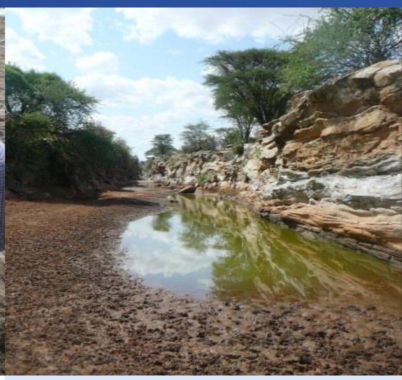
Aug 27, 2018

Water Balancing Implementation Plan

Implementation Plan for Bedele Brewery Water Balancing Plan (BWBP)

Final report



Executive summary

Heineken Breweries Ethiopia (HBSC) is seeking for cost-effective implementation opportunities for the period 2019 – 2020 to meet Heineken's global water sustainability program strategy targets at its Bedele Brewery in western Ethiopia in Oromia Region.

Based on the calculations and implementation plan presented in this report it appears that proposed water balancing interventions in the Upper Dabane Catchment (UDC) area – as preferred target area – of the Dabane River catchment will be more than sufficient to meet, or even exceed, the Bedele Brewery's water target under Heineken's global water sustainability program. Gross indication of costs of hard and soft interventions will be in the order of 8.6 million Ethiopian Birrs (ETB), to be implemented in 2019.

Colophon

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Glossary

3R	'Retention, Recharge and Reuse of water'
ASAL	Arid and semi-arid lands
BWBP	Bedele Water Balancing Plan
EB	eye-brow basin
ETB	Ethiopian birrs; local currency
FMNR	Farmer Managed Nature Regeneration
ha.	Hectares
HDW	hand dug well
HBSC	Heineken Breweries S.C., Ethiopia
IWRM	Integrated water resources management
K	Soil erodibility factor in m/s^{-1}
kebele	Fourth-level administrative division of Ethiopia
m asl	meters above sea level
MB	Microbasin
mm	millimeter
MSC	MS Consultancy
NDVI	Normalized difference vegetation index
P	Precipitation (e.g. rainfall) in mm
PD	person day of labour
Q_{surf}	volume of surface runoff
R_{day}	(average) daily rainfall depth
S	Soil retention parameter in mm
S_L	Sandy loam
SBH	shallow borehole
SLM	Sustainable Land Management program
SWC	soil water and conservation
TC	technical committee of SLM program
UDC	Upper Dabane Catchment
UNIDO	United Nations Industrial Development Organization
WHO	World Health Organization
woreda	Third-level administrative division of Ethiopia
WVE	World Vision Ethiopia

1 Introduction

Heineken Breweries Ethiopia (HBSC) has approached the consultant to investigate cost-effective implementation opportunities for the period 2019 – 2020 to meet Heineken's global water sustainability program strategy targets at its Bedele Brewery in western Ethiopia in Oromia Region.

Based on the calculations and implementation plan presented in this report it seems most likely that proposed water balancing interventions in the Upper Dabane Catchment (UDC) area – as preferred target area – of the Dabane River catchment will be more than sufficient to meet, or even exceed, the Bedele Brewery's water target under Heineken's global water sustainability program. Gross indication of costs of hard and soft interventions will be in the order of **8.6 million Ethiopian Birrs (ETB)** or 256,105 Euros, spread over an implementation period of one year (2019).

1.1 Background

HBSC's Bedele Brewery in Bedele administrative zone produces approximately 600,000 hectoliters of beer on an annual basis. The production water (maximum capacity of 60 m^3/hr) comes from an open-channel diversion weir in the Dabane river located south of the brewery and pumped to the brewery through a pipeline of approximately 7 km in length. Moreover, the water supply intake of Bedele town is located about 15 kilometers downstream of the brewery intake. Both intakes are indicated in Figure 1 on the next page.

The waste water of the beer brewery processes is treated back to national and WHO water quality standards and discharged back into the river, before the water intake of Bedele town, and thereby 'given back' to the local hydrological system. A mere 600,000 hectoliters (or 60,000 m^3) of 'water' (either in the form of beer in beer bottles) leaves, however, the catchment on an annual basis.

HEINEKEN International B.V. as a globally operating beverage industry committed in its Corporate Social Responsibility (CSR) strategy "Brewing a Better World" to inclusive growth, protecting water resources, reducing CO_2 emissions, sourcing sustainably, advocating responsible consumption, communities and health & safety of its people. Under this strategy it defined a specific water sustainability program including strategies targets towards 2020 for all its breweries in dry and arid (ASAL[1]) regions. This water sustainability program dictates that each brewery has to directly and locally compensate for these kind of 'water losses'. In case of the Bedele Brewery water balancing interventions should also contribute to a more guaranteed, sustainable and

[1] Arid and semi-arid lands (ASAL) regions are characterized by a severe lack of available water, to the extent of hindering or preventing the growth and development of plant and animal life.

environmental baseflow in the Dabane River at the water intake stations of the brewery and the one for Bedele town. Hence, the water balancing target is defined as 150% of the beer production, which is equivalent to 90,000 m³ per year for Bedele Brewery.

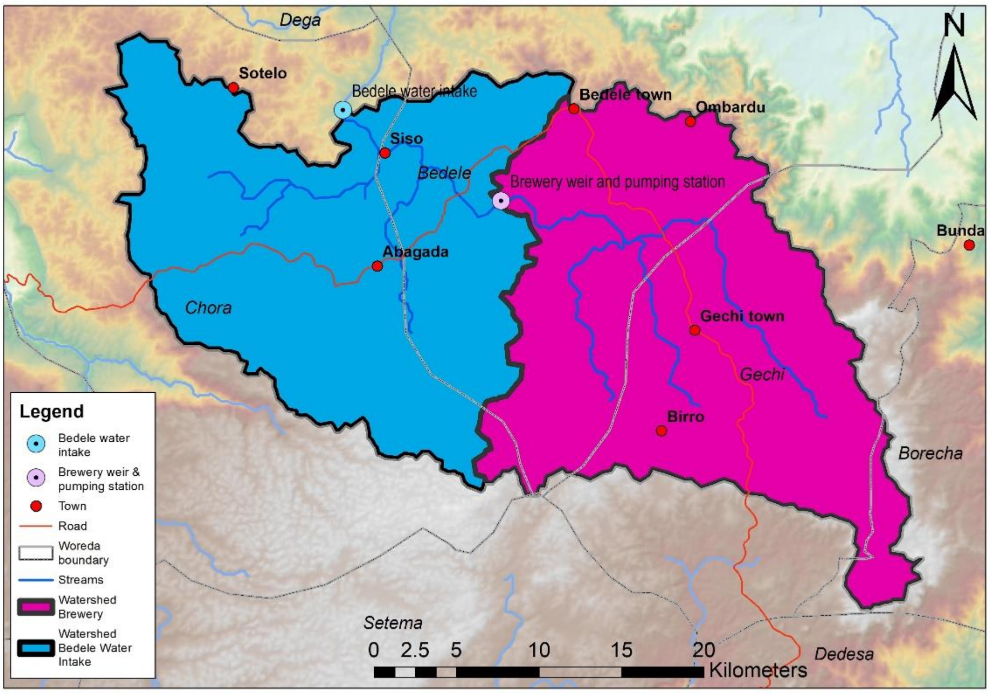

Figure 1. UDC with both Bedele town water intake and the Bedele Brewery intake, including their related catchment areas

1.2 Outcomes of field visit

Following the execution of ground truthing (i.e. field visit) at end of May 2018 to Bedele Brewery, Bedele Zone and Gechi *woreda*[2] specifically, the consultants acquired a better understanding of (i) key-stakeholders, their capacities and ongoing activities, (ii) where to do what, (iii) predict the impact of interventions on water retention in the watershed, and (iv) develop a monitoring plan to measure the collective impact on the amount of water retained in the Upper Dabane Catchment (UDC). In other words, a better insight on the water balancing targets. For these four steps the following activities have been executed:

1. Thematic maps of the UDC, including adminstritrative levels, digital elevation models (DEM), and hydrological and biophysical characteristics, have been developed;
2. Meeting with implementing staff of the SLM[3] (Sustainable Land Management Program) technical committee (TC) of Gechi *woreda*, agricultural office, and visited and assessed their ongoing landscape restoration intervention activities, as part of the ground truthing and field verification;

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[2] A *woreda* is the third-level administrative division of Ethiopia, comparable to that of a municipality or district. Above *woreda* you have Zone, Region and then Federal. The administrative level directly under *woreda* is *kebele*, which is comparable with ward or neighborhood.

[3] SLM is a long-term national project to restore degraded lands through community involvement and managed by the *woredas*. The SLM program is financed by the Ethiopian Federal Government with support of the World Bank and other donors.

3. The status of the current two (2) rainwater gauges and river discharge gauges have been verified. A survey and design plan for a (telemetric) river discharge monitoring system at the Brewery intake to monitor the long-term impact of all landscape restoration measures on the flow of the Dabane River will be introduced in Paragraph **Error! Reference source not found.** of this report;
4. Assessment of the catchment's hydrology, biophysical characteristics (Chapter 2) and expected impact of interventions (forecasting the effect of measures) based on analytical calculations. This has been derived and will be elaborated in Chapter 4 of this report.

Based on literature study and mapping of the catchment, Gechi *woreda* as upstream woreda appears to be a key-stakeholder in any water balancing interventions. With over 41% of its surface area within the Upper Dabane Catchment (UDC), upstream of the Bedele Brewery water intake, and approximately 51,000 inhabitants (census 2016) it is the main *woreda*. Furthermore, within the UDC it is the *woreda* with the lowest percentage of population with access to potable water (49%) (Tulema, 2017) and most prone to erosion and land degradation, with an estimated 6,000 to 15,000 ha of degraded land in 7 *kebeles* in East Gechi. This can also been observed from the change in vegetation cover (based on NDVI[4] analysis) between 2000 and 2015, which is shown in Figure 2 below, indicating a strong downward trend of vegetation cover in the whole Dabane catchment.

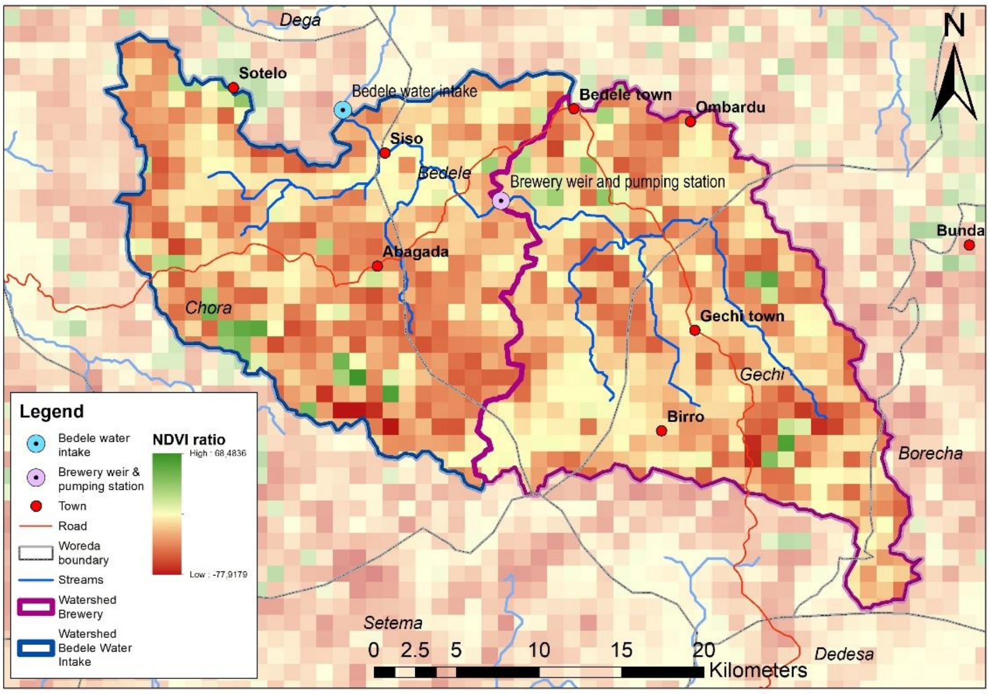

Figure 2. Change in mean annual vegetation cover (NDVI ratio) between 2000 and 2015. Red is a decline in vegetation cover, while green indicates a recovery or accretion of vegetation.

[4] The normalized difference vegetation cover (*NDVI*) is a simple graphical indicator that can be used to analyze remote sensing measurements to assess whether the target being observed obtains live green vegetation or not.

1.3 Considerations towards water balancing

Based on the previously mentioned observations and key points it is advised to focus the design and implementation of a water balancing plan for Bedele Brewery on implementing measures in the Upper Dabane Catchment (UDC) and Gechi *woreda* more specifically. The main reasons and considerations for this are:

- UDC is the catchment area of the brewery water intake, which will need to be secured from an operational perspective, whilst water balancing measures will reduce risks of low river flows, like the one occurred in 2013 where both the brewery and Bedele town could not abstract any surface water from their intakes for a period of 2 – 3 weeks. Increased water storage in the UDC will reduce the risk of low flows at the intake station of Bedele Brewery as well as for the intake of Bedele town downstream;
- Since the UDC is already the upper part of the catchment it means that interventions will notice little influence by upstream activities;
- The SLM technical committee (TC) at the Agricultural Office of Gechi Woreda consists of highly committed and motivated technicians, whom currently are already implementing the SLM landscape restoration measures on approximately 7,000 ha within Gechi Woreda (where focus was on the Koba sub-catchment, tributary of the Dabane River) in a three-year program. This SLM program in Gechi Woreda runs from 2016 – 2019, and includes 3R infiltration, soil water and conservation (SWC) and reforestation measures, and is based on community labor input. This provides a good entrance to be extended to the water balancing activities;
- Interventions taken in Gechi Woreda will have a big and direct impact; landscape and ecosystem restoration on degraded land upstream can restore the downstream baseflow at the intake, while major improvements on water facilities can still be made to improve the direct access to water for local communities of Gechi Woreda;
- It is sparsely populated without big (other) industrial stakeholders to date, only a few irrigation projects and only one Gechi town as main village, which should make the establishment of a genuine integrated water resources management (IWRM[5]) process with the present stakeholders and implementation of interventions less difficult.

For aforementioned considerations three main type of interventions are proposed to reach a neutral water balance:

A. Infiltration structures (e.g. 3R[6] techniques) and soil water and conservation (SWC) measures, such as soil bunds and contour trenches, to capture and store the runoff water during the rainy season and to increase and ensure local water availability, also during the dry season;

[5] *IWRM* is a process which promotes the coordinated development and management of water, land and related resources, in order to maximize the consequent economic and social welfare in a fair way without compromising the sustainability of important ecosystems.

[6] *3R* stands for 'Retention, Recharge and Reuse of water' and is a concept that focuses on low-tech and low-cost water buffering interventions that collect water when it is plentiful (wet season) and making it available when scarce (dry season). Typically, the 3R concept is part of *IWRM,* climate change adaptation and/or ecosystem restoration.

B. Reforestation activities to increase the vegetation cover and reduce the runoff;
C. Improve the access to drinking water for the population in the catchment by providing improved water supply facilities.

Additional objectives which are part or could act as spin-off of this Bedele BWBP are:
D. Identifying key indicators to be monitored and establish baseline;
E. Deliberate awareness creation on importance of improving tree coverage at farm and open communal areas through Farmer Managed Natural Regeneration (FMNR) forestry practices & planning so as to reduce runoff & improve soil fertility;
F. Establishing forest rehabilitation and protection through Community Based Organizations (CBOs) from farmers, developing by-laws and capacitating towards institutionalization;
G. Promoting livelihood options like improved seed, saving and credit groups, so as to diversify livelihood options of those negatively affecting the environment and/or affected by its degraded effects;
H. Establishing from village up to Woreda level a Dabane River Catchment Committee overseeing water resources management, linking to Woreda Office of Agriculture & Natural Resource Management office so as to ensure resource leverage, ownership and sustainability.

2 Biophysical and demographic context of Dabane River catchment

2.1 Biophysical context

The Dabane River catchment is located at the western part of Ethiopia and falls within Oromia and Benishangul Gumz Regional States. The Dabane River catchment is found within the larger Abbay River Basin, a key-basin which comprise about 45% of Ethiopia's total surface water resources, hosts 25% of the population, covers 20% of the landmass and generates around 40% of Ethiopia's agricultural produce. Didesa-Dabus is one of the eight sub-basins of Abbay River Basin and the major contributor of water to river Abbay. Dabane River catchment is located within Didesa-Dabus sub-basin which collects water via river Dabane and joins river Didesa.

Since Heineken's global water sustainability program and its related water balancing interventions aims at a more guaranteed, sustainable and environmental baseflow at the Bedele Brewery water intake, only the eastern section of the Upper Dabane Catchment (UDC) is being considered. This eastern section and its related boundaries are located upstream of the water intake of Bedele town (app. 15km downstream of the Brewery intake). The UDC from the Bedele town intake has a relatively small catchment of 877 km², has an annual average rainfall of 1965 mm, and may be affected by low flows at the end of the dry season (March – April). The UDC has a mountainous landscape and changes from almost 2,500 meters above sea level (m asl) in the upper part of the catchment to around 1,400 m asl at the Bedele town water intake over less than 40 kilometers. See Figure 3 on the next page.

The soils within the catchment are predominantly sandy loam underlain by young flood basalts of Miocene origin (23 – 5.3 million years ago), which again directly overlay the crystalline basement rock. Between the Brewery and Bedele Town water intakes a strip of intrusive (tectonic) granite of Precambrian age (4600 – 540 million years ago) – largely corresponding to the Dabane river valley and its riverbanks – overlay the basalt and basement rock. The biggest part of the catchment has slopes steeper than 5%, while more than half of the catchment is hilly and has slopes steeper than 10% - especially in the upper part of the UDC – making it extremely prone to erosion after the slightest sign of land degradation. The catchment area related to the Bedele Brewery intake is approximately half the size of the UDC with 448 km². See also Figure 4.

Within the scope of this Implementation Plan, water balancing targets and interventions will be compared with to this latter catchment area; the upper part of the UDC.

A base flow of less than 400 m³ per hour is considered 'low flow' for Dabane River, and occur often 10 – 20 days after a period of zero rainfall (Acacia Water, 2014). Base flow below 150 m³ per hour is considered 'critical', and actions should be undertaken to be ready for mitigation measures as long as the rain does not start.

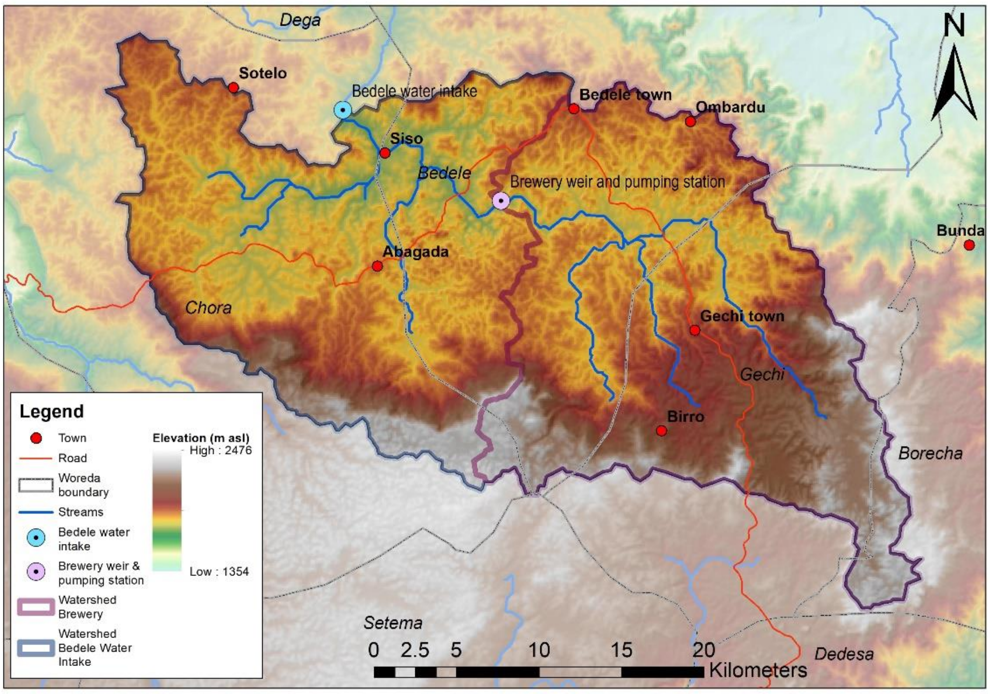

Figure 3. Topography, stream and catchment areas based on Digital Elevation Model (DEM) analysis

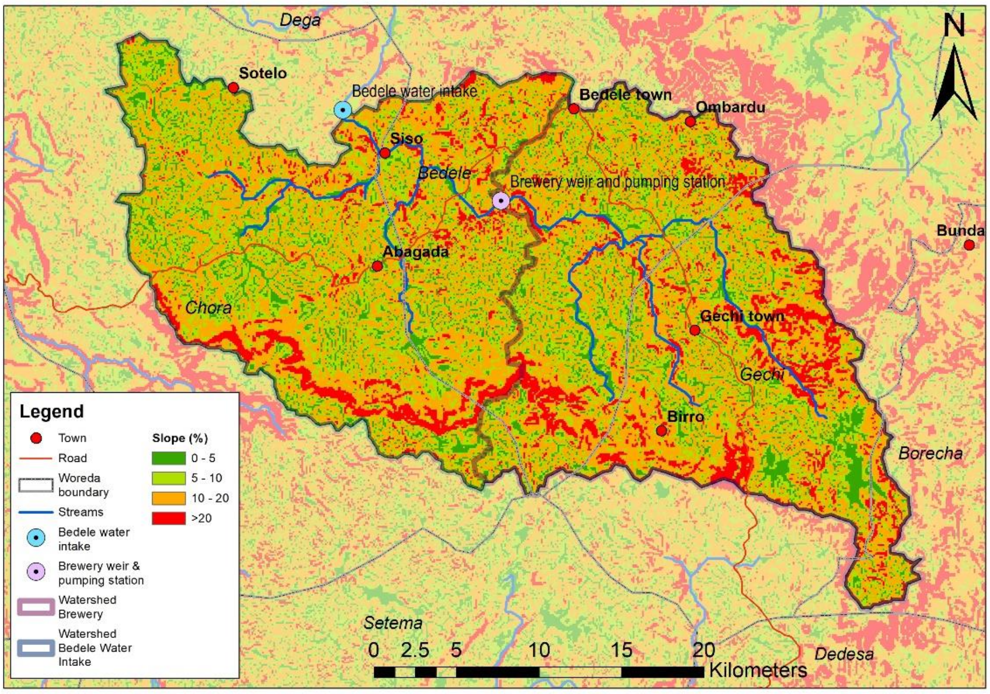

Figure 4. Slopes in percentages within the UDC

2.2 Demography

There are five *woredas* consisting of 18 *kebeles* covering the UDC of which 66,251 hectares (or 662.5 km²) are located within the UDC area. This is equivalent of 70% of the area of the 18 combined *kebeles*, with a total population of over 51,000 censused in 2016. This results in an average population density of 77 people/km².

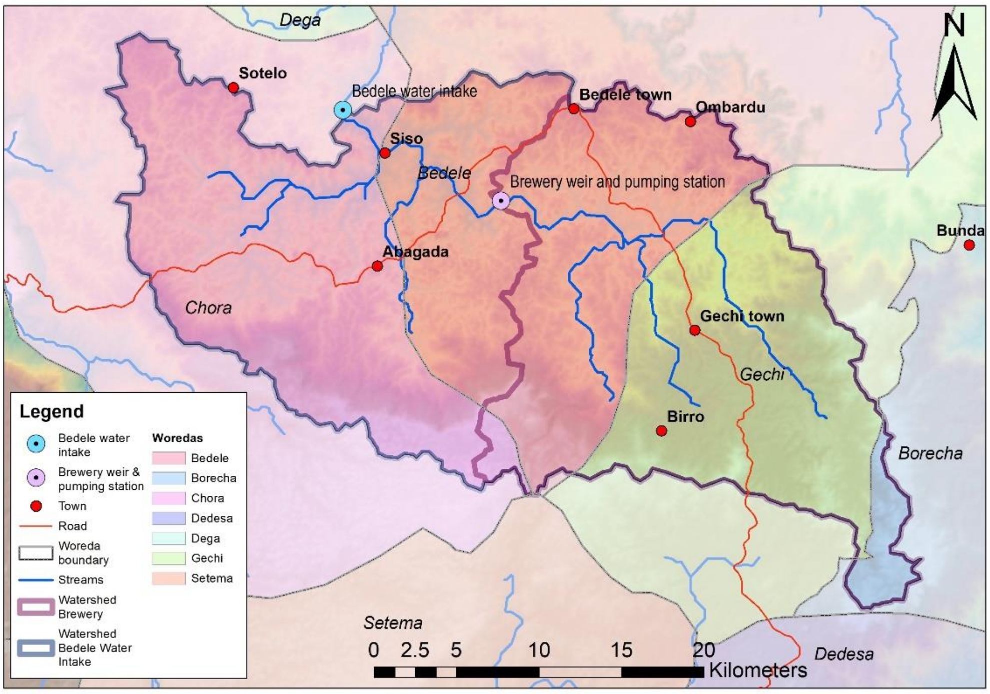

Figure 5. Administrative boundaries of the woredas overlapping the UDC.

It is indicated that the trend of population density will be growing with 3% on an annual basis, while the upper part of UDC is more densely populated than average. Gechi woreda is located in this upper part and is the main woreda with over 41% of its surface area within the UDC area. See also Figure 5 above. Note that Bedele Town *woreda* is its own administrative level within Bedele Zuriya *woreda* (**Error! Not a valid bookmark self-reference.**).

Table 1. Topographic characteristics of the five woredas within UDC

Woreda	Total Area		Area in Catchment	Share
	m^2	ha	ha	%
Chora	788.608.000	78.861	10.158	15,3
Gechi	634.028.030	63.403	27.519	41,5
Boricha	739.468.030	73.947	883	1,3
Bedele Town	8.522.800	852	461	0,7
Bedele Zuriya	744.974.980	74.497	27.230	41,1
Total	2.915.601.840	291.560	66.251	100,0

2.3 Land use and degradation

With a majority of the local population relying on small-scale farming on the predominantly sandy-loam soils, 'moderately cultivated land' is by far the predominant land use within the UDC, as can be seen from Table 2 and Figure 6 on the next page.

About 83% of Gechi woreda's households hold less than one hectare (1 ha) of land and is the highest in UDC compared to the average of 59% (Tulema, 2017), thereby illustrating the shortage of land in Gechi. Teff (8,000 ha), maize (3,100 ha) and sorghum (1,100 ha) are the main crops being cultivated. Other crops include avocado, potato, tomatoes, onion and cabbage. With a growing population this share is going to grow further on the already scarce agricultural lands, while national growing GDP and agricultural investments will push up intensively, mostly irrigated cultivated land as well. This is mainly at the expense of natural forest cover, open woodland and riverine forest, whose areas are already under pressure due to land grabbing, deforestation and soil erosion. See also Figure 2 for the impact of these land cover changes.

Table 2. Main land use within UDC

Land Use Land Cover	Area			Share
	m^2	km^2	ha	%
Intensively Cultivated Land	33.087.199	33	3.309	5,0
Moderately Cultivated Land	447.272.176	447	44.727	67,5
Natural Forest Cover	122.580.525	123	12.258	18,5
Open Woodland	8.348.740	8	835	1,3
Riverine Forest	42.333.404	42	4.233	6,4
Settlement	8.881.628	9	888	1,3
Total	662503672,5	662,5	66.250	100,0

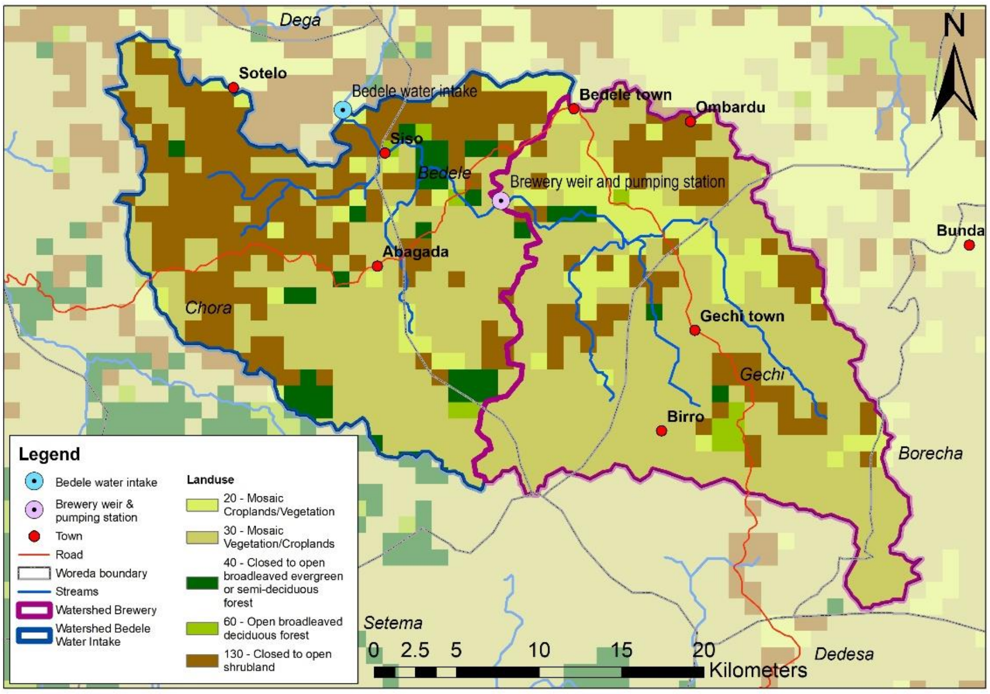

Figure 6. Dominant land use in the UDC

This trend is also reflected by analysis of areas most prone to erosion and land degradation (Tulema, 2017). See also Figure 7 on the next page. For seven *kebeles* East Gechi this equals to over 6,000 ha of degraded land. The UNIDO report (2017) even mentions a total area of approximately 7,300 ha which is degraded, while Gechi Woreda technical staff of the Agricultural Office working on the SLM implementation even speak about 15,000 hectares of degraded land within Gechi Woreda alone.

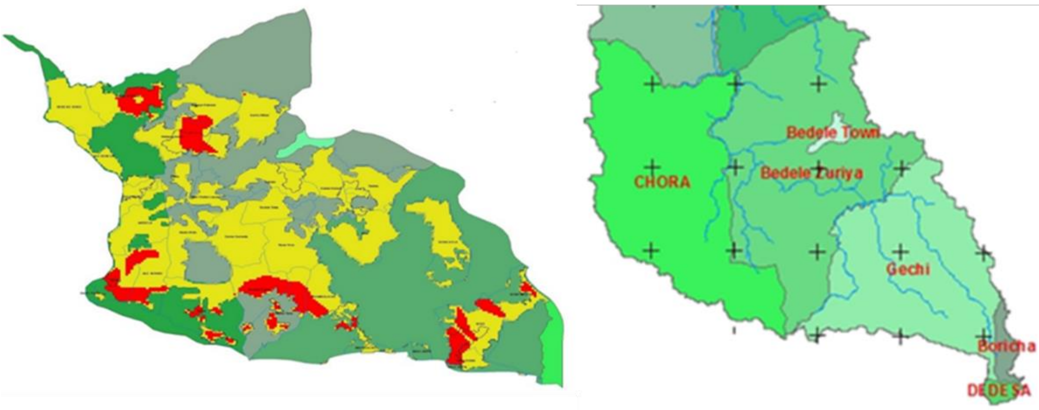

Figure 7. Distribution of 'high risk' (yellow) and 'very high risk' (red) areas most prone to erosion and land degradation in the UDC (source: adapted from 'Tulema, 2017')

The current population density, expected growth, coupled with with increased pressure on land resources, indicates that the upstream area of the Dabane catchment (i.e. the Upper Dabane Catchment) is a preferred target area for sustainable soil and water conservation (SWC) activities. The UNIDO report (Tulema, 2017) already indicated that any activities should start from Gechi *woreda*, since it is at the source of the Dabane River and has most severely degraded lands.

3 Intervention opportunities towards water balancing

The type of proposed interventions to reach a neutral water balance – as described earlier in paragraph 1.3 – are: A) infiltration structures (e.g. 3R techniques) and SWC measures, B) reforestation activities, and C) improvement of access to safe drinking water for the local population.

Based on literature study especially the effect of infiltration structures, SWC measures and reforestation activities can be significant towards reduced runoff, enhanced infiltration and soil loss. Earlier research in Northern Ethiopia shows for example that soil loss due to erosion can be reduced with 49 to 85% with on-farm rainwater harvesting techniques (Woldegiorgis, 2017). Numbers depend on soil type, slope steepness and exact combination of measures.

A brief overview of different 3R infiltration, SWC, reforestation and water infrastructure measures are provided in the next paragraphs.

3.1 (Soil) level bunds

A (soil) level bund is an embankment along the contour, made of soil and/or stones, with a basin at its upper side (Hurni *et al.*, 2016). Alternatively, there is also a level Fanya Juu ('throw uphill' in Swahili), which has its basin at its lower side and whereby the soil is moved upslope for construction. Both bund types reduce or stop the velocity of overland flow and consequently soil erosion. Level bunds are about 50 – 75 cm high and have a bottom width of 100 – 150 cm and a water retention basin on their upper side. Usually, tied ridges, placed in the basin every 10 m help to prevent runoff from flowing sideways and to concentrate overflow at one point along the bund. See also Figure 8 and Figure 9 for visual impressions of (soil) level bunds. About every 50m (but this can be less dependent on local preferences) a gap can be left open to allow oxen pulling ploughs to cross and reach their land.

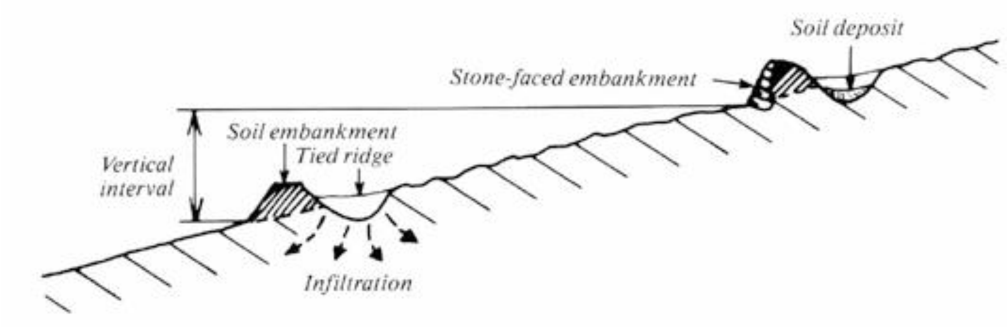

Figure 8. A cross-sectional view of (soil) level bund. With a level Fanya Juu bund the soil or stone-faced embankment is placed on the upslope side of the basin (source: Hurni *et al.*, 2016)

Figure 9. The level bund fin front of the slope follows a horizontal line. The basins behind the bund are separated by tied ridges about every ten metres. The newly constructed embankment still needs more revegetation. For this gentle slope, a 1m vertical interval was used because the slope gradient is less than 15%. In the background, parallel bunds which allow cattle to cross the land during ploughing are set up with some alternating gaps between them (source: Hurni *et al.*, 2016)

Adimassu *et al.* (2014) found that plots which were protected with graded soil bunds the average annual runoff was reduced with 28% and the average annual soil loss by 47%. Depending on slope steepness and based on type of crop and crop factors in Universal Soil Loss Equation, Morgan (2005, p123) indicates that contour bunds can reduce erosion rates with even 55 to 70%.

3.2 Trenches

A trench is a short ditch dug along the contour (i.e. across the slope) to trap runoff water in dry and moist areas (Hurni *et al.*, 2016). The trees will be planted in a planting pit in the centre of the trench (Figure 10). Trenches are particularly useful to help rehabilitate degraded lands. A trench is normally 2 – 3 m long and 30 – 50 cm deep, depending on soil depth. Trenches should be spaced about 1 m apart along the contour, and the rows should be staggered with a distance of 2 – 3 m so that overflow flows into the next trench below.

Typically, the soil dug out to make the trench is being used to form a tied ridge along the embankment of the lower side of the trench (i.e. a **soil level bund**). Therefore, trenches are usually applied in combination with **(soil) level bunds**, as can be seen in Figure 11. In combination with (soil) level bunds, trenches or tied contour ridges can reduce erosion rates up to 80 to 90% (Morgan, 2005, p123).

Figure 10. This sketch shows alternating trenches. Note that the level of the soil left in the centre of the planting hole is slightly lower than the trench (source: Hurni *et al.*, 2016)

Figure 11. Combined application of soil level bunds and alternating contour trenches under SLM program in Gechi woreda (*photo credit: Acacia Water)*

3.3 Microbasins and eye-brow basins

Microbasins (MB) and eye-brow basins (EB) are small structures with the shape of a half or full circle, excavated to obtain a small basin for planting a tree (Hurni *et al.*, 2016). Cropping trees already planted frequently include: avocado, banana and mango trees. See also Figure 12 - Figure 14. Microbasins vary in size according to their designation to conserve water, but are mostly small (~1 m^2) in moist to wet agroecological zones. Considering the size of MBs in moist areas, the estimated water retention is approximately 0.5 m^3 per MB. Eye-brow basins typically have a wider diameter, covering 2 – 3 m^2, resulting in an estimated average water retention of 1 m^3 per EB. Mixed with **hillside terraces** (paragraph 3.4), microbasins and eye-brow basins can be used as an economic means of water conservation.

Figure 12. Microbasins are used for tree planting in dry or degraded areas. Pits are dug in the centre of the basin for optimum use of stored water (source: Hurni *et al.*, 2016)

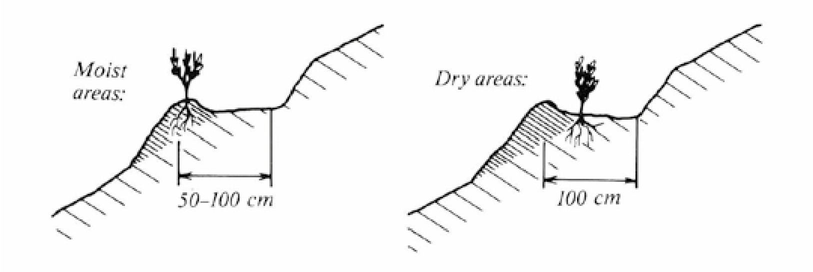

Figure 13. Cross-section of a microbasin (MB)

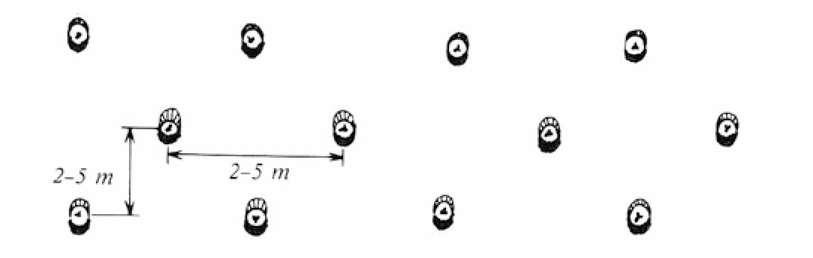

Figure 14. Spacing or placement of microbasins (source: Hurni *et al*., 2016)

3.4 Hillside terrace

A hillside terrace is a structure along the contour, where a strip of land is levelled for tree planting (Hurni *et al*, 2016). Hillside terraces are up to 1 m wide, are lined along the contour and constructed at about 2 – 5 m vertical intervals. Hillside terraces are mainly used to prevent damage from flooding below steep slopes, but also help to retain runoff and sediment on steep sloping land, enhance rainwater infiltration and to accommodate tree seedlings planted on them. They are also effective for conserving water on Badlands and in areas with low rainfall. Morgan (2005, p123) states that depending on the design, hillside terraces can reduce erosion with 65 to 99% (based on crop factors in Universal Soil Loss Equation).

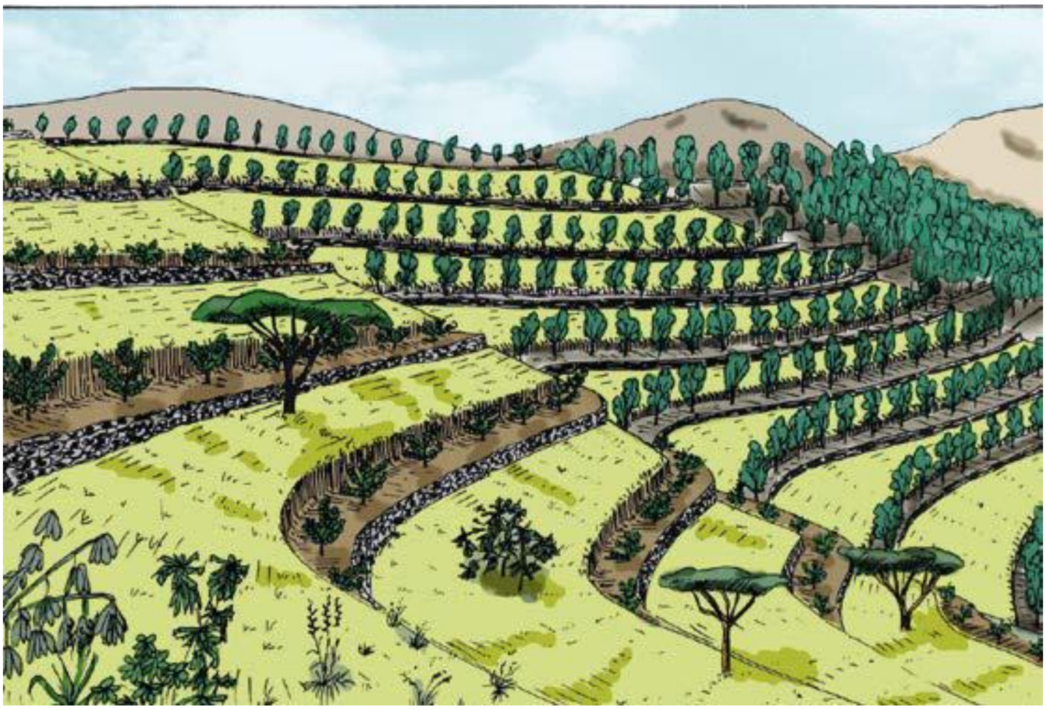

Figure 15. Sketch of hillside terrace application on heavily degraded slopes (source: Hurni *et al.*, 2016)

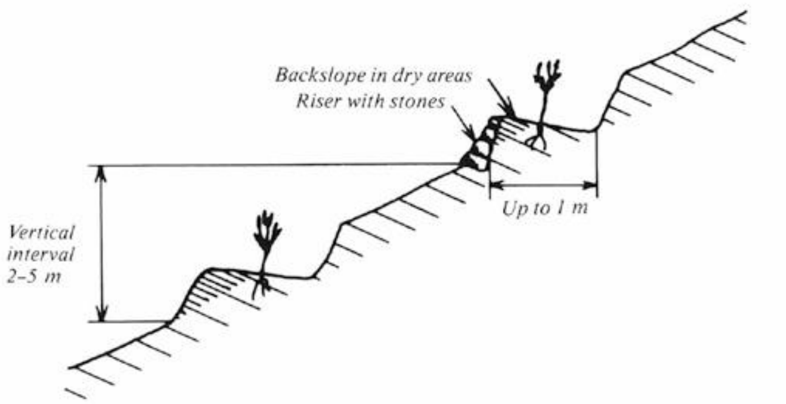

Figure 16. Cross-section of hillside terrace

Based on aforementioned study results and for conservative reasons a fixed runoff reduction percentage of 30% for the application of **(soil) level bunds**, tied contour ridges, water collection **trenches**, **microbasins** (MB) and/or **hillside terracing** is being applied to calculate water savings. All aforementioned 3R and SWC infiltration measures can be combined with planting of cash-crops avocado, banana and mango trees.

3.5 Gully rehabilitation & re-vegetation

A gully is formed when rill erosion expands by deepening and widening into a growing channel. As the channel deepens, it undercuts it head- and sidewalls, eventually forming a steadily expanding gully. Preventing a gully is better than cure. Thus, save money and labour by treating a gully in its early stage, when it is easy, rather than waiting until it is too late.

There are three major principles for controlling gullies:

1. Reducing the runoff coming into the gully by conserving water in the catchment so that it does not reach the gully, for example by (soil) level bunds, mulching, microbasins (MB) or trenches;
2. Diverting the water away from the gully with a Cutoff Drain or safe Waterway;
3. Conveying the water safely through the gully by reducing its speed and breaking its erosive force with Checkdams (see next paragraph) and various vegetative barriers.

Rehabilitation of a gully is a cumbersome process, but can become a productive land once again, transforming the line of destruction into a line of production. It involves revegetation and other measures to stabilize or even remove the gully. A cutoff drain above major gullies is useful for the time of establishment of **revegetation** in the gully if the diverted water can be drained safely. Area Closure reduces the amount of runoff into the gully. Also **trenches** and/or **microbasins** help to reduce the runoff into the gully. **(Soil) level bunds** should be used to retain the water in the catchment above the gully.

Revegetation can be used on all physical structures such as **level bunds**, **Fanya Juu bunds**, cut off drain and waterways and behind **gully check dams** (see paragraph 3.7). Also here, the most applied vegetation are stronger plant and tree types such as: bamboo, banana and mangos. The most important issue for successful revegetation is the complete exclusion of grazing animals from the area throughout the year. Other important steps include: (i) regularly cutting of weeds which grow during the rainy season and (ii) planting of sods of grass and legumes, although native species will grow best, and are well known to the farmers for their quality and value.

3.6 Reforestation

Related to **gully revegetation** is reforestation. Reforestation is the most effective way to conserve soil and water. Grass is able to reduce soil erosion greatly if established well. Grass also helps to stabilize bunds and other structures significantly if cattle are excluded from grazing all year. For selection of vegetation species choosing for native species is best, since they typically will grow better, and are more well-known to local communities for their quality and value, although all trees and grasses that bring benefits to the community – if taken care of – can be selected. Pioneer trees such as *Acacia salgina*, *Sesbania sesban*, willow (*salix spp.*), *eucalyptus spp.*, bamboo and banana can be considered.

Moving from bare soil to a proper grass cover or dense shrubbery with forest litter can reduce runoff rates with 50% (based on Manning's n-values determined by Harley 1975 and Hathaway 1945 in Morgan 2005).

For both **reforestation** and **re-vegetation,** it is therefore also important that an extensive seedling production, collection and planting program needs to be established. Within Gechi *woreda* this is already established under the existing SLM program.

Figure 17. Visit to implemented SLM landscape restoration measures in Gechi woreda (*photo credit: Acacia Water)*

3.7 Gully check dams

A check dam is an obstruction wall across the bottom of a gully or a small river to reduce the velocity of the runoff and prevent deepening or widening of the gully (Hurni *et al*, 2016). Gully check dams can be made of any material available locally, such as stones, live or dead branches, bamboo shoots, wooden poles, gabions, etc. See also Figure 18 and Figure 19. Gully check dams prevent the widening and deepening of a gully, and help to fill it up with sediment. They reduce the velocity of runoff in the gully. The potential energy is absorbed below the vertical drops of the overflow or spillway. Sediments are deposited behind the check dams so that the slope gradient of the gully is also reduced.

Based on literature and experience by Acacia Water, <u>an average check dam</u> with a length of 20m and a height of 2m <u>can annually slow down and retain approximately 250 m³ of water</u>.

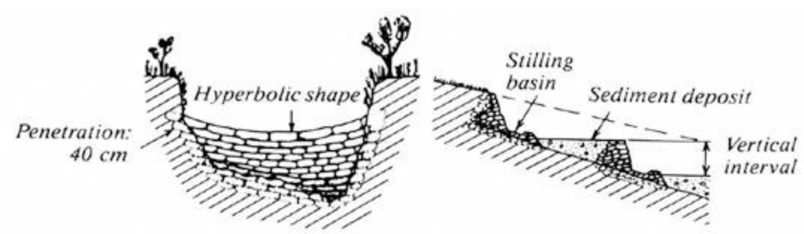

Figure 18. A gully cross-section and a section along the gully to show dimensions and vertical interval of checkdams (*source: Hurni et al., 2016*).

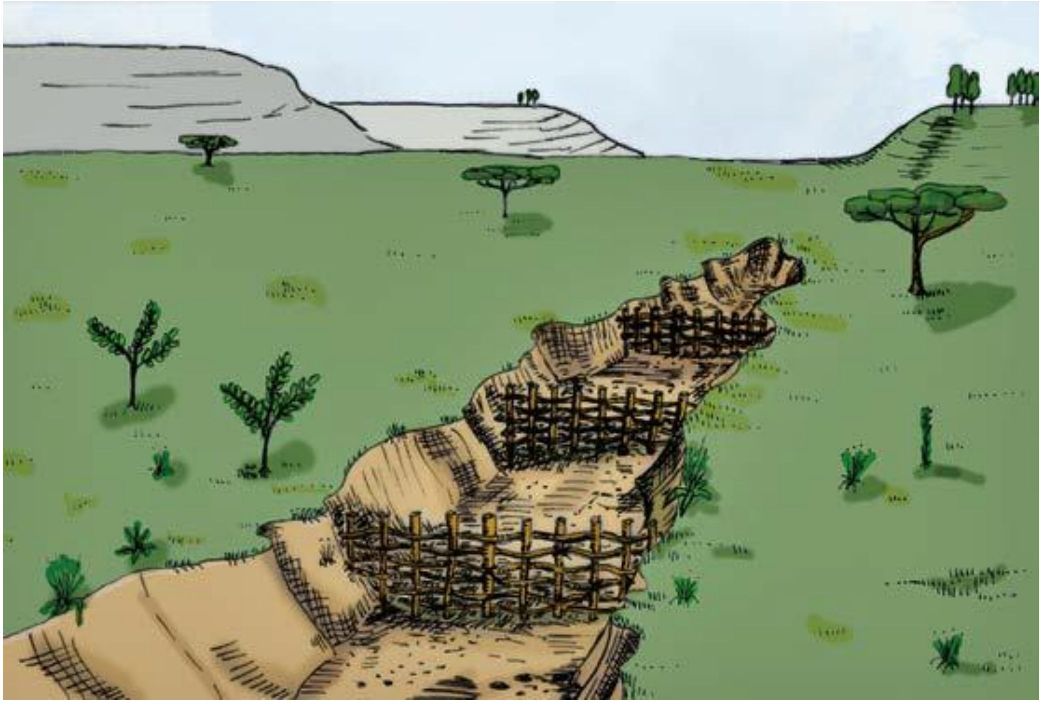

Figure 19. Sketch of a gully treated with a check dam, which in this case consists of brushwood. This can be very effective, particularly for smaller gullies, which are refilled with soil over a longer period. Instead of brushwood also hardcore boulders and/or bamboo shoots can be used. The structures should not be too far apart (*source: Hurni et al., 2016*).

3.8 Improved agricultural practices

To sustain and maintain any landscape and ecosystem restoration measures it is of paramount importance that agricultural practices by farmers within the UDC improves. Capacitating farmers, extension workers and governmental technicians and policy-makers in improved agricultural practices is therefore essential. A selection of improved agricultural practices with high anticipated impact and effectiveness are provided in the following paragraphs.

3.8.1 Mulching or no-tillage

Applying mulch means covering the soil with crop residues such as straw, maize and sorghum stalks, tree leaves, or other plant material or standing stubble. The cover protects the soil from the hot sun and from the impact of raindrops, minimizing soil crusting, erosion and runoff. Maintaining crop residues or mulch on the field reduces soil erosion and has a considerable potential for the restoration and maintenance of soil fertility. When to use mulch:

- No tillage;
- Under conventional tillage: plough under the mulch before planting the main crop to incorporate it into the soil;
- Under conservation tillage: keep the mulch on the field while the crop is growing so the mulch controls weeds.

Applying mulch (and no tillage) is an effective method to reduce soil erosion, in particular on slopes up to 15%. Morgan (2005) indicates that moving from traditional techniques (conventional tillage and no residue) to <u>no tillage with high residue cover can reduce runoff rates with 30 to 80%</u> (based on Manning's n-values determined by Engman 1986 in Morgan, 2005).

3.8.2 Agroforestry and Farmer Managed Nature Regeneration (FMNR) approach

One way of increasing the water harvesting potential of landscapes as well as maintaining good soil management and tree coverage is dryland farming or agroforestry. It aims at maximizing application of different plants and crops, mimicking nature. Sustainable and regenerative dryland farming or agroforestry incorporates rainwater harvesting measures (such as 3R and SWC) and a good understanding of the biophysical context, but includes also drought tolerant cropping and perennial crops.

The Farmer Managed Natural Regeneration (FMNR) is becoming a more and more popular and mainstream approach complementary to agroforestry movements, is especially applicable to dryland tropics and is considered a good entry point for resource-poor and risk-averse farmers to adopt a low-cost and low-risk technique.

The main aspects for successful dryland farming (including agroforestry and FMNR) are:

- Making water available: Harvesting all rainwater, and making sure it infiltrated into the soil, so that soil moisture and shallow groundwater are recharged. This is done by applying the earlier mentioned 3R measures such as **(soil) level bunds**, **trenches**, **microbasins** and **eye-brow basins**, **hillside terraces** and **gully check dams**;
- Improving soil fertility: Covering the soil as much as possible with organic matter (**mulching**) in order to prevent evaporation, prevent soil erosion and increase soil fertility and infiltration of rainwater;
- Increasing plant cover through **reforestation** and **agroforestry**: Planting a combination of as much different plants as possible using different layers (tall and small trees, shrubs, climbers, ground covering plants and annual crops) in order to maximize growth during the whole year, keeping the soil covered and improving resilience to droughts (different plants respond different to droughts).

Figure 20 gives a glimpse how the abovementioned combined application of 3R, SWC and agricultural practices can lead to successful agroforestry or dryland farming.

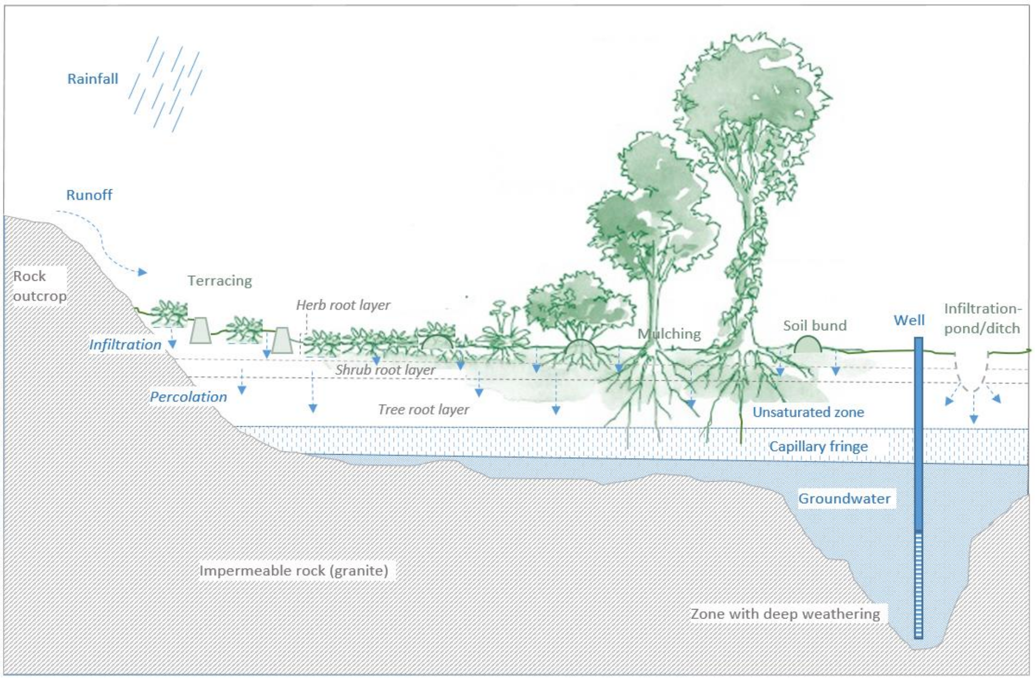

Figure 20. The combination of 3R and SWC measures that makes dry land farming successful

Experiments with conservation agriculture and agroforestry on steep slopes indicated a decrease of 12% in runoff rates and 60% in erosion-related soil loss (Acacia Water and MetaMeta, 2017). On average infiltration capacity increases threefold when moving from traditional rainfed or irrigated crop farming to agroforestry systems (Ilstedt *et al.*, 2007). Morgan (2005) also states that the changing of low-productivity crops such as maize, sorghum and millet fields into agroforestry systems or high-mulching cropping systems can reduce erosion rates with a factor 500 (so 500 times less erosion, and based on crop factors in Universal Loss Equation).

3.9 Water resources development

To reach the third main type of intervention (C. improvement of the access to drinking water for the population in the catchment; paragraph 1.3) improved water infrastructure and supply facilities need to be provided. Based on the biophysical conditions of the UDC area (Chapter 2) and stakeholder consultation implementation options have been weighed. The main interventions identified as high potential for water resources development are: spring development, shallow hand dug wells (HDW) and boreholes, and stream dam or diversion weir.

3.9.1 Spring development

According to stakeholder consultation there used to be many natural springs present in UDC, although exact numbers are unknown. Spring development as a clean water source may then be an option. A spring is water that reaches the surface from underground supply, appearing as small water holes or wet spots on hillsides along river banks. Springs can be used to collect its spring or seepage water and can (untreated) be used for livestock and agricultural purposes. Springs can be (re-)developed by enhancing its recharge, removing obstructions to the flow (e.g. fine-grained sediments, rock and vegetation), collecting the water flow and storing the water (i.e. 3R approach).

There are three main methods of spring development for use as drinking water sources:

1. Spring boxes;
2. Horizontal wells; and
3. Seep development.

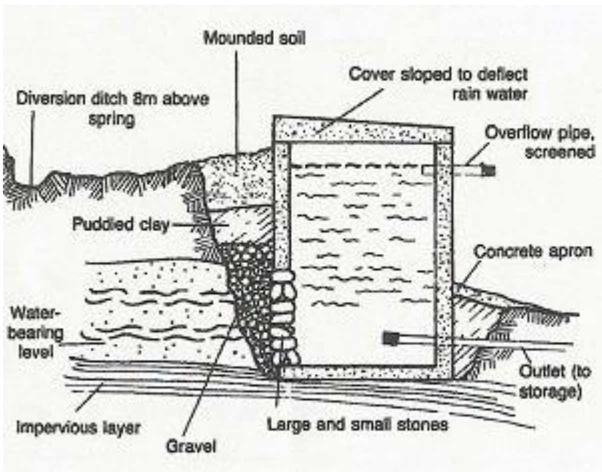

Figure 21. Spring box with permeable side (source: USAID, 2015, entitled "Water for the World")

Spring boxes

A small area is dug out around the spring and lined with gravel (A Layman's guide to Clean Water, 2015). A concrete box with a removable cover is placed over the spring to collect and store the water. The cover prevents contamination and should be heavy enough to keep people from removing it to dip buckets and cups into the collection box. A tap and an overflow to prevent a back-up in the aquifer should be installed. For springs that flow from one spot on level ground, an open-bottomed spring box should be placed over the opening to capture all available flow.

Horizontal well

Where a spring has a steeply sloping water table (steep hydraulic gradient), horizontal wells may be used for spring development. Horizontal well intakes must be located in an area with a sloping water table in order to have adequate discharge.

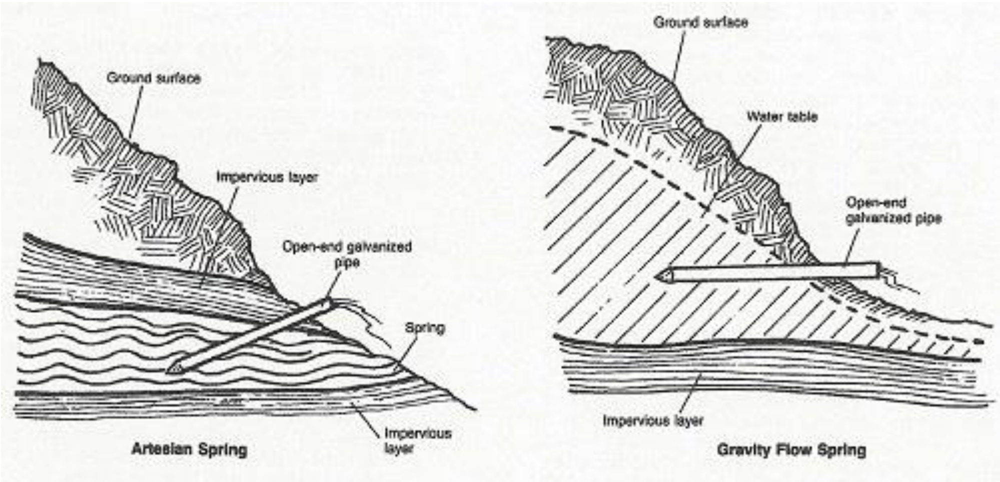

Figure 22. Cross-section view of horizontal wells (source: USAID, 2015, entitled "Water for the World")

Pipes with open ends or with perforated drive points or well screens can be driven, jetted, or augured into an aquifer horizontally or at a shallow slope to tap it at a point higher than the natural discharge.

The pipe must also enter the aquifer deeply enough to ensure the required minimum flow throughout the year. The water supply reaches the surface by flowing from the tapped aquifer through the installed pipe. See Figure 22 for an example of intake placement for horizontal wells.

Seep development

If water seeps from the ground and covers an area of several square meters, a third method may be used. Pipes can be laid to collect the underground water and transport it to a collection box as shown. A poured concrete wall just downslope of the pipes can trap the water for more efficient collection. With this seep water collection method, maintenance costs are higher as pipes often clog with soil or rocks. Also, the expense and difficulty of construction may prohibit its use. Unless the seep supplies abundant quantities of water, this method should not be considered.

General remarks

Based on the consultant's experience and literature the <u>average spring abstraction capacity is around 0.7 m³ per hour per spring</u> (any type). Based on 8 hours of abstraction per day, 5.6 m³ or 5,600 Liters of water can be abstracted on a daily basis from one spring, thereby able to supply 225 persons (considering the national water supply standard of 25 liter per person per day within one kilometer).

Considering the proposed and combined implementation of **3R and SWC measures**, area closures, **reforestation** and **improved agricultural practices**, and the resultant enhanced groundwater recharge it is expected that existing springs within the area will start flowing with larger volumes and year-round again. Spring development can be made on gully lands, below forest and shrub lands.

3.9.2 Shallow wells and boreholes

Another effective method can be the rehabilitation and construction of new hand dug wells (HDW) and shallow boreholes (SBH), as this is to date still the major source for potable water supply for inhabitants of UDC according to information collected from Gechi Woreda Water Office.

The water offices of the woredas have extensive experience with implementation of HDWs and SBHs. It is important and advised to execute good and in-depth preliminary groundwater assessments and geophysical surveys in order identify prospective areas with high potential for shallow groundwater).

Based on the consultant's experience and literature the average abstraction capacity is around 0.7 m^3 per hour for both HDWs and SBHs. Considering the national standard of 25 L/c/d and 8 hours of water supply, 225 persons can be supplied from one constructed HDW or SBH.

3.9.3 Diversion weir

A diversion weir (sometimes called an overflow dam), is a small dam created across a valley or river channel and often used to create an impoundment reservoir. Diversion weirs are well-known water barriers in the Dabane Catchment to divert water to irrigation schemes. The barrier across the river causes water to pool behind the structure (just like a dam), but allows water to flow over the top (Figure 23). Most weirs are used to create a pool of water abstraction and irrigation purposes, but they are sometimes also used for drinking water supplies or beverages production (e.g. Bedele Brewery intake).

Figure 23. Typical (flood) diversion weir for water harvesting and stream diversion (photo credit: Bancy Mati, 2016)

In the case of Bedele Zone and Dabane catchment, diversion weirs are mainly targeting irrigated agriculture. From interviews with Agricultural officers of Gechi Woreda it is understood that there are 3 existing diversion weirs in UDC, while currently an irrigation scheme of 11 ha with diversion weir is under construction in Gole Kora woreda and a similar scheme of 17 ha is currently being built in Golo Maya woreda. Based on literature studies and the consultant's experience the estimated average water storage capacity or volume of a diversion weir is approximately 10,000 m^3.

Nevertheless, realizing and understanding that all irrigated agriculture eventually leads to salinization[7] of agricultural lands, further implementation of diversion weirs for the purpose of irrigated agriculture is not advised. Alternative farming methods, such as dryland farming and agroforestry (see paragraph 3.8), offer good opportunities for healthy and fertile soils for farming and should therefore be adopted and implemented. It is therefore advised that the SLM coordination unit and Agricultural Offices of the *woredas* within Bedele Zone focus more on improved agricultural practices, such as **mulching** and **agroforestry**.

If irrigated agriculture through diversion weirs wants to be continued, clear agreements should be made at Zone level with the different stakeholders in regard to water intake volumes, most notably with the water utility from Bedele town, Bedele Brewery as well as with the different Agricultural Offices of the *woredas* within UDC/Bedele Zone.

[7] All surplus water of irrigated agriculture is lost to the ground and will eventually evaporate into the sky. This upward flow of water transports mineral to the surface, resulting in salt concentration in the soil surface. When the concentrations of salt reach levels of 0.5 to 1.0%, the concentration becomes toxic for most plants and soils become unfertile and can no longer be used for cultivation.

Sustainable implementation of diversion weirs for the purpose of potable water supply is still possible and has good potential within the UDC.

4 Implementation Plan

As indicated in paragraph 2.3, any sustainable water balancing, 3R and SWC activities should start from Gechi *woreda*, since it is at the source of the Dabane River, whilst it has the lowest water supply coverage and has the most severely degraded lands within the UDC.

Five *kebeles* within Gechi Woreda have been selected as target locations for the Bedele BWBP for two reasons: 1) they are not targeted by the national SLM program (interview with TC and Agricultural Office, Gechi woreda, red.), while 2) they have severely degraded and eroded lands, as can be seen from Table 3 below. Based on different sources, the total area of degraded lands within these five *kebeles* account for 35 up to 90% of the total area of degraded land in Gechi woreda.

Because they are within Gechi Woreda they fit within the implementation plan and capacity of the SLM program by the TC. With a justifiable additional (financial) support under this Bedele BWBP they will be able to extend this to implementation of landscape restoration measures in the five proposed kebeles.

Table 3: Target kebeles under Bedele BWBP

S. No	Woreda	Kebele	Area in UDC (km²)	Area of Degraded Land (ha)	Pop. In UDC (2016)
1	Gechi	Jisa	20,152,200.00	1,641	3,385
2	Gechi	Koba Kela	22,822,600.00	1,504	3,819
3	Gechi	Gole Kora	11,740,000.00	939	2,229
4	Gechi	Gole Maya	5,141,040.00	411	1,164
5	Gechi	Gole Seka	12,815,300.00	1,025	2,185
				5,521	**12,782**

4.1 Proposed Workplan

The activities proposed in this workplan or Implementation Plan for the Bedele Brewery water balancing – including type and number of interventions – are based on activities and interventions implemented under the SLM program in Gechi Woreda and the different 3R infiltration, SWC, reforestation and water infrastructure measures introduced in Chapter 3. Documents provided by the TC and Agricultural Office of Gechi Woreda, provided a good insight on the scale, and amount of labour and work achieved on approximately 7,000 ha addressed under the SLM progam. Under this three-year program (2016 – 2019), for example, 141km of **soil level bunds**, 16km of stone faced soil bunds (**Fanya Juu bunds**), 12,372 pieces of water collection **trenches**, and 110km of **hillside terraces** have been executed.

For drafting of the proposed activities for the Bedele BWBP the following six main points were considered:

1) Meeting the water balancing target of 90,000 m³ per year;
2) Targeting the 5,521 ha of degraded land in five *kebeles* in Gechi Woreda;
3) Proposed activities in the Bedele BWBP should be in line with the executed activities by the TC and Agricultural Office of Gechi Woreda under the SLM program;
4) Proposed activities must physically and capacity-wise fit within the context of Gechi Woreda;
5) Likewise to the SLM program, it is intended that actual implementation will predominantly be executed by community labour;
6) Establishing Community Based Organizations (CBOs) towards sustainability.

In order to determine the possible surface runoff reduction of **(soil) level bunds, trenches, microbasins (MB)** and/or **hillside terracing** combined, first the actual surface runoff (Q_{surf}) after a rain event needs to be determined. Q_{surf} is again based on average daily rainfall (R_{day}), the soil retention parameter (S) and the soil erodibility factor (K_S). Based on the annual average rainfall of 1965 mm within the Upper Dabane Catchment an average daily rainfall depth could be established. Since predominantly sandy loam soils are present within the UDC in a mountainous landscape with contoured field and through literature study the soil retention parameter and soil erodibility factor could also be established. An overview is provided in Table 4 below.

Table 4. Parameters for surface runoff (Q_{surf}) calculations

Parameter	Description	Value	Source
R_{day}	(average) daily rainfall depth	5.38 mm	Based on annual average rainfall
Soil retention parameter (S)	Retention parameter for sandy loam (S_L) and contoured fields. Range: 68 – 114 mm	91 mm	Zhang (2010), Das *et al.* (2005)
Soil erodibility factor (K_S)		2.94 E^{-07} m/s^{-1}	Pachepsky *et al.* (1984)

Based on these parameters Q_{surf} was found at 39%, meaning that with a rain event of 10mm nearly 4mm runs overland off to streams and rivers instead of infiltrating into the ground. The runoff reduction percentage of the combined 3R and SWC infiltration measures is again based on literature studies, while maintaining a conservative number, and therefore set at 30%. Based on a total area of 5,521 ha (or 55.21 km²) of degraded land and assuming 50% efficiency in targeting 3R and SWC interventions, an estimated 17,000 m³ of water will be prevented from running off superficially, but will infiltrate locally into the ground, thereby eventually ensuring a prolonged and more stable baseflow in the Dabane River.

Since communities are used to providing community labor through the existing SLM program, it is suggested that actual implementation of interventions will predominantly be executed by local communities against the standard national SLM-reimbursement of 24 ETB/day (i.e. 24 ETB/PD).

Based on aforementioned considerations, assumptions and the different 3R infiltration, SWC, reforestation and water infrastructure measures introduced in Chapter 3, a workplan for the Bedele BWBP is proposed which can be found in Table 5 on the next page.

4.1.1 Monitoring of water balancing targets

Monitoring of meeting the water balancing targets to be achieved will mainly be twofold:

1) short-term impact of interventions in terms of water volumes will be based on analytical calculations. Rough water saving estimations are already provided in Table 5 'Proposed Workplan and activities' on the previous page. Water saving estimations will have to be revised after refinement and sequencing of the final implementation plan;
2) long-term changes in water volumes will be monitored through the upgrading and installation of telemetric river gauging stations at two points in the downstream part of Upper Dabane Catchment. Installation of a telemetric river discharge monitoring system is further elaborated in the next paragraph.

4.1.2 Telemetric discharge monitoring at Brewery water intake

The field visit to the Brewery water intake in May 2018 showed there is a need to upgrade the discharge monitoring. The reasons for upgrading are twofold:

1) Need for the Brewery's operations to be able to predict low water flows (<400 m³ per hour) in the Dabane River, and to undertake actions and prepare mitigation measures when the base flow drops under the critical level of 150 m³ per hour;
2) To establish a timeseries of measurements and identify long-term changes in water volumes, and be able to relate this to water savings as result of the implemented SLM, 3R and SWC interventions as proposed in Table 5.

For both objectives installation of telemetric river gauging stations at two points in the downstream part of the UDC is proposed, of which at least one just upstream of the Brewery's intake and one just downstream of it. Current proposal is to install an ATMOS-41 all-in-one weather station and a HYDROS-21 three-in-one water level sensor in combination with the ECH2O Em50 data logger of the Meter Environment Group[8].

A final survey and design plan for this (telemetric) river discharge monitoring system at the Brewery water intake will be drafted by MS Consultancy, but can only commence when water levels in the Dabane River have dropped. This work is scheduled for April 2019 and is still part of the Proposal Letter for Bedele Brewery Water Balancing Plan: preparatory phase 2018 (Acacia Water, 2018b). Staff of MS Consultancy will also have to determine if telecommunication signals will be strong enough to place telemetric equipment at the Brewery's water intake.

As can be seen from Table 5 on the next page, the proposed activities require a total community labour input of nearly **147,000-person days (PD)** distributed over one year (2019), while intervention implementation have a mere estimated cost of **4.0 million Ethiopian Birrs (ETB)**. The calculated and projected water savings (either in the form of reduced runoff, infiltrated or locally stored) as resultant of these combined interventions will exceed **120,000 m³ of water per year**, which equals to an average cost-efficiency of 18.09 ETB per m³ and exceeds the actual water savings target of 90,000 m³/year by 33%.

[8] https://www.metergroup.com/environment/products/

Table 5. Proposed Workplan and activities, including estimated costs and water savings

No	Activity	Amount	Unit	Labour/costs	Unit	Total amount of PD required	Estimated costs [ETB]	Water saving; description	Water saving; estimation [m³/year]	Cost-efficiency [ETB/m³]
1	(Soil) level bunds	50	km	150	PD/km	7,500	180,000.00	30% runoff reduction	For 4 SWC measures combined: 17,399	33.22
2	Fanya Juu (stone faced soil) bunds	5	km	250	PD/km	1,250	30,000.00	30% runoff reduction		
3	Water collection trenches	5,000	no	2	PD/3 trenches	3,333	80,000.00	30% runoff reduction		
4	Hillside terraces (including trench construction)	40	km	300	PD/km	12,000	288,000.00	30% runoff reduction		
5	Gully check dams (e.g. gabions) construction and maintenance. Average size: 20 m³ (20m x 2m x 0.5m)	50	no	160	PD/no	8,000	192,000.00	~ 250 m³/check dam	12,500	15.36
6	Gully re-vegetation (0.5% of degraded land)	30	ha	550	PD/ha	16,500	396,000.00	No direct/calculable water savings	-	
7	Reforestation (1% of total degraded land)	60	ha	550	PD/ha	33,000	792,000.00	No direct/calculable water savings	-	
8	Microbasin (MB) construction	10,000	MBs	1	PD/5 MBs	2,000	48,000.00	0.5 m³ retention/MB	5,000	9.60
9	Eye-brow basin (EB) construction	4,000	EBs	1	PD/2 EBs	2,000	48,000.00	1.0 m³ retention/MB	4,000	12.00
10	Spring development	10	no	1,700	PD/no	17,000	408,000.00	0.7 m³/hr/spring	20,440	19.96
11	Rehabilitation and construction of new hand dug wells (HDW) and shallow boreholes (SBH)	20	HDWs and/or SBHs	50,000	ETB/HDW or SBH	34,000	1,000,000.00	0.7 m³/hr/HDW or SBH	40,880	24.46
12	Diversion weir (or overflow dam) construction	2	Dams	5,000	PD/dam	10,000	240,000.00	~10,000 m³/weir	20,000	12.00
13	Installation of telemetric river and discharge monitoring system at Bedele Brewery intake	2	no	150,000	ETB/no		300,000.00	N/A	-	
					Sub-total	**142,636 PD**	**4,002,000.00**	**ETB**	**120,219**	**18.09**
					Sub-total		119,463.00	EUR		0.54 EUR/m³

4.2 Work and time planning

Exact planning of works, locations of interventions, sequencing of activities and within which time-frame is critical and needs further elaboration and coordination. This needs to be discussed with the field level team, wherein at least the to be appointed project manager of WVE, the TC of Gechi Woreda, Agricultural Office, and contact person of Bedele Brewery, should be represented. Also, community representatives of Gechi and/or Bedele *woredas* should be included to make the plan more practical, the process more participatory and sequencing of activities more ground-reality based. To sequence the activities there is a need to determine expected key-outcomes, outputs and then activities under each output.

Experiences from the national SLM program learns that a three-phased approach towards the landscape is most effective;

1. Start with the most-affected higher grounds of an area through mitigation measures, such as gully check dams, re-vegetation, (soil) level bunds and micro-basins (Q1 & Q2);
2. Then address and construct bigger (water) infrastructure measures in the lower reaches near or around a stream or catchment area, such as diversion weirs and check dams, and improve the agricultural practices on fields (Q2 & Q3);
3. Lastly focus on the middle part of the landscape with small-scale SWC interventions to reduce run-off, enhance water infiltration and the development and accretion of (re-)vegetation, for example through construction of trenches, hillside terraces, eyebrow basins, and reforestation (Q3 & Q4).

Further elaboration, sequencing and planning of project interventions and activities can be executed after acceptance of this Water Balancing Implementation Plan and signing of the Memorandum of Understanding (MoU) between WVE and HBSC, and should be initiated by the new project manager/coordinator of WVE. The total timeframe for the Bedele BWBP is one year: January 2019 – December 2019.

4.3 Coordination and management

Execution, implementation, coordination and management of proposed interventions under the Bedele BWBP is proposed to be coordinated by an appointed project manager/coordinator from World Vision Ethiopia (WVE; see Box 1 below) and the executive technical committee (TC) of Gechi Woreda, Agricultural Office. The choice for WVE is their long-term presence in Gechi and Bedele *woreda* and their intention to start soil and water conservation (SWC) activities in these woredas (WVE is active in SWC activities in other parts of the country). The project manager/officer of WVE should have a background in land and water management, or at least experience in execution of land and water management (or natural resources management) related activities and could be stationed at one of their existing offices in Gechi and Bedele town.

Execution of activities will be in close collaboration with a representative and contact person Bedele Brewery (the Human Resource manager of the brewery has been proposed) and with the SLM focal point within the Agricultural Office of Gechi Woreda (Mr. Adame Telegn, Head of Agricultural Office, or Mr. Tarikes Tesema, Head of Gechi Watershed).

Co-operation between HBSC/Bedele Brewery and WVE has been discussed further within the framework of this project, and they have come to an agreement of co-operation on basis of a public-private partnership (PPP). It would be recommended to sign a MoU for this PPP, whereby the different long-term and sustainability objectives of each organization are also acknowledged.

Box 1: World Vision Ethiopia

World Vision Ethiopia (WVE) is the biggest child focused NGO operating in Ethiopia since 1975, including emergency response programmes during the 1984 famine. This was followed by a period of rehabilitation (1986 – 1987) and a self-review that came up with the concept of Area Development Programmes (ADPs) as a model.

World Vision's work in Ethiopia contributes to the wellbeing of vulnerable children in partnership with the church, civil society and the government. In more recent years WVE has started to seek cooperation with and support from private sector as well. Initiatives include education, food security, health, WASH, but also more and more integrated water resource management and landscape/ecosystem restoration. All programmes are implemented with the goal of addressing the strategic and basic needs of children while supporting and building long-term capacity of families and communities.

WVE is implementing development programs in Gechi and Bedele woredas mainly on education, irrigation, SWC, water supply and child development. It also supported the construction of 5 springs since 2015.

Technical and institutional support and back-stopping on implementation of activities will be provided by Acacia Water, MSC and WVE.

Cost estimation of the soft interventions, including 'Coordination and Management', as part of the Workplan for the Bedele BWBP, is provided in Table 6 on the next page. Note that soft interventions account for approximately 53% of the total needed budget.

Table 6. Cost estimation of soft interventions, including Coordination and Management, of Workplan for Bedele BWBP

No.	Description	Amount	Unit	Labour/costs	Unit	Estimated costs [ETB]	
14	SLM, 3R and SWC trainings, 3 per kebele	5	Kebeles	15,000.00	ETB/training	225,000.00	
15	Project Manager/coordinator WVE	24	Months	75,000.00	ETB/month	1,800,000.00	
16	Transport and hardware investment (including 2 new motor bikes)	1	Lump sum	1,000,000.00	ETB	1,000,000.00	
17	Senior advisor WVE, including DSA	30	Days	12,000.00	ETB/day	360,000.00	
18	Technical advisor (Medior) Acacia Water	30	Days	26,000.00	ETB/day	780,000.00	
19	International flight tickets	3	Tickets	50,000.00	ETB/ticket	150,000.00	
20	Perdiem (DSA) Acacia Water staff	30	Days	7,000.00	ETB/day	210,000.00	
21	Local transport Acacia Water staff	3	Missions	17,500.00	ETB/mission	52,500.00	
					Sub-total	**4,577,500.00**	**ETB**
					Sub-total	136,642.00	EUR

4.4 Budget

Based on the cost estimations for the proposed workplan activities (paragraph 4.1) and the soft interventions including coordination and management (paragraph 4.3) for the Bedele BWBP, the total anticipated budget is nearly **8.6 million Ethiopian Birrs (ETB)**. Using a recent average exchange rate of 33.50 ETB/EUR, the total estimated amount is equivalent to approximately 256,105.00 Euros.

The distribution of costs between actual intervention implementation activities and soft interventions including coordination & management is almost the same, with a positive balance to the latter (53.4% versus 46.6% respectively).

Table 7. Total budget and cost specification

Cost item	Cost	Share
Sub-total Workplan activities	4,002,000.00	46.6%
Sub-total soft interventions	4,577,500.00	53.4%
Total in ETB	**8,484,756.00**	**100%**
	33.50	ETB/1 EUR (Av. past 90 days)
Total in EUR	**256,105.00**	

4.5 Stakeholder and Institutional involvement

Representatives of Bedele Zone (and Bedele Woreda) should be invited and actively involved in meetings, discussions, workshops and trainings under the Bedele BWBP implementation. Their exact role and contribution will be defined in a later stage while drafting this implementation plan, and should be done in consultation between the client (HBSC), the SLM technical committee of Gechi Woreda and the project manager of WVE.

Similarly: design, planning and implementation of activities should always be in close consultation and co-operation with the beneficiary *kebeles* and their local communities, since they will provide the lion's share of labour input, whilst their acceptance and ownership are needed for cost-effective, sustainable and long-term use of the implemented measures.

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