource and Service Management approach applied to the pilot area Kalemgorok-Katilu in Turkana (Acacia, IRC, 2013).

3 Vision for 2024 by stakeholders

During the stakeholder meeting held at the end of the situational assessment (June 2013), a map of the 3R/MUS pilot area was drawn, and a plenary discussion held to make a start with a longer term vision for the area.

The visioning discussion provided the first building blocks for a vision and longer-term plan for the area. In summary the visioning contained the following points:

- Safe water shall be accessible in every household.
- Hygiene and cleanliness shall be improved.
- Livestock gets enough water within less than 500 m.
- Forestry coverage shall increase.
- Agriculture improves through increase of agricultural land availability.
- Therefore increase of food security.
- Water is available in larger quantity through larger storage quantity.
- Decrease of water borne disease ratio.

Among the main issues which need attention, the group identified:

- The need to identify water catchment areas.
- Have an active and efficient O&M in place for existing water points.
- Capacity building of community members and leadership of management team.
- Recharge of groundwater to improve water sources.
- Develop water quality analysis.
- Put in place an efficient service delivery charter.
- Increase the latrine coverage to decrease Open Defecation.
- Sensitize the communities on the environment.
- Look at peace-solution with neighbouring communities.
- Plant trees to improve forest coverage.
- Encourage people to reduce size of the livestock.

Detailed feedback on the visioning done by stakeholders during the initial field assessment can be found in the report 'Towards a better balance between water demand and supply: The Local Water Resource and Service Management approach applied to the pilot area Kalemgorok-Katilu in Turkana' (Acacia, IRC, 2013).

4 Water gap analysis

4.1 Definitions and assumptions

The water gap is expressed as the amount of water (m^3) that will be required to provide for all the different types of water uses during a dry period of 10 months. It is assumed therefore that the water storage facilities, like water pans or sub-surface dams, are not replenished by rain water during this period. Deep boreholes that tap from sources much older are calculated to provide water 8 hours/day during the whole dry period.

The water gap for the Kalemgorok-Katilu area has been defined as:

Water gap in 2024 = (Demand in 2024) – (Existing capacity in 2014)

The objective of estimating the water gap for the different water uses is to be able to quantify and qualify interventions in the WMP that will bridge the gap. The following assumptions are made:

- Estimation is for the year 2024.
- Calculation for a typical dry year with a period with no rainfall during 10 months.

It is important to realize that all figures used are broad estimates and may still show considerable variations in reality. However, where possible the figures have been verified by using different sources of information and confirmation by the stakeholders of the area.

Calculations were carried out with the help of a special tool[5] developed for the KALDRR-WASH programme.

All tables presented in this report and related to the calculation of water demand were extracted directly from the calculation tool.

4.2 Calculation of total water gap

4.2.1 Estimated capacity of existing water infrastructure

The following table provides the estimated capacity of all existing water infrastructure in the Kalemgorok-Katilu sub-locations for a 10 months dry period. It is assumed that:

1. Infrastructure that at present is non-functional or partly functional can be brought back to its design capacity.
2. Infrastructure that is functional but not yet handed over to the communities (water pan and borehole under construction or constructed for road work) will be made available for multiple uses in the near future.
3. Water pan effective capacity is equal to half the full capacity (due to evaporation and infiltration).

Most of the yields were estimated by the participants during the workshop and shall be confirmed through further investigations. Water points were clustered according to the population they serve as the total water gap will be calculated per cluster. The current total capacity per cluster is in m^3 for a 10 month dry period.

[5] The tool was developed using Excel and is available upon request with World Vision.

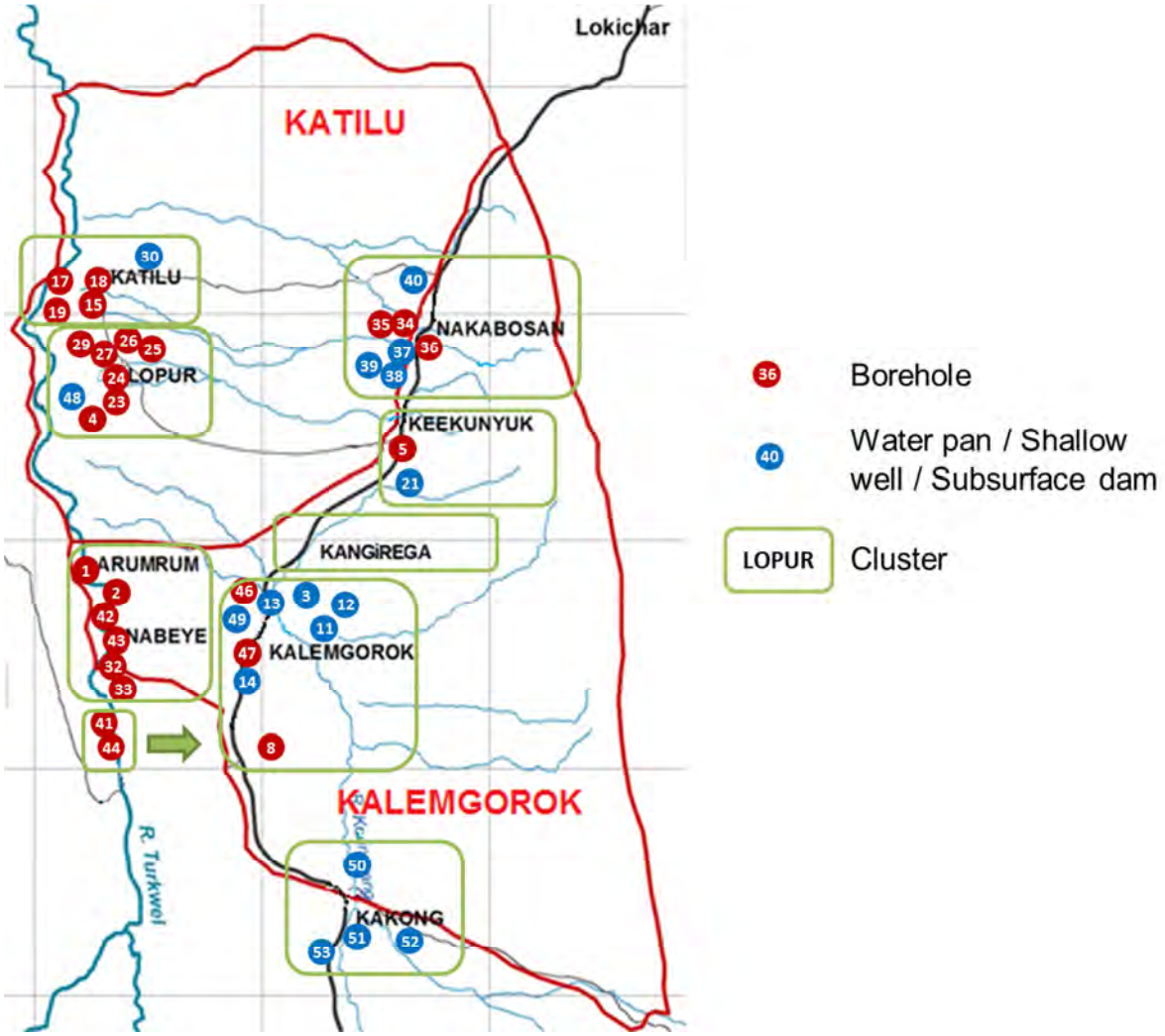
Figure 3: Available water infrastructure in 2014 in the target area

WATER SUPPLY										
Cluster	#	Sub location	Type	Name	Borehole			WP/SW/SSD		CLUSTER TOTAL CAPACITY
					Yield (m3/hr)	Pumping (hrs/d)	Capacity (m3/10 months)	Capacity (m3)	Effective capacity (m3/y)	
Katilu	15	Katilu	BH	Katilu primary	6	6	10,000			26,500
	17	Katilu	BH	Garage			1,000			
	18	Katilu	BH	Baraka			6,000			
	19	Katilu	BH	Limanyang			2,000			
	30	Katilu	WP	Kaloyapar				15,000	7,500	
Lopur	4	Katilu	BH	Nyangaita	6	6	10,000			36,500
	23	Katilu	BH	Bethleem			2,000			
	24	Katilu	BH	Kabel Ekato			2,000			
	25	Katilu	BH	Sukuta			2,000			
	26	Katilu	BH	Munyakao			1,000			
	27	Katilu	BH	Liopur			2,000			
	29	Katilu	BH	Korinyang			10,000			
	48	Katilu	WP	Namibia				15,000	7,500	
Nakabosan	34	Kalemngorok	BH	Nakabosan			2,000			27,000
	35	Kalemngorok	BH	Napusinyan			2,000			
	36	Kalemngorok	BH	Rionomor	8	6	10,000			
	37	Kalemngorok	SSD	Nakabosan					1,000	
	38	Kalemngorok	SSD	Kangichuchuk					1,000	
	39	Kalemngorok	WP	Kangichuchuk				20,000	10,000	
	40	Kalemngorok	SSD	Kaakipom					1,000	
Keekunyuk	5	Kalemngorok	BH	Keekunyuk	6	6	10,000			15,000
	21	Kalemngorok	WP	Kapelo				10,000	5,000	
Kalemngorok	3	Kalemngorok	SSD	Ekoropus					1,000	106,450
	8	Kalemngorok	BH	RCEA			1,200			
	11	Kalemngorok	SW	Apaemuria					250	
	12	Kalemngorok	WP	Kalorio				10,000	5,000	
	13	Kalemngorok	SSD	Kankrega					1,000	
	14	Kalemngorok	SSD	Korinyang					1,000	
	41	Outside	BH	Nawoeyaregae	32	8	70,000			
	44	Outside	BH	Kachumakume			1,000			
	46	Kalemngorok	BH	Etaraja			10,000			
	47	Kalemngorok	BH	Nakilinga			6,000			
	49	Kalemngorok	WP	Lodoupua				20,000	10,000	
Kangirega							0		0	0
Kankongu	50	Kalemngorok	WP	Lodoupua 2				20,000	10,000	40,000
	51	Kakong	WP	Nade				20,000	10,000	
	52	Kakong	WP	Kogito				20,000	10,000	
	53	Kakong	WP	Napitau				20,000	10,000	
Arumrum /Nabeye	1	Kalemngorok	BH	Apalima			2,000			12,000
	2	Kalemngorok	BH	Simailele			2,000			
	32	Kalemngorok	BH	Echoke			2,000			
	33	Kalemngorok	BH	Nabeye			2,000			
	42	Kalemngorok	BH	Namakat 1			2,000			
	43	Kalemngorok	BH	Namakat 2			2,000			

SSD: Sub-surface dam, WP: Water pan, BH: Borehole, SW: Shallow well

See the following figure for the location of water points in the pilot area:

Figure 4: Location of existing water point in the target area



Comment:

Boreholes #41 and #44 are located outside the target area but were identified by the stakeholders as significant future water sources for the population based in Kalemgorok cluster; therefore, the water capacity of these 2 water points was added to Kalemgorok cluster.

4.2.2 Domestic water demand

A preliminary discussion was conducted to agree on the assumptions and hypothesis to consider for population in the coming years:

- Population numbers are based on the 2009 census: 5,531 people for Kalemgorok and 17,686 people for Katilu (which means a total of 23,217 people for the target area).
- Multiple criteria could lead to an increase of population in the coming years: the expected extension of the irrigation scheme along the Turkwel river (supported by the AfDB) and, the improvement of the highway and the implementation of oil industry in the area, which will attract significant amount of new families and businesses; therefore, the group agreed on an annual population growth slightly higher than the national average at 3%.
- Most participant agreed that the growth will be equally across the area and that the in- and outflux of people from the area will be in balance.

Based on this, the population considered for calculating water demand will be the following:

Figure 5: Estimation of population in the target area

Year	Population	HH
2014	30,393	3,799
2024	40,845	5,106
2034	54,893	6,862

The table below presents the projected population for 2024 disaggregated for 2024:

Figure 6: Projected population in 2024 per cluster

Cluster	Population	HH	%
Nakabosan	950	119	2%
Keekunyuk	475	59	1%
Kalemngorok	9,499	1,187	23%
Kangirega	0	0	0%
Katilu	11,399	1,425	28%
Lopur	16,148	2,019	40%
Arumrum	2,375	297	6%
Total	40,845	5,106	100%

Additionally, as the economic situation of the population is expected to improve in the coming year (through development of new industries and finalization of the highway), it was agreed to consider for 2024 a daily water demand higher than the national average of 20L/capita/day, at **35L/capita/day**; the domestic water demand calculated will therefore be:

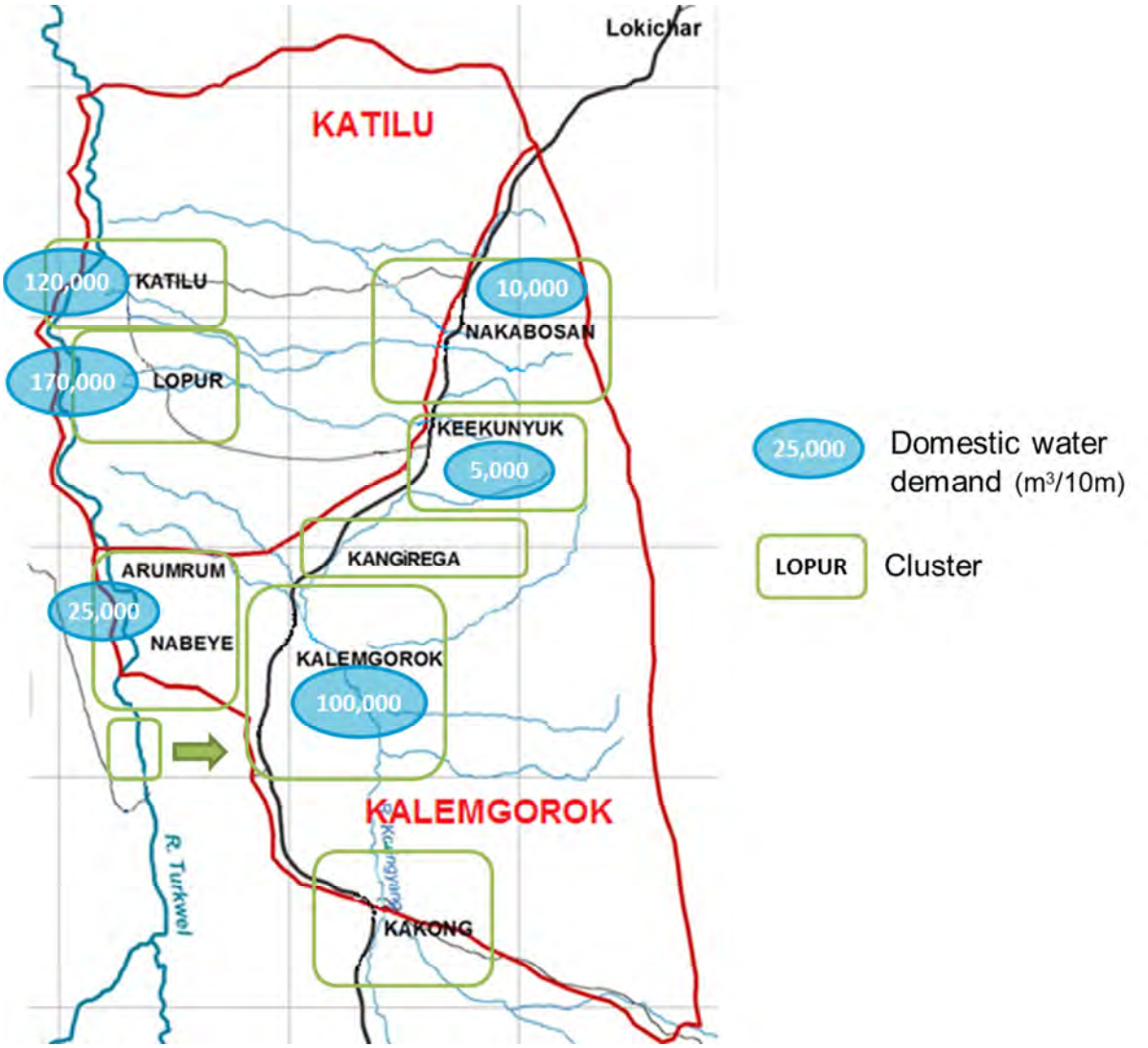
Figure 7: Domestic water demand estimation in Kalemgorok-Katilu sublocations

		Water demand (L/h/day)
		Basic domestic
		35
Year	**Population**	
2014	30,393	1,063,744 L / d 1,064 m^3/d 319,123 m^3/10 months dry period
2024	40,845	1,429,583 L / d 1,430 m^3/d 428,875 m^3/10 months dry period

Based on these calculations, the domestic water demand in 2024 is rounded-up to **430,000 m^3** for a 10 months dry period.

The water demand was disaggregated by clusters; it can be visualised on the following map:

Figure 8: Domestic water demand per cluster in 2024 in the target area



Remark:
It should be noted that although located outside of the target area, the town of Kakong has a cluster of its own as it has water points which are used by the population within the target area; however, the water demand of the people of Kakong town is not taken into account, as shown on the map above. Kangirega, on the other hand, is a cluster where there is only livestock.

4.2.3 Livestock water demand

Assumptions on number of animals per household and daily consumption of water per day have been discussed during the workshop. The general agreement is that pastoralists have more livestock than agro pastoralists – therefore average number of animals between pastoralists and agro pastoralists has to be differentiated.

Based on this discussion, the population of the target area has been roughly divided into these 2 groups:

Figure 9: Division of population

Cluster	Pop (%)	
Nakabosan	2%	(1) Inland 27%
Keekunyuk	1%	
Kalemgorok	23%	
Katilu	28%	(2) Along river 73%
Lopur	40%	
Arumrum	6%	

The table shows that about 73% of the total population of the target area lives along the river (clusters of Katilu, Lopur and Arumrum) while 27% live in the clusters further away from the river (Nakabosan, Keekunyuk and Kalemgorok).

For each of this group of population: (1) households living "inland" (pastoralists) and (2) households living along the river (agro pastoralists), stakeholders have estimated the number of animal heads/household. Based on this estimation, a weighted average of number of animal heads/household has been calculated, taking into account the weight of each group of population:

Figure 10: Weighted average of animals heads per household

	FEWS.NET estimates	Estimation participants		Weighted average
		(1) Inland	(2) Along river	
Cattle	7	10	7	7.8
Goats	22	50	22	29.6
Sheep	17	40	17	23.2
Camel	3	25	1	7.5
Donkey	0.5	5	2	2.8

Example of calculation:

For cattle, the weighted average is equal to: (10x27 + 7x73) : (27+73) = 7.8

Daily water consumption per type of animals was also reviewed by the workshop participants; reviewed data are presented in the table below:

Figure 11: Estimation water demand per animal type

	FAO estimates			**Group estimates**
	Demand L/LU/day	Livestock Unit (LU)	Water demand L/h/day	**Water demand L/h/day**
Cattle	50	0.5	25	**35**
Goats		0.1	5	**7**
Sheep		0.1	5	**7**
Camel		1.1	55	**70**
Donkey		0.6	30	**30**

Once the total number of animals and the average daily consumption are calculated, it is possible to evaluate the total water demand projected for 2024:

Figure 12: Livestock water demand for Kalemgorok-Katilu

	Number of livestock heads					
Year	Cattle	Goats	Sheep	Camels	Donkey	Livestock Unit
2014	29,633	113,973	87,379	28,493	10,637	N/A
2024	39,824	153,170	117,430	38,292	14,296	N/A
2034	53,520	205,847	157,816	51,462	19,212	N/A

	Water demand (L or m3/day)
	Livestock
Year	
2014	4,760,255 L / d 4,760 m3/d
2024	6,397,384 L / d 6,397 m3/d
2034	8,597,550 L / d 8,598 m3/d

For a 10 months dry period:
The livestock water demand in 2024 will be 6,397 m^3/day x 300 days = 1,919,215 m^3, rounded-up to **1,920,000 m^3**.

Given the number of camels estimated as well as their significant water demand (in comparison with the other types of animal), one can assume that **camels represent roughly 50 % of the livestock water demand**. To further locate camels and other animals (=all apart from camels) water demand on the map, assumptions were made and discussions led on movements of animals. Among others:

- Camels are not necessarily located next to their owner, although they remain back in the dry land (for security reasons):
  - Camels from Katilu and Lopur are based in Kamgirega.
  - Camels from Arumrum are based in Kalemgorok, with the other camels from Kalemgorok.
- Camels from Keekunyuk and Nakabosan are on the other hand based next to their owner.
- Regarding all other animals, the general agreement met is that about 80% of all animals are located along the river during the dry season, while the 20% remaining are located in Kakong, near the settlement area.

Figure 13: Location of camels and other animals in the target area

	Pop.	CAMELS			OTHERS ANIMALS			
	%	Calc.	Round-up	Location	Calc.	Round-up	20%	80%
Katilu	28%	267,907	648,000	Kamgirega	267,907	268,000	Located in Kakong	Located along the river
Lopur	40%	379,535			379,535	380,000		
Arumrum	6%	55,814	56,000	Kalemgorok	55,814	56,000		
Nakabosan	2%	22,326	22,000	Nakabosan	22,326	22,000		
Keekunyuk	1%	11,163	11,000	Keekunyuk	11,163	11,000		
Kalemgorok	23%	223,256	223,000	Kalemgorok	223,256	223,000		
	100%	960,000	960,000		960,000	960,000	192,000	768,000

Regarding the other animals, 4 areas were defined along the river:

1. One near to Katilu.
2. One near to Lopur.
3. One area gathering the livestock of Arumarum + half of the livestock of Kalemgorok,
4. One area gathering the other half of Kalemgorok livestock + the livestock of Nakabosan and Keekunyuk.

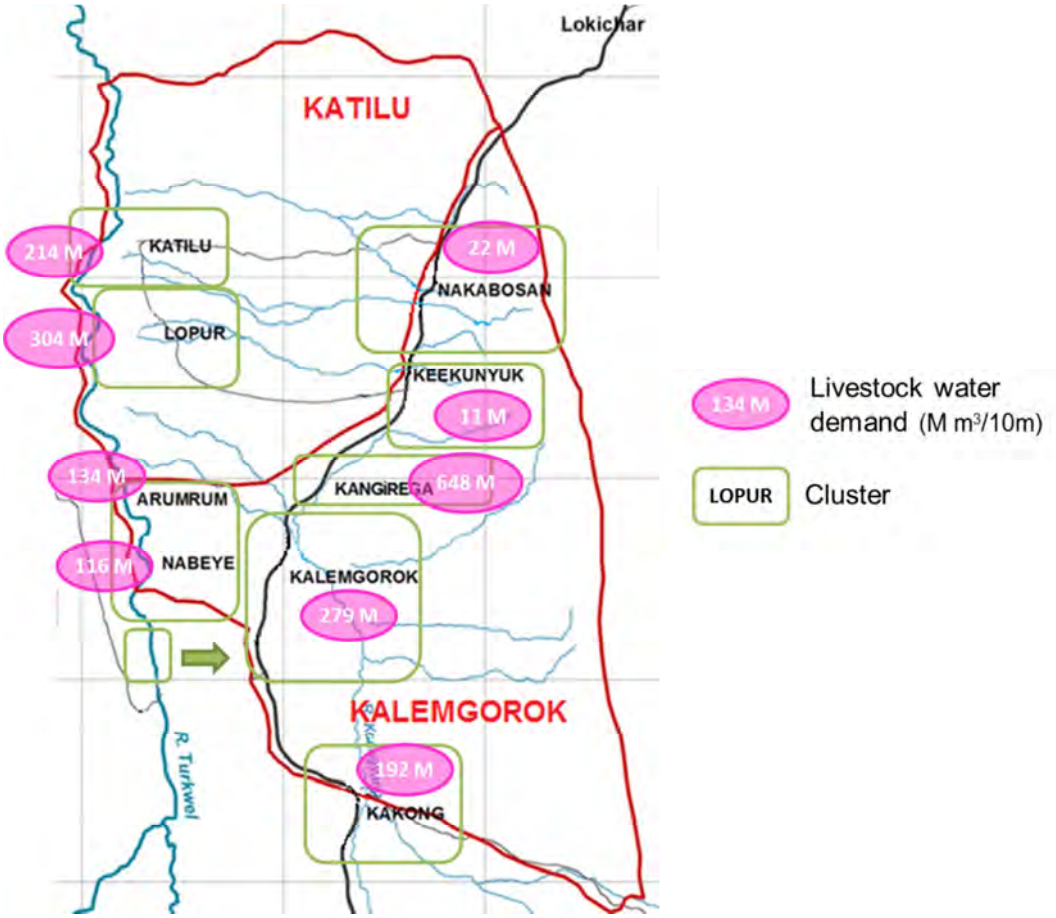
It shall be made clear that this division of livestock is schematic, to be able to identify in a rough way water demand and gaps; IRC and the group are aware that in reality, distribution of livestock is less mathematical.

Figure 14: Distribution of other animals

OTHERS ANIMALS			
	Areas along the river		Kakong
	80%	Round-up	20%
1	214,400	214,000	
2	304,000	304,000	
3	134,000	134,000	
4	115,600	116,000	
		768,000	**192,000**

The total livestock water demand can be visualised on the map below:

Figure 15: Livestock water demand per cluster in 2024 in the target area



4.2.4 Agriculture

This target area is very particular in regards to the other KALDRR-WASH pilot project areas as a large scale irrigation scheme is present next to the Turkwel river. In the framework of this Water Master Plan, focus will be given to small-scale farming only (farming at household level), for surfaces of one acre or less.

Before looking at potential areas for small-scale agriculture development, a number of assumptions have been made regarding the type of crops to be considered, the harvesting period, the rainfall pattern and the type of irrigation. These assumptions are summarised in the following table:

Figure 16: Assumptions for calculation of agriculture water demand

Assumption 1: Eto = 8.5 mm/day

Assumption 2:

Information are provided only for crops selected within the targeted area

Crop	Growing period (days)	Harvest 1	Harvest 2
Beans			
Cabbage			
Groundnut			
Maize	90	July	January
Melon			
Millet			
Onion dry			
Sorghum	120	July	January
Spinach	60	July	January
Tomato			

Assumption 3: Rainfal station used: Lokitaung

Assumption 4:

Crop	% of each crop in the garden	% of water saving with drip irrigation
Beans		
Cabbage		
Groundnut		
Maize	50%	50%
Melon		
Millet		
Onion dry		
Sorghum	40%	50%
Spinach	10%	50%
Tomato		

Some definitions

Eto:	reference crop evapo-transpiration (in this case, grass is taken as reference crop)
Kc:	crop factor; factor between the reference grass crop and the crop actually grown
ETCrop:	crop water need; amount of water needed to meet the loss through evapo-transpiration
Growing period:	period between sowing to the last day of the harvest

Regarding potential development of small scale agriculture, the following assumptions have been made by the group:

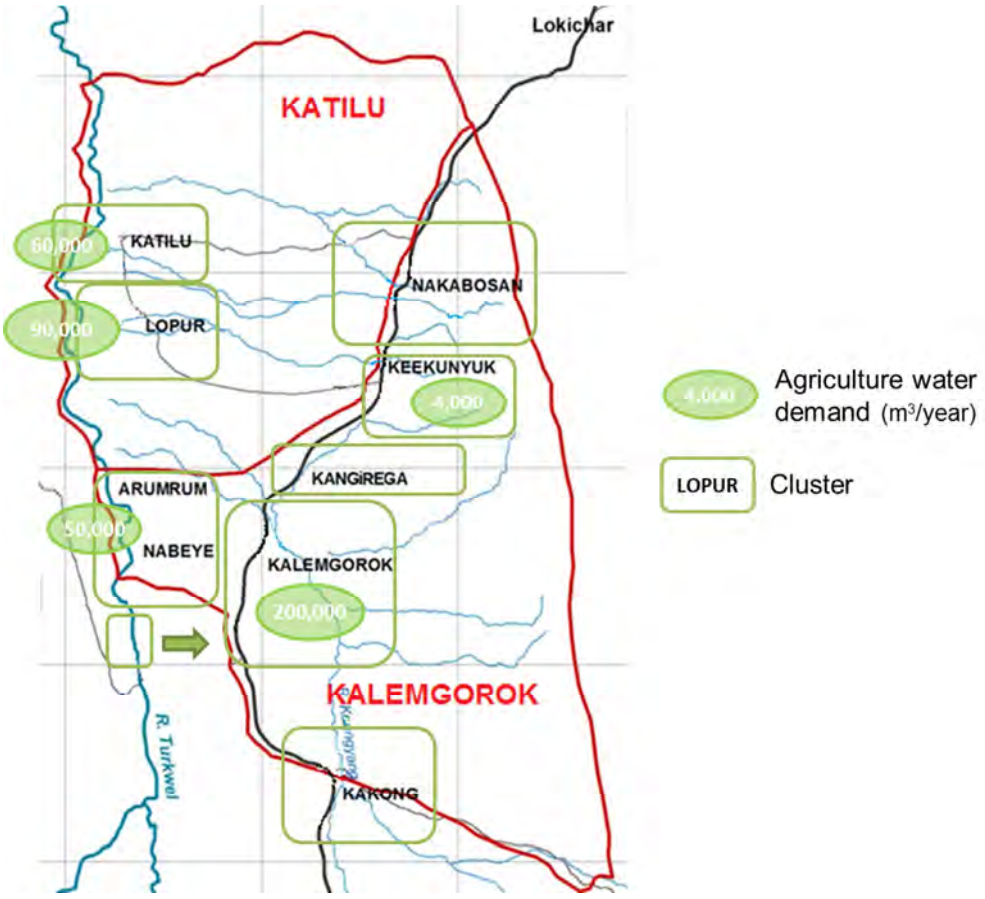
- In Katilu/Lopur, land dedicated to agricultural land is planned to be extended to 2,800 acres; there is also a huge potential for further development as it is planned to develop a canal irrigation directly fed by the river.
- In Arumrum/Nabeye, a project funded by the AfDB is foreseen, with 800 acres land to be cultivated.
- In Keekunyuk, an additional 50 acres (to the existing 30 acres) is planned.

- In Kalemngorok, there are currently about 3,000 HH which are cultivating 1 acre of land each; with the annual population growth; this surface is planned to be increased up to 4,000 acres by 2024.
- Volumes were calculated directly using the "Water demand" Excel calculation sheet. Methodology of calculation is detailed in the assessment report[6].

Figure 17: Agriculture water demand for 2024 per area

	Irrigation water need in 2024				
	Calculations		Round-up		Comments
Katilu/Lopur	135,305	m^3/year	150,000 (60,000+90,000)	m^3/year	Huge potential of the Turkwel river
Arumrum/Nabeye	38,659	m^3/year	40,000	m^3/year	
Keekunyuk	3,866	m^3/year	4,000	m^3/year	/
Kalemgorok	193,294	m^3/year	200,000	m^3/year	/

Figure 18: Agriculture water demand per cluster in 2024 in the target area



[6] See [3]

4.2.5 Seasonal migration

There are fluxes of migrating livestock in the target area, coming mainly from North Turkana and the East during 3 months per year.

Six pockets of migrating herds have been identified, for which number of animals have been discussed and agreed upon during the stakeholder meeting (figures are given for 2014). The number of people migrating with the herd has been evaluated roughly and in proportion with the size of the herd.

Figure 19: Seasonal migration in the target area

Area	Cattle	Goat	Sheep	Camel	Donkey	Population	Location
A	5,000	5,000	5,000	300	500	225	Katilu
B	2,000	10,000	10,000	3,000	700	350	Kangirega
C	15,000	7,500	7,500	0	200	500	Arumrum
D	5,000	10,000	10,000	500	500	300	Kalemgorok
E	15,000	12,500	12,500	10,000	1,000	1,200	Kalemgorok
F	2,000	10,000	10,000	10,000	3,000	1,300	Kakong

Assumptions for calculating water demand are the same as the one used for "Domestic water demand" and "Livestock water demand":

- An average water consumption of 35L/capita/day for domestic use.

An average water consumption per type of animal as detailed in Figure 11: Estimation water demand per animal type

- .
- A multiplying factor of 1.34 between data of 2014 and data of 2024, based on annual growth rate of 3%.

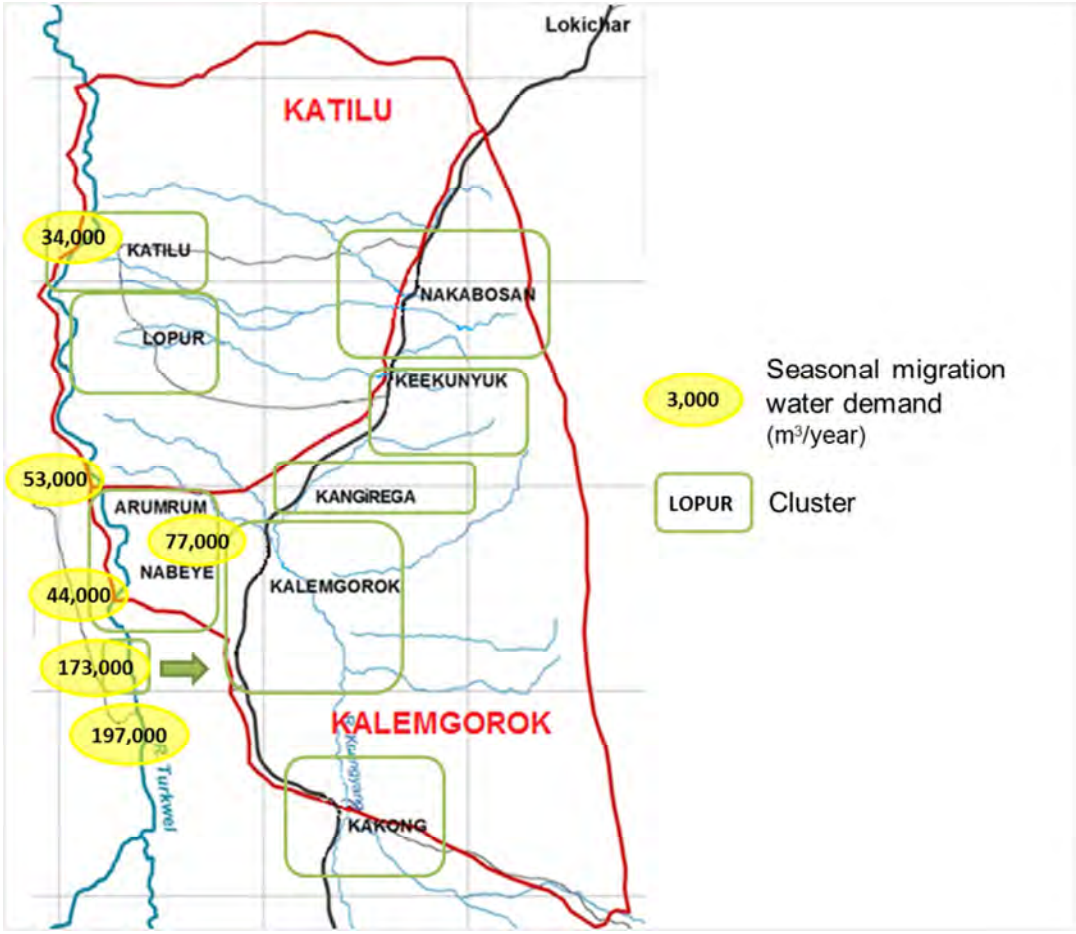
Based on these assumptions, the calculations gave the following results:

Figure 20: Water demand for seasonal migration (m3/year)

Area	Volume (m3/year)		
	2014	2024	Round-up
A	25,314	33,920	34,000
B	39,727	53,234	53,000
C	57,293	76,772	77,000
D	32,882	44,061	44,000
E	128,826	172,627	173,000
F	146,837	196,761	197,000

Regarding the location of "pockets" of migrating livestock, and although these locations were clearly identified in Figure 20, it is to be noted that all water demands were shifted towards the Turkwel river as, according to the group, this is the place where migrating population bring their animals in the dry season. The map next page reflects this.

Figure 21: Seasonal migration water demand per cluster in 2024 in the target area



4.2.6 Wildlife

Stakeholders confirmed the presence of wildlife in the area, but in quantities which are not significant. Therefore, water demand for wildlife during the dry season is considered equal to **0 m^3**.

4.3 Water gaps and water surplus

Water demands and water availability have been compiled in a table (see next page). The following assumptions have been made to distribute water demand among the different water sources:

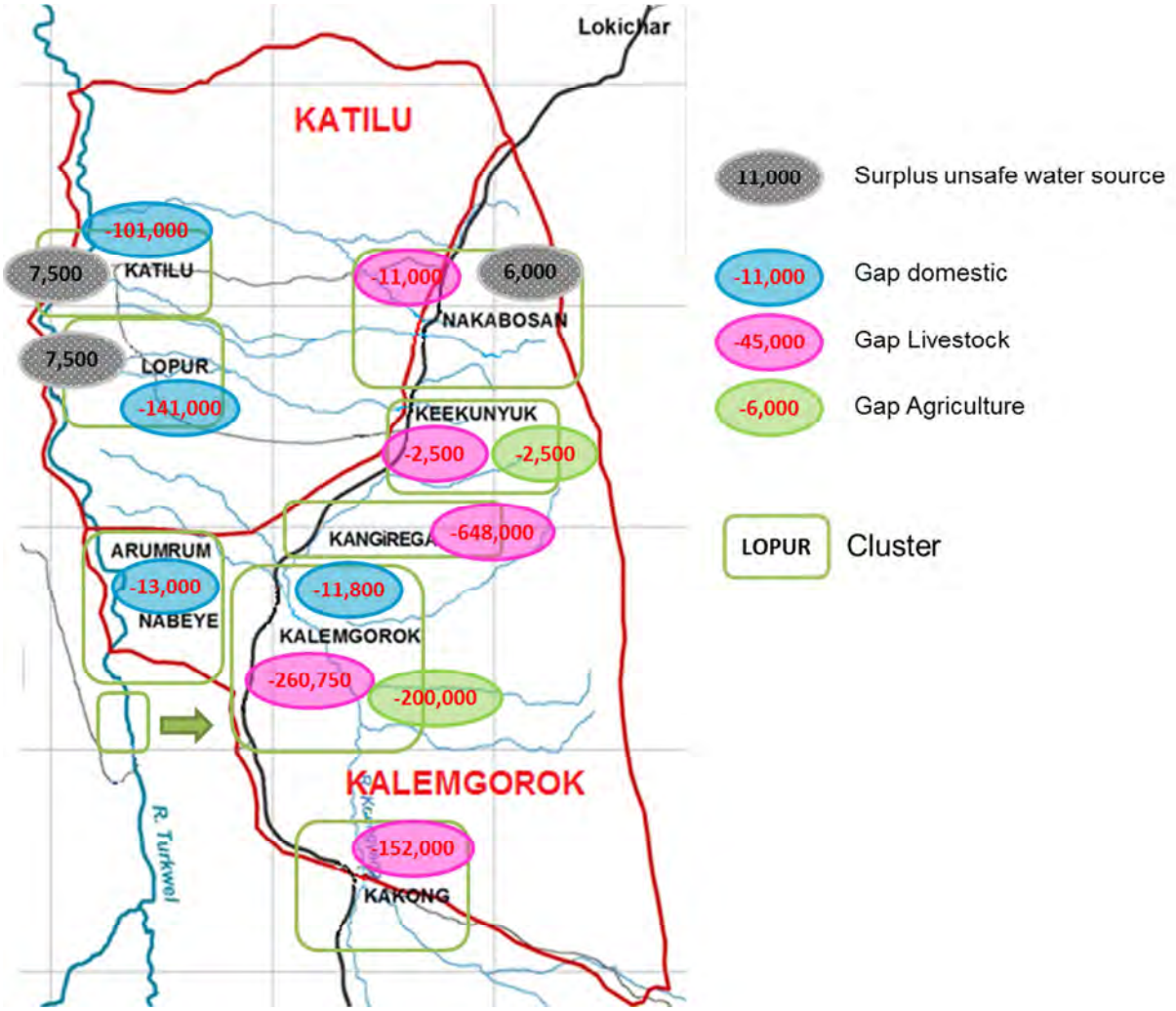
- Regarding domestic water demand, only safe source of drinking water such as boreholes are considered.
- In clusters located next to the river (**Katilu, Lopur, Arumarum-Nabeye**), livestock and seasonal water demands are answered through the river, which flows all year long.
- In clusters not located next to the river (**Nakabosan, Keekunyuk, Kalemgorok, Kangirega, Kakong**), it is assumed that livestock needs are met using water pans; however, these water pans are considered operational only 3 months per dry season.
- For cost-efficiency and sustainability reasons, water for agriculture is assumed to be delivered from unsafe water sources such as water pans rather than safe water source (boreholes).
- Regarding seasonal migration, and even for herds not located to the river, we assume that livestock is brought to the Turkwel river.

Figure 22: Water gaps and water surplus analysis

Cluster	Use	Water demand	Available			Use	Supplied by....			GAP	Surplus	
			River	BH	Unsafe		River	BH	Unsafe		BH	Unsafe
Katilu	D	120,000	∞	19,000	7,500	D		19,000		101,000	/	7,500
	L	214,000				L	214,000					
	A	70,000				A	70,000					
	S	34,000				S	34,000					
Lopur	D	170,000	∞	29,000	7,500	D		29,000		141,000	/	7,500
	L	304,000				L	304,000					
	A	100,000				A	100,000					
	S	0				S						
Nakabosan	D	10,000	0	14,000	13,000	D		10,000			/	6,000
	L	22,000				L		4,000	7,000	11,000		
	A	0				A						
	S	0				S						
Keekunyuk	D	5,000	0	10,000	5,000	D		5,000			/	/
	L	11,000				L		5,000	3,500	2,500		
	A	4,000				A			1,500	2,500		
	S	0				S						
Kalemgorok	D	100,000	0	88,200	18,250	D		88,200		11,800	/	/
	L	279,000				L			18,250	260,750		
	A	200,000				A				200,000		
	S	217,000				S	217,000					
Kangirega	D	0	0	0	0	D					/	/
	L	648,000				L				648,000		
	A	0				A						
	S	53,000				S	53,000					
Kakong	D	0	0	0	40,000	D					/	/
	L	192,000				L			40,000	152,000		
	A	0				A						
	S	197,000				S	197,000					
Arumrum-Nabeye	D	25,000	∞	12,000	0	D		12,000		13,000	/	/
	L	250,000				L	250,000					
	A	50,000				A	50,000					
	S	77,000				S	77,000					

A map locating water gaps and water surplus is visible next page:

Figure 23: Map of water gaps and water surplus in the target area



Comments:

- The "Surplus unsafe water source" is water from water pans.
- In Nakabosan, there is a surplus of water (from a water pan) while at the same time, a livestock water gap of 11,000 m^3 was calculated. This is due to the assumption that water pans deliver water during 3 months only, while livestock water demand is spread over the 10 months of the dry season; therefore, the water surplus of 6,000 m^3 is there in theory during the 3 months that the water pans are operational (which could be used for more livestock or agriculture). For the remaining months of the dry season, the water pan is assumed to be dry and cannot meet the livestock demand.

5 Strategic building blocks

In the previous chapter, an analysis has been conducted on how much water is required (or is in surplus) for the different types of water uses, and where. To bridge these water gaps, interventions need to be planned. Not only infrastructure interventions, which are discussed in the next section, but also in the areas of Water Service management (5.2), Water governance (5.3) and capacity development for all stakeholders (5.4). These four areas are referred to as "Strategic building blocks of the Water Master Plan". Stakeholders involved in the process divided responsibilities for the coordination of these different strategies (see Chapter 6) that form together the area Water Master Plan.

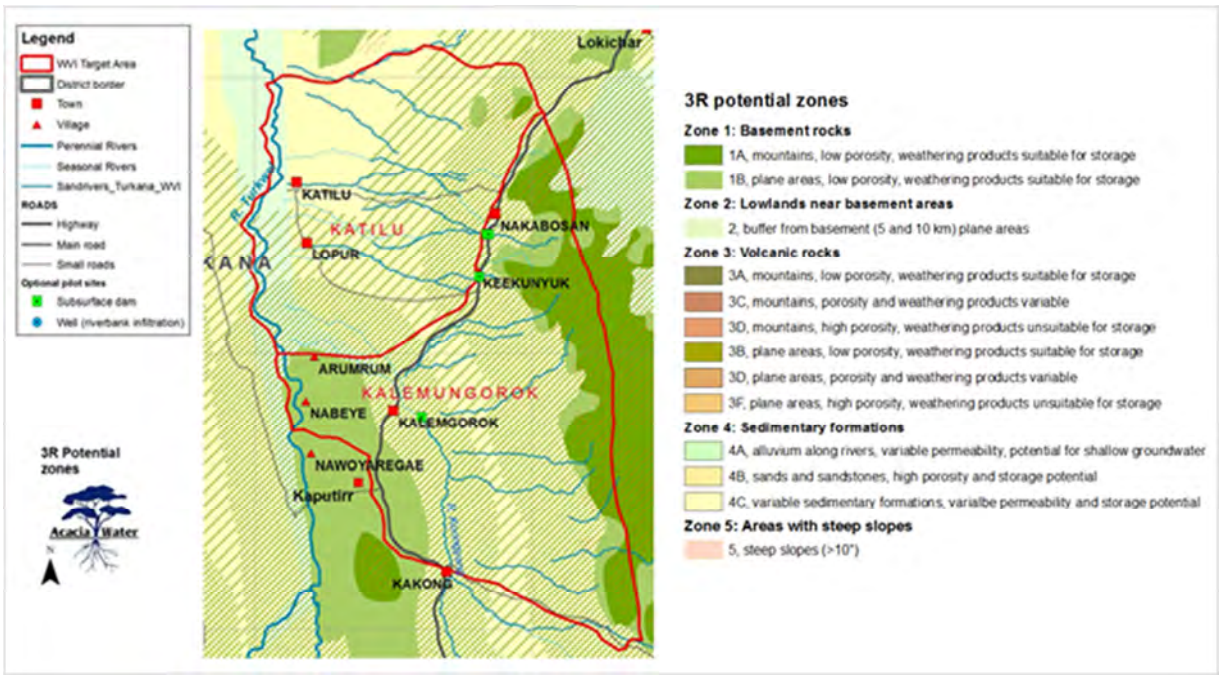
5.1 Water infrastructure planning

5.1.1 Potential 3R interventions

At locations with water shortage, 3R interventions can be used to increase the amount of water available during the dry season, by storing and buffering water that falls during the rainy season. Several technologies are available, and the choice depends on both the physical landscape and type of water demand.

An analysis of the area for potential 3R interventions was conducted in June 2013 and an area map produced (Figure 24), dividing the area in zones with different 3R potential:

Figure 24: 3R potential zones in the target area



Source: Acacia, IRC, 2013

In the Kalemgorok-Katilu target area the following 3R potential zones are present:

- Zone 1A: Mountains, low porosity, weathering products suitable for storage.
- Zone 1B: Plane areas, low porosity, weathering products suitable for storage.
- Zone 5: Steep, slope (>10°).

Figure 25: Possible 3R interventions in the Kalemgorok-Katilu area

	A Pans and/or valley dams	B Sanddams	C Subsurface dams	D Shallow, freatic groundwater: wells and riverbank infiltration	E (Flood)water spreading and spate irrigation	F Gully plugging, checkdams, and other run-off reduction	H Closed tanks	G Deeper, confined aquifer groundwater: wells / boreholes
Zone 1A	x[1]	x	x	x		x	x	x
Zone 1B	x[1]	**x**	x	x	x	?	x	x
Zone 2	x	x[2]	**x**[2]	x	x	x	x	x
Zone 4A	x			**X**	x		x	x
Zone 4C	x			x	x		x	x
Zone 5	x	(x)		?		x	x	x

The crosses denote the potential:
x. possible
***x**. high potential*
***X**. very high potential*
(x). limited potential
? unknown
The superscripts denote:
1. Possibly sealing required
2. Combined with 3B, 3D, 3F, 4C, 4D if impermeable layer is present

Figure 25 provides an indication of which 3R interventions are the most promising in the area. A more elaborate analysis and description can be found in the assessment report of 2013[7].

5.1.2 Recommendations for infrastructure planning

Participants of the stakeholder meeting made an additional analysis of the available infrastructure in the target area, and made the following comments:

- Most of the boreholes in Katilu were built in the 70s, which means that most of them are at the end of their lifetime. As a result, many boreholes will have to be built/rebuilt soon.
- Existing broken water source and water points shall be repaired.
- Water troughs for cattle are needed in most of the locations.
- A feasibility study shall be conducted to explore the possibility to have a water system based on the river as water source, which would distribute treated water for all domestic use via a piped network. This would be a reliable source with sufficient guaranteed capacity, in particular to meet domestic water needs.
- There is good potential of sand dams near Keekunyuk and Nakabosan but the scoop holes should be replaced by shallow wells equipped with pumps, to ease the fetching of water and to avoid the annual need for rehabilitation/digging of new scoop holes.
- Finally, the group mentioned the upcoming construction of a large dam in Kalemgorok location; the water from the dam would be used for domestic, livestock and agriculture purposes.

5.1.3 Action Plan 2014

The list below shows the list of prioritised action points for infrastructure agreed upon by the group, listed by order of priority:

1. Construct new boreholes.
2. Creation of storage tanks near boreholes.
3. Construction of water troughs for livestock in grazing areas.
4. Develop piped network with storage tanks and water kiosks.

[7] See [2].

5.2 Water service management

5.2.1 Existing water service management strategies and their effectiveness

In summary the understanding of the existing water management system is:

- Water service management is governed by the provisions of the Water Act and includes management by:
  - WSBs acting through the district water office at the district level.
  - WUA (Water Users Association): related to the WSB (Water Service Board).
  - WRUA (Water Resource Users Association): related to WRMA.
  - At the community level, management of water is the responsibility of water users, who are expected to elect Water Management Committees to act on their behalf.
  - The water committees are responsible for tariff setting for domestic and livestock use, and for ensuring equity in access to water.
- Operation and maintenance should be the responsibility of the WUAs and Water Management Committees but in many cases, NGOs and the water office do step in to support the operation and maintenance of water facilities.
- The Water Act is not fully followed, partly because institutions like the WSB lack the capacity to cover the whole county and therefore is locally not present.

Given the preponderant role of the WMC, additional clarifications were given on its role and responsibilities:

- The WC employs external technicians when there is a break down at water point level.
- Fees are preferably managed through a bank account; users usually pay on a monthly basis (150 KES/month for pastoralist, 3,000 KES/month for "business man" and 5 KES/2 jerricans (=40 liters) for common users).
- Many water points in the area are managed through water kiosks, considered as an efficient way to control water distribution.
- If needed and if financially feasible, watchmen are hired to take care of the water point; this is particularly true for water points which are equipped with solar panels.

5.2.2 Suggestions for improvement of water service management

The following suggestions were made for improvement of water service management:

- Encourage collection of money at water points in an efficient way through:
  - Making list of users.
  - Improve management of payments.
  - Better book keeping.
    - An example was given from Kainuk where there are compulsory water meters with monthly billing; a "wall of shame" shows which user did not pay its bill.
- Push for better coordination, transparency and accountability of the WC.
- Monitor and control the water better (in terms of quantity, quality and sustainable use).
- Be efficient in repairing broken water points, which has direct impact on queuing at functioning water points.
- Regarding agriculture, encourage irrigation early morning or late evening and put in place irrigation schedule.

5.2.3 Action Plan 2014

The priorities set by the group regarding service management are:

1. Organise committee training in April 2014 (WVI, GoK, CG, WUA).
2. Organise tours between water users in August 2014 (WUA, CG, WVI, Others).
3. Purchase tools for maintenance.

5.3 Water governance

The Turkana stakeholders discussed water governance in their area and have observed the following:

5.3.1 Existing water governance structures

The group listed the existing structure / institutions for dealing with policies and regulation:

- For issues of access:
  - WRMA.
  - Water Committees.
- For conflict resolution:
  - Water committees.
  - Local administration (chief).
  - By laws.
- For water allocation:
  - NGOs.
  - MWI.
  - County government.
  - Faith-based organisations/churches.
  - National government.
- For monitoring:
  - Water committees.
  - Local administration.
  - Communities.
  - Donors.

Most issues are dealt with at local level directly with the Water Management Committees; when it comes to issues of access to water, proposals are made through the DWO/WRMA and other national bodies. Conflict resolution is made through the local and/or traditional administration such as the chief, DC, DO etc. It can however be forwarded higher up if necessary. Insecurity remains one of the biggest issues for access to water; conflicts do not arise necessarily due to external actors, but also within the area as two groups compete for the same resources: the pastoralists and the farmers. Both are based along the river bed and want to make use of the same water, and better governance is needed to tackle the problem.

5.3.2 Effectiveness of water governance structures

The existing governance structures were described as being not effective by the group; reasons mentioned include:

- Need for transparency and accountability.
- Need for registration of water sources to the social services.
- Need for effective banking of collection fee.

The following are the effectiveness rates given for each organisation or instrument by the participants:

- Most of the Water Committees are not that effective (abuse of funds, consider water points as being their own).
- WRMA are effective as they follow-up on the ground.
- Local administration is not implicated much in the water governance.
- By laws are there but nobody follows.
- NGOs are considered effective as there are the ones assisting (bring funds for training);
- MoW lacks capacity and presence in the field.
- FBO (Catholic Church, Reformed Church, etc.) are seen as effective as they assist community in digging and supply.
- The national government is too far to have any impact locally.
- County government is too new to be rated.

5.3.3 How to improve water governance and management

The working group was asked to come-up with suggestions on how to improve water governance; suggestions include:

- Reinforce laws to encourage active involvement of all stakeholders.
- Get a better overview of usage pf water and avoid misuse of water (if any).
- Better implement policies as there is a gap between policies and their application on the field.
- Set the registration of water points with social services (although it should be done in theory).
- Introduce shifts between animals and human at water points.
- Implement proper methods of irrigation which are less water consuming.
- Put in place standard payment rate and encourage water payment for migrating population.
- Partner with The Kenyan Wildlife Service (KWS).
- Implementers should monitor and evaluate the project from the start.
- Discourage dependency from aid.

5.3.4 Action Plan 2014

The priorities set by the group regarding water governance are mainly focused at communities and Water Committee level:

1. Capacity building of communities to increase awareness about by-laws:
   a. Participation and consultation to get clarity about role of the community under the new water law.
   b. Need for capacity building to get the right awareness and capacity about what the new water law means for the community.
2. Encourage settlement of private companies instead of WMC for management of the water points.
3. WMC should manage the assets through bank accounts.
4. Expand the registration to all members.

The group also mentioned that there is a strong willingness to have County government to come and collaborate with other organisations; currently, governmental structures are difficult to reach and ask for financial support to come and help the communities, which hampers development of the area.

5.4 Capacity building

5.4.1 Existing capacity gaps

The participants of the WMP workshop have identified the following gaps regarding water service management and governance structures:

- Lack of proper management and sense of ownership.
- Lack of technical expertise and feasibility studies.
- Insufficient funds.
- Lack of transparency and accountability.
- Lack of monitoring and evaluation and reporting.
- Insufficient water quantity and poor water quality (no water treatment, no water testing).
- Lack of committee involvement / awareness.
- Lack of sustainability.

5.4.2 Opportunities

- Implement proper financial management.
- Train water technicians or employ experienced water technicians.
- Train water users on proper water management (or by exposing them to other users to encourage learning), including for seasonal population.
- Push for transparency and accountability.
- Promote community ownership of the project from the start.
- Encourage capacity building to enable sustainability as external donation withdraws.

5.4.3 Action Plan 2014

Based on a general analysis of capacity weaknesses in water service delivery, the WMP workshop listed the following actions for capacity development (no order of priority given):

1. Make technical experts available, paid through collection fee.
2. Feasibility study on availability of quantity and quality of water.
3. Capacity building and management of water services.
4. Put in place proper financial record keeping and listing of water users.
5. Monitoring and evaluation by the water committee.
6. Implement proper water storage.
7. Organize exposure tour.

6 Action Plan 2014

Table 2: Action plan for the Kalemgorok-Katilu sub-locations

Component	Proposed Actions for 2014	Responsibility[8]
Water infrastructure	• Construct of new boreholes. • Creation of storage tanks. • Construction of water troughs for livestock in grazing areas. • Develop piped network to storage tanks and water kiosks.	World Vision and Sub-county Water Officer
Water Service Management	• Organise committee training in April 2014 (WVI, GoK, CG, WUA). • Organise tours between water users in August 2014 (WUA, CG, WVI, Others). • Build new pipe extensions and kiosks. • Purchase tools for maintenance.	Kenya Rural Development Authority and Ministry of Agriculture
Water Governance	• Capacity building of communities to increase awareness about by-laws: – Participation and consultation to get clarity about role of the community under the new water law. – Need for capacity building to get the right awareness and capacity about what the new water law means for the community. • Encourage settlement of private companies instead of WC for management of the water points. • WC should manage the assets through bank accounts. • Expand the registration to all members. • Make technical experts available, paid through collection fee. • Feasibility study on availability of quantity and quality of water.	Katilu Ward Administrator
Capacity Building	• Capacity building and management of water services. • Put in place proper financial record keeping and listing of water users. • Monitoring and evaluation by the water committee. • Implement Proper water storage. • Organize exposure tour.	Wa Resource Management Authority

[8] World Vision will coordinate with these organizations to appoint one person in particular per organization.

7 Annex

Annex 1: List of participants – Water Masterplan Workshop – Lodwar – 11/12-03-14

#	Name	Organization	Location	Position	Phone number	Email
1	Melanie Carrasco	IRC	The Hague (NL)	Programme Officer	+31703044045	carrasco@irc.nl
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13	James Lomilo	Kaekunyuk WUA	Kaekunyuk	Chair person	0725704002	
14	Lucy Ewoi	Kainuk WUA	Kainuk	secretary	0727443623	
15	Martin Echakara	*Not communicated*	Kaputir	Assistant chief	*Not communicated*	
16	Hosea Emeri	*Not communicated*	*Not communicated*	*Not communicated*	*Not communicated*	
17	Peter Emuria	KARMA	Kaputir	Chair person	*Not communicated*	info@karma-turkana.org
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21	Eliud Mupaliah	*Not communicated*	Kainuk	Agricultural officer	0716214099	eliudmupalia@yahoo.com
22	Peter Ekiru	*Not communicated*	Kaputir	chairperson	0721222940	
23	Moses Ereng	*Not communicated*	Kalemgorok	chairperson	*Not communicated*	
24	Alice Nakitela	*Not communicated*	Kalemgorok	secretary	*Not communicated*	
25	Esekon Micheal	Kalemgorok	Kalemgorok	Water member	*Not communicated*	
26	Micheal Lossee	*Not communicated*	Lorogon	Assistant chief	*Not communicated*	
27	Samwel o ongole	Nakwamoru WUA	Nakwamoru	secretary	*Not communicated*	
28	John Engor	CDMC Chairman	*Not communicated*	*Not communicated*	*Not communicated*	
29	Kolai simon	*Not communicated*	*Not communicated*	*Not communicated*	*Not communicated*	

#	Name	Organization	Location	Position	Phone number	Email
30	David Erukudi	County government	*Not communicated*	Administrator	*Not communicated*	
31	Joseph ekunoit	*Not communicated*	*Not communicated*	*Not communicated*	*Not communicated*	
32	Zipporah Imoni	*Not communicated*	*Not communicated*	*Not communicated*	*Not communicated*	
33	Susan Ekwam	*Not communicated*	*Not communicated*	*Not communicated*	*Not communicated*	
34	William Ewoi	*Not communicated*	Lokapel	Member	*Not communicated*	
35	Paul Lodaan	Lorokon WUA	Lorokon	Chairman	*Not communicated*	
36	Lokiru Patrick	*Not communicated*	Lorokon	Secretary	*Not communicated*	
37	Roselyne Esinya	*Not communicated*	Kalemongorok	Member	*Not communicated*	
38	Simon Engor	*Not communicated*	Nakwamoru	Chair person	*Not communicated*	
39	Daniel silale	*Not communicated*	kanaodon	Assistant chief	*Not communicated*	
40	Esther Silale	*Not communicated*	*Not communicated*	*Not communicated*	*Not communicated*	
41	Ronald Amollo	World Vision Kenya	Kainuk/katilu	Engineer	*Not communicated*	
42	Chrispine Wafula	WRMA	*Not communicated*	Sub regional manager	*Not communicated*	
43	Peterson erus	World Vision Kenya	*Not communicated*	Senior Manager	*Not communicated*	