SOMALI REGIONAL STATE OF ETHIOPIA

GOOD PRACTICE GUIDELINES FOR WATER DEVELOPMENT

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Abbreviations

ACF	Action Contre le Faim
ADRA	Adventist Development and Relief Agency
AR	Annual Review
ARF	Annual Rain Fall
BoFED	Bureau of Finance and Economic Development
CBO	Community-based Organization
CLPA	Catchment Learning and Practice Alliance
DAs	Development Agencies
DFID	Department for International Development
DPPB	Disaster Prevention and Preparedness Bureau
EAC	Equivalent Annual Cost
EC	Ethiopian Calendar
EPM&EDA	Environmental Protection, Mines & Energy Development AgencyET Evapo-transpiration
ETo	Reference Crop-Transpiration
FAO	Food and Agricultural Organization of the United Nations
GDP	Gross Domestic Product
GIS	Geographic Information System
Ha	Hectares
HAVOYOCO	Horn of Africa Voluntary Youth Committee
HWEA	Household Water Economy Analysis
IDS	Institute of Development Studies
IDS/Tufts	Institute of Development Studies/Tufts
IRC	International Rescue Commitee
Kc	Crop Coefficient or Crop Factor
Lcd	Liters cubed per day
LCRDB	Livestock Crop and Rural Development Bureau
LNGO	Local Non-governmental Agency
LPA	Learning and Practice Alliance
m^3	Meters cubed
M&E	Monitoring and EvaluationMDG Millennium Development Goal
Mm	Millimeters
MUS	Multiple Use Services
NGOs	Non-governmental Organizations
O&M	Operational and Management
OWDA	Ogaden Welfare Development Agency
PCDP	Pastoral Community Development Project

PLDO	Pastoral Livelihood Development Organization
RiPPLE	Research-inspired Policy and Practice Learning in Ethiopia
RWRDB	Regional Water Resource Development Bureau
SAAD	Somali Aid & Development-Ethiopia
SCUK	Save the Children UK
SNRS	Somali National Regional State
SNNPR	Southern Nations Nationalities and Peoples Region
SO	Strategic Objective
SODIS	Solar Disinfection
SORPARI	Somali Regional Pastoral and Agro-pastoral Research Institute
SRSE	Somali Regional State of Ethiopia
TLU	Tropical Livestock Unit
TWGs	Technical Working Groups
UN	United Nations
UNICEF	United Nations Children's Fund
UNISOD-LNGO	United Society for Sustainable Development
USAID	United States Agency for International Development
WMC	Water Management Committee
WaSHCO	Water, Sanitation, and Hygiene Committee
WUA	Water Users' Association
WWO	Woreda Water Office

Preface

These guidelines have been produced by our Region for our Region in order to guide future development of our critical water resources. As you will know, our Region is acutely short of available water for a range of different uses at specific times of the year and particularly during years of low rainfall. Access to water that is affordable and of sufficient quantity—and necessary quality—is a daily challenge for our people. Yet it is central to our future development as a region.

Our communities, whether engaged in pastoralism, agriculture, or urban-based occupations, need water to support their livelihoods and to ensure the future development and prosperity of our children. As we move forward and implement our Five-Year Plan, we must ensure water resource availability in all areas—including urban areas—to secure the water futures of everyone. This is a difficult task and one that we must work together to achieve, including making difficult choices about regional priorities.

This guideline document has been produced by a team of regional experts, through consultation at all levels, including with local communities. It has been a truly stakeholder-driven exercise and the result is a clear set of guidelines that helps us to shape future policy, planning, and investment decisions in the Region. These are grouped under three core strategic objectives: that we work towards achieving water security; that we ensure that use of water resources enhances productivity; and that we ensure future sustainability of the resource itself, including in the face of future uncertainties driven by climate change and other factors.

I would like to congratulate all those involved—including our external partners USAID, DFID, Tufts University, the Institute of Development Studies (UK), and RiPPLE. Please let us ensure that together, under this framework, we act as one in developing our water resources in a sustainable manner, that we remain cognizant of the three key strategic objectives at all times, and that we regularly return to these guidelines to update and modify them as necessary.

I remain committed to their execution and commend them to you.

His Excellency, Abdi Mohamoud Omar
President of Somali Regional State of Ethiopia

Chapter 1: Introduction

1.1. Water Resource Development in Somali Region

"Within the coming five years while ensuring reliable security and good governance, the Somali Region will achieve rapid and sustainable economic and social development at minimum as set out in the Millennium Development Goals (MDGs)" SRSE Regional Development Plan 2002–2007 (EC).

This is the clear and unequivocal goal of the Somali Regional State of Ethiopia. These guidelines have been developed in support of this objective. At the same time, they recognize the challenges involved in bringing the necessary access to and availability of water resources to underpin this development.

The Somali National Regional State of Ethiopia covers almost a third of Ethiopia's land area, and much of it is semi-arid. The Region is home to some five million people, of whom about 60% practice pastoralism (Seid, 2012). About 15% are sedentary, riverine farmers and the rest practice different forms of agro-pastoralism (ibid). The altitude of the Region varies between 200 and 2,000 meters above mean sea level; mean annual rainfall is between 150 to 660 mm a year. The low annual rainfall and its uneven distribution, together with the frequent recurrence of drought, have made water the single most important element that determines the living style of the population. People, together with their herds of camels, goats, sheep, and cattle, move from place to place, continuously, in search of water and grazing. The normalized difference of vegetation index is between 0.05–0.1, which is low to moderate and typical of vegetation cover in a semi-arid environment.

Altitude is the main determinant of rainfall volume, and both increase towards the northeast of the Region. Based on this, SRSE considers water resource development as one of the top priorities of the Region.

Precipitation in the overall Somali Region, based on available daily rainfall measurement data from 1980–2009 as provided by the Ethiopia Meteorological Authority, averages 390 mm, with significant differences between the dry south and east and the wetter north. As the provided time series includes considerable gaps, the real annual rainfall can be considered as closer to values, as given in literature, of 500 mm. Strong inter-annual variations lead to periodic floods and droughts. Potential evapo-transpiration is estimated with 1,500–2,500 mm/year (Muchiri, 2007), resulting in an overall negative water budget.

The region has significant streamflow in four major river systems as well as numerous ephemeral rivers. Moreover, in some parts of the Region, although surface water may not be available, substantial shallow and/or deep groundwater exists, though, depending on depth, at sometimes prohibitive cost. Economic rather than absolute scarcity of water is the greater determinant of access to the resource across the Region. This has significant implications for how and where the Region decides to invest in resource access improvements.

At present, an estimated 10% of the annual budget is spent on water resources development. Much of this amount involves emergency resource provision. The long-term need is to reconfigure investments away from continued emergency interventions and towards sustainable developmental actions which provide a structured, supportive development framework for the Region as a whole. As water availability is one of the greatest determinants of economic activity and social movement and settlement, the decisions taken now will have lasting consequences far into the future.

It is also important to note that water availability in the Region is part of a wider resource picture in which streamflow across the Region derives from rainfall outside the Region and flows to adjacent countries, including Somalia, where significant use of water is made in irrigation and for livestock watering and other activities. The resource management challenges in the Region are therefore partly regional and even international in nature. Dialogue and resource development discussions should be entered into with neighboring regions and countries as soon as possible, though guidance on this is beyond the present scope of this document and may well fall largely within the jurisdiction of the federal government.

Key factors driving patterns of demand for water in SRSE include rapid human and livestock population growth and movement, within the Region and to and from the Region (and from neighboring regions and countries), and the impact of climate change. This is both in a direct sense in terms of changes to the timing, type, and location of rainfall, and indirectly in terms of how changes in human and ecosystem responses alter patterns of demand for the resource. New patterns of demand for different types of water (rainfall, streamflow, groundwater, surface capture, etc.) and the capacity to respond or not to these demands shape the economic choices made by individuals and communities. The policy directions of local and national authorities also affect economic behavior at different levels as people seek security of income and exploit new economic opportunities. In the long term, these changes may prove more significant than climate change itself in shaping demand for the resource.

There are also important ways in which economic, social, and cultural factors interplay with future policy choices in SRSE. One of the most important relationships surrounds pastoralism and livestock production. In Ethiopia as a whole, this sector accounts for at least 20% of the country’s GDP and a large proportion of export revenues, thereby providing a key source of hard currency. In SRSE, the sector’s importance is even more pronounced. The SRSE provides a substantial part of this economic subsector in which external market relationships to Gulf countries are of particular importance. There are many views on how best to support and enhance this valuable economic contribution, including increasing commercialization and market linkages beyond Ethiopia. However, there are also key constraints on sector development, including the quality and health of livestock for export, a large factor in which is the choices made by pastoralist groups in SRSE resulting from the distribution of water and graze. The complex relationships between the two help to determine overall the performance of livestock production in the Region and, by extension, the economic and social health of the Region as a whole.

At the same time, there are arguments that pastoralism needs to change in order to adapt rapidly to new and emerging social, political, and natural environments. These are driven by population growth (livestock and human), wider national economic policy, and the decisions of many formerly pastoral-only communities to diversify their livelihoods. Decisions on water investments will, in future, be crucial in responding to current choices and shaping the future directions of pastoralists within SRSE. By extension, these decisions will also have a bearing on wider national-level development in Ethiopia.

At the same time, the Region is also home to a strong and emerging agricultural—rainfed and irrigated—subsector. Specific production systems are difficult to separate fully, and many of those involved in these areas are also closely involved in pastoralism or agro-pastoralism. To establish a firm dichotomy between farming and pastoralism would be a key error at a regional planning scale. These interrelationships are also recognized within the guidelines, which argue for better understanding and policy responses, emphasizing that decision-making on water development requires a cross-sectoral "out-of-the-box" approach, involving multiple stakeholders at different levels. This includes recognizing that challenges exist both in managing and developing land as well as water. While the irrigation potential of the Region is estimated by some to amount to 600,000 ha, under 6% of this area is currently utilized—not simply because of water management, but because of the inherent land management challenges, including converting customary tenure into more permanent, titled land rights.

The need to overcome these challenges and move the Region onto a firmer development footing is now pressing. Roughly a third of SRSE is dependent on food aid (compared to about 10% in both Oromiya and SNNPR), reflecting a structural food gap and highlighting the acute vulnerability of much of the Region's population. Literacy and primary school enrolment rates are also far below national averages. The premise in these guidelines is that in responding to this vulnerability it is important not to dissociate emergency from developmental responses, given that in many ways the two are synonymous. The premise is that a more effective developmental approach to water resources investment will help in reducing wider social and economic vulnerabilities in SRSE and so mitigate the need for future emergency responses.

1.2. About the Guidelines

These guidelines build on a platform provided by the Ethiopian Water Resources Management Policy, Guidelines, and Strategy that are now over a decade old. They were shaped and developed using a multi-stakeholder approach launched during a workshop in Jijiga, presided over by the regional president. This stakeholder forum comprised over 40 representatives of government, non-government, private sector, and development actors. Three technical working groups were established focusing on pastoralism and agro-pastoralism, agriculture (rainfed and irrigation), and the resource base, water, including domestic supplies. These three groups were tasked with taking forward analysis and research that would provide a baseline input into these guidelines. The first step was an extensive literature review carried out by consultants from the

Region supported by TWGs members. This was followed by the design of research trips to different zones and woredas, with the assistance of RiPPLE (see www.rippleethiopia.org). During these trips, participants gathered key data on current water development challenges using a range of participatory methods. Based on earlier consultations and briefings on the guidelines' structure and content, these data were then included as a key input into the first draft. Overall regional guidance was provided by a policy adviser and technical backstopping support by an international consultant.

The guidelines are shaped around three target Strategic Objectives (SO). They provide a framework on which resource development can take place and strategic choices can be made. The emphasis is long-term planning, rather than responding to immediate needs. These strategic objectives respond directly to directions set out in the National-level Policy, namely:

1. To follow an integrated rather than fragmented approach to water resource development;
2. To search for multipurpose projects that are more viable than single purpose; and
3. That water resources development shall be underpinned by rural-centered, decentralized management and participatory approaches under an integrated framework.

They also respond to the regional 5-Year Plan (see Box 1).

Box 1: Key objectives of the current regional 5-Year Plan

Low implementation capacity is a widespread phenomenon and has been identified as the main challenge limiting the performance of the Region. It is more conspicuous in the water sector, since waterworks demand availability of heavy machineries, equipment, and tools, and, as well, the existence of specialized technical know-how that can use heavy machinery and equipment. Moreover, inefficient organizational structure, lack of a smooth chain of relationships, and poor information flow from local levels combined with weak management all contribute directly or indirectly to low implementation. In this context, the regional plan talks about:

Goal: To develop and scale up the overall implementation capacity of the water sector.

Strategies: Building the necessary manpower, material, and institutional capacities; focusing on low cost, affordable, and labor-intensive technologies; improving the quality of decision-making and technical performance, building an efficient and effective managerial system of the organization; reviewing and re-adjusting the existing organizational structure, planning system, and M&E systems in order to create a conducive environment for efficient and effective management; developing tailor-made database systems that facilitate smooth and efficient working processes, generation of standardized quality reports, documentation, and retrieval; facilitating and advocating for staff career development programs and remuneration adjustment to motivate and retain experienced staff, and ensure supervision, monitoring, and evaluation are conducted at the end of each quarter (four times within a year).

Source: 5-Year Plan 2002–2007, SRSE, Jijiga.

1.3. How to Use These Guidelines

These guidelines are designed for use at the level of strategic planning and development. They are not operational guidelines that support installation of particular water systems, nor do they promote specific water management techniques in different regional environments. There is a wealth of existing advice and operational guidance on the technical aspects of scheme development that can be referred to. What they do, though, is provide an overall strategic framework under which, for example, standards and guidance can be structured and simplified.

This strategic framework applies across the range of water development contexts in the Region as a whole, taking account of the many and varied uses to which water is put as part of different household and community livelihoods strategies.

The guidelines are structured according to three core Strategic Objectives, which provide a framework for resource development and management. These are:

1) Achieving Water Security;
2) Enhancing Water Productivity; and
3) Ensuring Water Sustainability.

These objectives are based on the consultation and analysis that took place with partners and stakeholders during the design process, including regional planning documentation and national-level guidance on water resources development.

All three objectives should be taken account of in future investment decision-making by all agencies, whether in government, non-government, or as part of the private sector. Each section has a set of principles on which the strategic objective is based and that should form the backbone for future development rationales. Decisions on investments, planning, and programming should be able to demonstrate adherence to each of these principles, in order to ensure high-quality decisions are taken that line up with wider regional development objectives.

Under each Strategic Objective, key issues are arranged by section. Each of these issues cross-cut the key socio-economic development challenges facing different parts of the Somali Region's economy. At the end of each section, a series of management options are proposed. Managers, investors, and developers of new water schemes or of related programs and projects that have a bearing on water as a resource are expected to address these issues and to be able to articulate how their proposed developments contribute to positive economic and social goods and avoid potential negative impacts resulting from poor planning and development.

Chapter 2: Water Resource in Somali Region and General Strategic Directions

2.1. Brief Summary

The Somali Regional State of Ethiopia is endowed with four perennial rivers and a number of seasonal streams. Also, the Region has a huge potential for underground water. The total volume of underground water is not estimated in all the research conducted.

Due to the north and south movement of the Inter-Tropical Convergence Zone (ITCZ), the Region has two distinct rainy seasons. Most of the pastoralists and agro-pastoralists depend heavily on these rains for their livelihood. Local groundwater recharge is possible due to the rains in different seasons. There are also dry seasons, which extend to very long dry seasons when the rain becomes erratic and unpredictable. Long and extended dry seasons are responsible for livelihood loss, including loss of a huge number of animals.

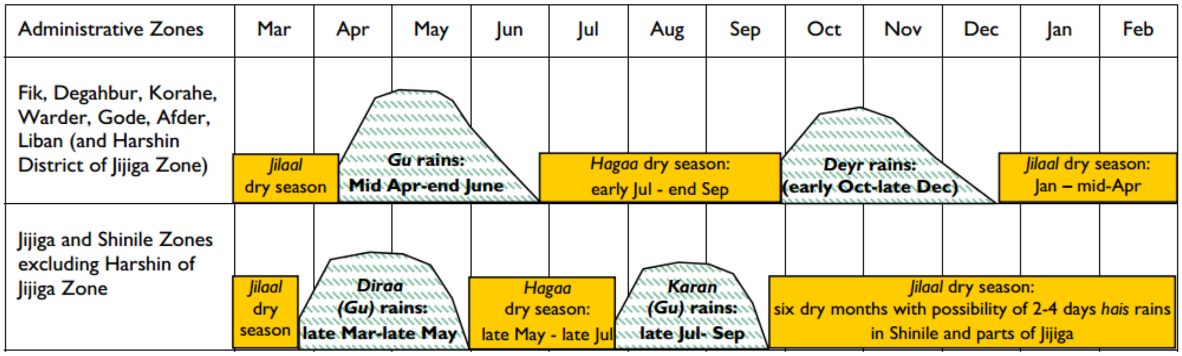
In order to deal with the effects of climate change that are responsible for delayed and erratic rains, coordinated, planned, and technologically supported efforts need to be made. This all summed up will help to understand the water resources in the Somali Region further and in a way that is closer to reality, and also better equip decision-makers to deal with variability and handle competition of resource-related issues effectively.

2.2. Understanding the Resource

A first step in better management and development of water is knowing where it is and how it behaves under different conditions; in addition, how much of it is demanded when, where, and by whom, and how better management can support changing patterns of demand. At present, the SRSE suffers from a huge gap in such information, the bridging of which must be a starting point in achieving greater regional water security.

This is critical because of the Region's complex hydro-climatic systems affected by the interplay of both local and global factors. These include the movement of the Inter-Tropical Convergence Zone, which passes over the country twice a year and results in two distinct short-duration rainy seasons in the east of the country, the *gu* (April to June) and *deyr* (October to November). The alternating dry seasons are known as the *jilaal* (December to March) and *haggaa* (July to September). Availability of water that falls as precipitation is then exacerbated by high evapo-transpiration rates (1,500–2,500 mm per year), which increase the fugitive nature of the resource—it is difficult to capture and store. The seasonal rainfall patterns are depicted in the diagram below.

Wet and Dry Seasons in Somali Region



Source:http://www.dppc.gov.et/Livelihoods/Somali/Downloadable/SNRS%20Regional%20Summary.pdf

Variability between seasons and years is the norm. Combined with changes in policy and wider socio-economic changes, a specific pattern of agro-ecological and livelihoods zones has emerged. Future water security for this variegated landscape requires a range of approaches. Central to achieving security in such a context is the need to address two elements of this variability: first is the capacity to absorb the extremes of variability without seriously damaging livelihoods and to improve the way in which local and regional systems are capable of responding; the second is to strengthen the capacity to predict so that variability becomes less of an unknown, reduces risk, and supports greater decision-making certainty.

To enable these response capacities, the Region should begin undertaking the following:

- Building on the work of the TWGs established under this guidelines process, BoFED should establish a cross-institutional annual resource assessment exercise. As indicated in Tables 1 and 2, this will produce data and data analysis that inform planning and budgeting and support prioritization of the coming year's investments.
- As part of this exercise, the Region should establish an effective rainfall, streamflow, and groundwater monitoring system, based on simple physical measurements. This will ground-truth other remote sensing data provided by central government authorities and external agencies to help build up a more sophisticated resource management picture. This system will feed into the annual resource assessment exercise and will conform with approaches established under the 2001 Water Resources Management Policy and the 2002 Water Sector Development Program. (See Figure 1.)
- The system should be user-friendly, with simple spreadsheets and GIS referencing that is easily updated to provide—at a minimum—data on storage capacity, location, population coverage, and functionality of different water sources.
- An important component of both exercises will involve understanding human and other systemic responses to change—including the coping strategies that communities and

households use to adapt to extremes. This will involve comprehensive stakeholder participation.

- Specifically, monitoring will need to take account of the various drivers, pressures, and responses that are taking place across the Region's varied livelihoods and agro-ecological systems (and taking into account the major river basin systems in the Region—see Box 2 and 3 below).

Table 1: Resource Assessment and Monitoring: Physical Measurement Instruments and Activities

Resource	Activity and Measurement
Rainfall	- Ensuring functionality of currently available rain gauge stations, where possible install new gauging stations. - Use of traditional and location-specific categorization of rain; “below,” “normal,” and “above.” This will need to be defined in terms of annual rainfall quantities based on local knowledge and expert interpretation.
River flow	- Ensuring functionality of currently available river gauges, where possible install new ones, including on major ephemeral rivers. - Use of traditional and location-specific categorization of riverflow; “below,” “normal,” “above,” and “flood.” This will need to be defined in terms of annual riverflow quantities based on local knowledge and expert interpretation.
Underground water	- Mandatory installation of observation pipes on new boreholes by all implementers, capacitating woreda water offices to conduct groundwater monitoring on existing boreholes. - Mandatory submission of drilling reports (with water quality tests) to RWRDB and WWOs by drillers and implementing agencies. - Regular groundwater sampling and testing from strategic boreholes (existing) by RWRDB and agencies with water quality testing capacity. - Where possible, installation of groundwater observation boreholes in strategic zones.

Table 2:Resource Assessment and Monitoring: An Outline for Development

Tasks	Key Activities
Establish data development and management unit at Jijiga level	Coordination, assimilation, synthesis, and storage and retrieval system. Centralized, but open access data made available online. Creation of Management Information System.
Establishment of catchment learning and practice alliances	Institutionalized support to collation and storage of local information on water points, resource behavior, and changes in demand and supply
Establishment of annual resource assessment survey	This will be led by a cross-disciplinary team derived from the Guidelines Forum. It will take place at the end of the jilaal dry season each year. The survey will involve data mining and refinement, the self-assessment by

	woredas and zones through a questionnaire template, and visits to zones, woredas, and communities across a representative sample.
Monitoring system development	This will require closer collaboration with local woredas and other local stakeholders, including NGOs and the private sector (drillers and water truckers in particular, but also private developers of *birkeds* and other surface structures). The system will provide a sample snapshot of changes taking place over time and probably—given resource constraints—will need to be based on a sample of woredas in different agro-ecological zones.

Box 2: Major river basins of the Region

SHAAC (2008) identifies the key basins within SRSE as the following:

Wahit Shebelle River Basin, which comprises the drainage of the seasonal rivers of Fafan, Jerar, and Dakhato. This is the largest basin, with an elevation ranging from 2,000m to 200m above sea level, sloping towards the Wabi Shebelle River. The entire Shabelle and Nogob zones and parts of Fafan, Jarar, Koreha, and Afder Zones lie in this basin. These seasonal rivers play a significant role as a water resource of the Somali Region. Most successful boreholes are located in their sub-basins.

Genale-Dawa-Web River Basin (Juba Basin), which comprises three major river drainage systems. The elevation of the basin ranges from 150m to 1,600m above sea level, and the entire basin slopes southwards. The entire Liban Zone and part of Afder Zone lie in this basin.

North-eastern-Warder drainage Basin, which comprises most of Dolo Zone and parts of Fafan and Jarar Zones. This Basin is characterized by a plain with a gentle slope draining towards Somalia, and on to the Indian Ocean.

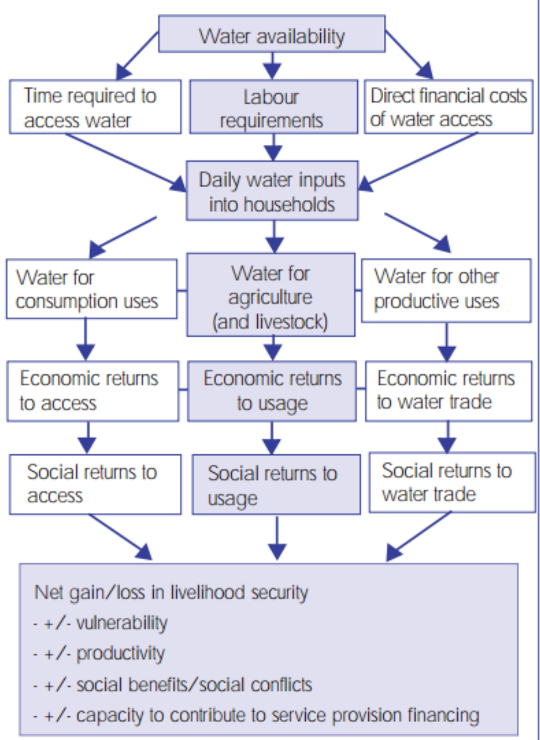
Awash Basin, which comprises the drainage areas of several seasonal rivers in Siti Zone, including Erer. It covers areas west of the Amhara Highland and entire Siti Zone. The drainage system is easterly, towards the Awash River.

SHAAC, 2008

Figure 1: Major Drainage Areas of the Somali Region

Source: Kmusser [CC-BY-SA-3.0 (http://creativecommons.org/licenses/by-sa/3.0)], via Wikimedia Commons

Figure 3 Household Water Economy



(SecureWater, 2002)

Box 3. Water and livelihoods—complex interactions

"Managing and developing water in SRSE requires a detailed knowledge and understanding of the complex relations between availability, access, and use across a range of scales and livelihoods types. This should build on studies that have examined the costs to households of poor water access, particularly in terms of time spent in gaining access, effort expended (in terms of calories and, therefore, cost to consumption expenditure), and costs associated with health impacts (morbidity, medicines, diarrheal impacts on child life expectancy, etc.). Understanding of these interactions has been developed under a range of "household water economy" approaches, the basic premise of which is that systematization of knowledge is required—and is possible. The following diagram is one attempt to build a more systematic understanding of water availability, access, and use at a household level:

More recently, this analysis has been formalized into the "household water economy approach." The purpose of these emerging tools is to enable decision-makers to understand better the impacts of new schemes, the potential risks and rewards of different locations, and the kinds of targeted design features that can support particular user groups, e.g., the poorest and most marginalized within communities.

In the SRSE case, these approaches are recommended as starting points for individual project appraisal, helping in prioritizing types of approaches, specific locations (for impact), and the internal design of different systems. More recently, the concept of multiple-use water systems has gained currency, reflecting much of this earlier livelihoods thinking."

See http://www.musgroup.net/ and http://www.rippleethiopia.org/page/hwea

2.3. Dealing with Variability

As described above, variability is hard-wired into the region's hydro-climatic system. This variability may be changing over time as global climate systems respond to warming of the atmosphere. At the present time, however, the granularity of Global Climate Models is such that their resolution will not support prediction at the scale of a region within Ethiopia, such as SRSE. Dealing with variability therefore needs to address practical concerns, described below, in anticipation of future shocks.

Buffering water stocks: At present the Region has low levels of storage capacity and poor ability to manage effectively the storage capacity that it does have. Buffering should take two forms—surface and subsurface water storage to mitigate the peaks and troughs of extreme variability. But in the context of land-water relationships that are complex, very careful assessment of potential livelihoods and environmental impacts needs to be undertaken (using the above-mentioned methods) prior to location and development of buffering stocks. See Table 4 and Box 4.

When setting, the following considerations should be taken into account:

- Their potential for multiple use and the management options that would be required to support their future sustainability;

- Their likely impact on the environment through their draw on surrounding households and communities—in particular their livestock effects;
- The possibility of poor setting and design precipitating conflict over access (temporally and spatially);
- The possibility of "closing sources" (particularly boreholes) at specific times of the year or until they are required, e.g., in particularly poor years;
- Ensuring that community participation is central to design and location, reflecting tangible benefits to households, relative cost improvements in gaining access, and the likelihood of a sustainable community of users emerging with whom governance arrangements can be embedded in future. See Table 3.

Table 3: Technology Choices for Buffering Water Stock for Different Settings

Setting/Ecological Zone	Normal Supply Choice	Buffering Supply Choice
Urban settlement in riverine areas	River intake with treatment; individual roof harvesting; truck/cart delivery	Large offshore flood storage dams
Urban settlement in other areas	Motorized borehole-based, individual roof harvesting systems; truck/cart delivery	Large surface water storage dams
Agro-pastoral (settled) areas	Borehole-based systems (motorized and hand pump); Hand-dug wells; *birkeds*; ponds; haffir dams	Large surface water harvesting dams; subsurface sand dams (seasonal river belts)
Pure pastoral areas	Large haffir dams, *birkeds*, ponds	Strategically positioned boreholes; safe distance could be not less than 20–30km to reduce impact of permanent water sources to pastoral land
Irrigated agriculture areas	River offtakes with gravity weir or surface pumps; large storage surface dams; rainfed	Large offshore flood storage dams

Understanding flow rates and aquifer discharge: In parallel with the need to increase regional storage, greater effort is required in understanding the behavior of the river basins and aquifers within the Region. Analysis of Wabi Shebelle data between 1971–1976 and 1986–1989 suggests substantial declines in flow rates. This kind of ongoing monitoring is now critical, given the possibly significant impacts of climate change. Little firm hydro-geological data is available for the SRSE. Based on recent studies, the main strata and associated aquifer characteristics are as explained in the following Table 4 (SHAAC, 2008). Table 4 outlines the scale of the required knowledge.

Table 4: Main Stratigraphic Zones of Somali Region

Zone	Stratigraphic	Aquifer Characteristic

	Characteristic	
Siti	Recent Basalt	The upper part of the formation is highly weathered; the lower part less so and contains fresh water. A maximum thickness of more than 200 m is expected for this formation.
Fafan and Dolo	Jessoma Sandstone	Based on its characteristics, it could potentially hold significant water resources; however, there is no retaining or impervious layer at shallow depth, so recharge water percolates deep. Wells tend to be over 300 m deep, reaching 400 m in Danot. In some areas, wells are known to have been abandoned due to low yield.
South Korahe, Shabele, Afder	Korahe or Main Gypsum Formation	Most of the boreholes drilled in this formation are abandoned due to salinity. Drilling in this unit should reach the underlying Kabridahar limestone formation so as to obtain fresh water. However, even then the location matters, because the thickness of the gypsum formation increases from Korahe Zone towards Shabele and Afder Zones; e.g., in Shabele, the gypsum formation is about 800–1,000 m and in Afder Zone it is more than 1,000 m, making drilling uneconomical.
Partly Nogob, Partly Liban	Urandab Series	Boreholes drilled in this unit were mostly abandoned because of being dry. The lack of groundwater in this unit is due to presence of shale, which prevents vertical and lateral recharge of the formation.

Source: (SHAAC, 2008)

More than half the Region overlies the Ogaden-Juba multilayered aquifer, which is among the world's 37 largest aquifers, covering 1 million m^3 between Ethiopia, Kenya, and Somali. Development of this aquifer will be a future option, though subject to improvements in the overall security environment in this part of the Region.

Box 4: Managing and mitigating droughts—traditional responses

The major surface sources that the Region has developed reflect fairly recent trends (in the last half-century) in response, largely, to growth in human and livestock concentrations. They are:

Birkeds: These traditional rainfall-runoff water-harvesting structures are used both for human and livestock consumption. There are estimated to be many thousands of them across the Region, most of which are privately owned. Their exact location and number is unknown and an audit of them pinpointing their concentration is now overdue.

This self-supply mechanism provides water during and subsequent to the rainy season, sometime for up to three months after the end of the rainy season. Seepage is reduced through cement lining of the tanks. Some *birkeds* are covered, which helps prevent from evaporation losses. *Birkeds* provide a functional storage capacity of some 50 m^3, estimated to provide water for a family of six with 30 head of livestock for 60 days at a consumption rate of 15 Lcd. Larger, communal-scale *birkeds* have been provided by agencies, with between 3 and 30 times the capacity. Communal *birkeds* may face management challenges. Where there is private ownership, by waiting until the dry season, private owners can achieve very high profits from the sale of water to more nomadic herders. In some cases, the vested interests in these *birkeds* can block development of alternative sources. In many cases, *birked* development has led to more permanence in certain grazing areas. These are signs of the value of water across time in the Region, but also of the need for careful stakeholder engagement in the future development of schemes.

Ponds: These are simply water catchment features that either involve expanding on existing natural repressions or developing earth embankments to help trap more surface runoff.

Haffirs: These large-scale structures catch runoff from larger catchments, some being lined with geo-membrane to improve water retention. To serve the watering requirements of livestock, these are some of the most cost-effective supply structures, requiring limited maintenance and management. At present, there are 12 in the Region, supplying about 30,000 people and some 150,000 head of livestock. Large haffirs may provide over 40,000 m^3.

2.4. Managing Competition

The political economy of developing the resource in SRSE will inevitably entail changes for certain sets of users and providers over others. At present, there is considerable resource competition between livestock and domestic use and, as the box above highlights, between different providers of the resource too, in some cases. Privileging one set of users—or providers' uses (the two are not synonymous as many users and providers overlap)—is inherently risky wherever there is existing resource competition. There are no simple solutions, but understanding the changing structure of demand for water at both the local and regional scale is key. This is an important part of the assessment processes outlined earlier and should be a core undertaking. At a minimum, demand data should be provided that highlights (and models, ideally) how much water is demanded, by which groups, sub-regions, and users and when and where. This should be modeled not just in a "normal" year, but in years of lower-than-average rainfall too.

This is inherently multi-stakeholder in approach and usually is institutionalized in the form of catchment or watershed management approaches. SRSE should build on existing approaches being developed nationally. Where transboundary resources between regions or SRSE and neighboring countries are concerned, constitutionally this then becomes a responsibility of the Federal Ministry of Water Resources and Energy.

Managing competition requires balancing needs and interests between different uses and users using different governance mechanisms, but usually involving a hierarchy of priorities (such as that set out in the national water resources policy). There are various mechanisms that have been employed globally, usually around the notion of Integrated Water Resources management, that can support the institutionalization of this process, including multi-stakeholder catchment or watershed management approaches. SRSE should build on existing approaches being developed nationally, including river basin boards. However, a more learning-based model is recommended for the Region.

In anticipation of the long lead time involved in more formalized systems of catchment management, these guidelines recommend a relatively informal version of catchment management based on and developed out of the resource assessment and monitoring exercises described above. These should be termed **Catchment Learning and Practice Alliances**, bringing together key users of the resource, with those involved in—or stakeholders in—management and development of the resource. It should also bring in other external actors (e.g., SORPARI). These CLPAs will convene the above assessment exercises under the umbrella of the regional-level LPA, which will emerge from the multi-stakeholder forum from which these guidelines have emerged. The CLPAs will follow a process of communicating and discussing water resource needs, ways of supporting local-level development initiatives, and communication between the resource development and resource user communities. The emphasis will not be on decision-making as such, but on supporting the emergence of a more effective decision-making environment. In time, they could assume greater actual agency in decision-making processes. Due to the geographic limitations of bringing together individuals within physical catchments, it is suggested that initially they be convened at the zonal level and bring together key stakeholders from the major water body and resource user communities in that zone. In time, greater catchment unit characteristics can be developed. The annual water budget of the Region should support their development.

Chapter 3: Achieving Water Security—Available, Accessible, and Affordable at the Point of Need

3.1. Brief Summary

Achieving water security requires sustainable harnessing of the available water resources, using traditional and non-traditional methods/technologies which will make adequate water accessible to communities where and when needed at an affordable cost. While availability of water is a function of ecological conditions, and ancient communities settled within the confines of its natural availability, human development has seen breakage of these barriers for centuries. In Somali Region, water occurs as rainfall, runoff, and groundwater, and harnessing involves traditional and non-traditional methods and technologies which aim at making it available, accessible, and at affordable cost, where and when it's needed for humans, livestock, and agriculture.

There are challenges in the Region to achieve the above; among them, the low functionality rate of existing systems, growing pressure on the water resources due to population growth (human and livestock), unequal and elusive distribution of the resource in the Region, climatic changes, high cost of water, especially to the rural and urban poor, to mention but a few of the challenges.

In view of the above challenges and the development options available or that might be available in the future, this chapter provides strategic directions on how water security can be achieved, as summarized below:

- Ensuring that selection of water supply methods and technologies are context specific, are developed based on community-driven approaches, ensure full participation from beginning to end and that beneficiaries contribute to capital investment;
- Strengthening coordination of stakeholders;
- Standardization of technical requirements, equipment, and approaches;
- Ensuring management of water resources at the lowest level possible.

Setting tariff based on real costs to ensure cost recovery, yet affordable to the users, establishing social tariffs for the poor, ensuring transparency and accountability and strengthening supervision should be considered.

3.2. Ensuring Availability

Water availability is both ecologically and human controlled. The water resources of the Region occur as precipitation (rainfall), surface runoff, and groundwater. Ensuring availability in space and time and for whatever uses (human, livestock, and agriculture) involves harnessing of the resource when and where it's needed for use. Traditionally, water has been made available by construction of ponds, hand-dug wells, *birkeds*, water holes in seasonal river beds, and surface runoff or river diversion ditches. Non-traditional methods include: motorized and hand pump-fitted boreholes, hand-dug wells improved with hand pump, including those installed on subsurface sand dams, haffir dams, river intakes (with treatment for human supply and raw for irrigation) and roof harvesting. The table below shows recommended scenarios for choice, applicability, and management options for the above technology types.

Table 5: Technology Choices for Different Settings in the Region

Technology Type	Settings for Application	Management Options
Safe water sources		
Motorized borehole	- Areas has groundwater. Well depth exceeds 60 m and supplies large population (people) or industry.	- Managed by WMC on behalf of community, aim at O&M cost recovery. - If pump is to be installed at less than 70 m, consider using solar power.
Borehole with hand pump	- Area has groundwater. Well depth less than 60 m and supplies small population (people).	- Managed by WMC on behalf of community, aim at O&M cost recovery.

Technology Type	Settings for Application	Management Options
Sealed hand-dug well installed with hand pump/ subsurface sand dams	- Area has shallow groundwater, usually near perennial or seasonal river beds. - Improving storability in seasonal river bed.	- If public will be managed by WMC, aim at O&M cost recovery. - If yield is good and population is large, pumping with solar power should be considered.
River intake with treatment facility	- Riverine communities and towns where large population (people) to be served or industrial activity justify the heavy investment.	- Centrally managed by a technical team employed by the responsible authority. Public-private partnership is a likely better option. aim at full cost overtime and O&M recovery.
Unsafe water sources		
Household or group *birkeds*	- Areas with sufficient rain to fill tank and household have interest for self supply for human and livestock.	- Private. - Owners can be supported to improve water quality through filtration and SODIS.
Communal "super" *birkeds*	- Areas with sufficient rain to fill the tank +200 mm ARF. - A consideration for human use only if area is not feasible for borehole, otherwise meant for livestock in pastoral and agro-pastoral areas, parallel to borehole for human use.	- Managed by WMC on behalf of community. - Where human consumption is a consideration, installation of simple treatment facility and well with hand pump is necessary. - Solar/wind powered pumping of raw water for livestock is recommended.
Haffir dams	- Areas with sufficient rain to fill the tank +200 mm ARF. - A consideration for human and livestock use where borehole is completely not feasible in pastoral and agro-pastoral areas. Also for irrigation potential and buffering near urban settlements.	- Managed by WMC on behalf of community. - Treatment facility and well with hand pump for human use. - Solar/wind powered pumping of raw water for livestock.
Roof harvesting	- In institutions and towns with feasible roof surfaces; very few homes in rural Somali have feasible roofs.	- Private. - Quality can be improved by installation of simple first flush separators and teaching people on application of SODIS.

In extreme situations, ensuring availability will entail expensive transfer from areas with high potential to areas without (interbasin transfer). Some transfers might even involve transfer from outside the Region. Such interbasin transfers are not new to the Region. One example is the Filtu-Hargele-Jarati Water Supply Projects:

Case 1: Filtu mega-project, which provides service for 200,000 beneficiaries, diverted from Genale River for 11 surrounding villages with a distance of 150 km.

Case 2: Hargele-Jarati mega-project diverted from Web River; distance of diversion is 40 km with 200,000 beneficiaries.

3.3. Ensuring Accessibility and Affordability

Access should not simply be determined by availability and affordability (often referred to as absolute and economic scarcity). There are also situations in which access to water needs to be ensured for populations that are otherwise unable to afford access. These situations need to address the poverty dimensions of water resource development. As illustrated earlier, there is a complex and context-specific interrelationship between sources, those who choose to or have to use them, and how they are actually used. While there are obvious factors such as price at source, distance and time-cost dimensions, and water quality choices, there are other intervening factors, such as potential alternative sources.

The principle of water equity should be enshrined in approaches to developing the resource and also inform the analysis of the resource and the workings of the proposed CLPAs mentioned above. This means the lowest percentile income groups should not be disproportionately affected by new developments. Resources should be made available at reasonable cost (relative to income levels) and, in extreme cases, water for household, productive, and livestock uses should be available freely.

There is an important principle being established elsewhere in Ethiopia, that by encouraging self-supply, increases in access to affordable water can be met most efficiently and quickly. This may be the most significant interim measure to introduce in SNRS. It is a particularly important measure to set against the consistently high-cost water trucking operations. To agree on the balance between support to self-supply and provision by government or other agencies, particular kinds of regulation are required on avoiding water “commercialization” and profiteering by water owners in the dry season and on minimum standards on water quality provision to human populations. Linked to these areas of management are the water trucking and water vending activities in the Region, particularly in and around urban centers. Recently agreed guidelines on water trucking in emergencies should be adhered to, and there should be a gradual replacement of water trucking by more structural development decisions on supporting population movement to less water-scarce areas and/or more effective—and sustainable—development of alternative sources (principally boreholes).

Ensuring accessibility will require maintaining a high functionality rate, in the range of 85% to 90%, for the currently available sources, and installation of new facilities to meet demand for human, livestock, and agriculture use. Ensuring a high functionality rate will require a comprehensive understanding of factors responsible for the current low functionality rate and reauire designing mitigation measures. What is notable now, even without the study, is that standardization of equipment, harmonization of approaches, capacity building, and ensuring management responsibility at the lowest level will be required to address the challenges. Other areas to address include effective coordination and defining and enforcing management responsibilities among stakeholders at all levels, right to the water point. New facilities will need to be constructed at higher standards and correct specifications to ensure they have a long life span, with a participatory process throughout the entire project cycle. To ensure ownership and therefore proper operation and maintenance, a community-driven approach is recommended, including ensuring that communities contribute to capital investment. See Box 5 on how social issues relate to water access.

Box 5: Social issues related to water access

In Dembel woreda, Mudemedew kebele, the community travels to Semecab for a water source, a journey of three hours. There is a closer source in Kerenley, which is one and a half hours away. Due to issues related to clan differences, the population of Mudemedew prefer to travel to Semecab for water.

In Awbare, after a geophysical survey in five kebeles, a decision was made to drill a borehole in Mohamed Ali kebele. A consultation was made with the kebele and the drilling was done at the recommended place. After the borehole was successfully completed, an attempt was made to organize a WaSHCO from Mohamed Ali kebele, but another kebele called Kebrimealin claimed that the water source belonged to them because it is within their territory. It was discovered that the borehole was drilled a few meters away from the border of Mohamed Ali kebele. The community of Mohamed Ali resented this and refrained from using the system until a lot of effort was made to organize a WaSHCO from the two kebeles.

A system that would ensure the community has collected and banked money equal to the operation and maintenance cost for a water system for at least six months before handover and that they continue to meet their daily tariff costs and that proper monitoring is carried out by woreda water bureaus to ensure transparency and accountability would improve response time for repair of broken systems by the community. See box 6 for examples of water costs.

Box 6: The cost of water—the poor pay most

One of the challenges faced by kebeles is the high cost of water. In Mermersa kebele (Shinile woreda) one jerry can of water costs 25 cents, which is 12.5 birr per m^3. In Dire Dawa, water is sold 1.5 birr per m^3 and Mermersa is only 7 km away. Also the cost to water sheep and goats is 10 cents per head, cattle is 25 cents per head and camel is 25 cents per head. In Gad (Shinile woreda), the cost of water rose from 0.25 cents per jerry can to 0.5 cents, which is 25 birr per m^3. Hence, due to the high price of water, the community prefers to use water from dry river beds during wet seasons and the subsequent months up to the extreme dry seasons. In Biyodidley (Aysha Woreda), the cost of watering one camel and cattle costs 1.5 birr each. Also, in Biyokobebe, Lasarat, and Degago kebeles in Aysha woreda, water is sold at 0.5 cents per jerry can, forcing the poor to look for other non-protected sources like dry river beds. In Lasarat, cattle are charged 1 birr each and a camel 2 birr; also five shoats are charged 1 birr. In Kerenley (Dembel), the cost of watering one cow is 0.5 cents and 10 shoats pay 3 birr. In Giliso, where animals travel long distances in search of water, the cost is 1 birr per cow, 2 birr per camel and 0.5 cents for three shoats. The poor in most of the kebeles cannot afford to pay and hence are forced to travel long distances to the dry river beds.

Source: Azaria Berhe, Siti Research Visit Report

3.4. Development Options

3.4.1. Irrigation

Irrigation has been practiced for many centuries in Ethiopia. It is not a new innovation for the SRSE. However, there are growing pressures to expand and to intensify irrigation within the Region as a result of changing livelihood strategies, demand for food, cash crops, and feed for livestock. There is also a tendency for the human and livestock population to move towards the river valleys and dry season grazing areas more permanently. The Somali Regional State is known to have an estimated land potential for irrigation of 600,000 hectares along the banks of four perennial rivers and a number of seasonal streams. At present, much of the irrigation potential (in terms of irrigable land availability) is underutilized. This is not an accident, but future development will require careful attention due to other contextual factors, including land-ownership, environmental protection, flood management, and upstream/downstream relations. There are also technological constraints and conflict-affected areas to consider.

One key approach is to build on the development “corridors” established under the 5-Year Plan. While the use of “model farmers” is proposed, the danger is that their very specificity makes scaling up and replication difficult. The Region should establish support to irrigation that is part of a wider socio-economic development objective of supporting pastoral production. This should focus on the production of fodder and some cash crops for local markets, linked to a more effective regional-level livestock development and marketing operation. Rather than irrigation becoming a stand-alone sector, it should be more fully integrated within livestock development, supporting the production of healthier, more productive animals and adding significant value to the sector as a whole. Some elements of this will entail greater sedenterization, but this should be carried out only voluntarily and as part of a measured and structured approach to shifting livelihoods across the Region.

With respect to achieving water security for irrigation purposes, there are important technological developments that need to be realized in the Region. These include the establishment of affordable but acceptable technological options for small-scale farmers and agro- pastorals, and better management and control of the river systems, including tributaries.

The cost of sourcing the water should be considered when the type of irrigation is selected. The type of irrigation selected should not only be appropriate to the climate and the type of crop or fruit to be cultivated but also to the cost incurred to pump or divert the water to the fields.

Policy-makers and administrative bodies need to resolve a complex set of issues involving land reform and tenure, water rights, and the coordination of resource allocation and utilization among various competing sectors.

To increase water accessibility and cover more area for irrigation, regulated application of water for irrigation could be promoted, and great emphasis has to be put on the real cost of extracting the water and delivering it to the farm, and on the cost of restoring the water resource after it has been depleted or polluted.

Determining the feasibility of irrigation development in the Region should be based on availability, accessibility, and affordability of water. Key questions required to address the feasibility of developing small-scale irrigation in the Region include:

- Indigenous irrigation practices and systems—could these be scaled up after the pros and cons of the methods are researched? The good practice option of matching it with the site-specific characteristics in the area could be taken. The evaluation criteria and indicators that could be used in the process include: 1) agro-ecological suitability; 2) economic and social feasibility; 3) the positive impact in increasing resilience against impact of climate hazard; and 4) its negative environmental impact.
- Is there effective access to markets from potential irrigable areas?
- Are there available government support services?
- What types of other inputs are available, including fertilizers?
- Is there the involvement of community elders?
- What woreda-level human resource capacities exist to support agro-pastorals?
- How can linkage best be achieved between bureaus and universities?

Key is the involvement of cross-institutional actors, including the Somali Regional Pastoral and Agro-pastoral Research Institute (SORPARI). Jijiga University could be invited to join hands in training proper DAs with context specific to different scenarios. If this is not possible, a separate training college would be envisaged to achieve the goal.

A regional irrigation development strategy should be developed that focuses on small-scale irrigation utilizing surface flows and, where there is more accessible groundwater, using that resource, though only with the assistance of water-saving techniques given the additional costs of supply. Key support areas will include the following, using local techniques with support in technological interventions to deliver water and water management and soil moisture retention techniques on farms:

- Support to identification of priority areas within zones and woredas;
- Irrigation technology support by the RWRDB and Agriculture Bureau;
- Production and marketing outreach supported by the above and with the assistance of BoFED;
- Support to market access: differential market access leads to very high price differentials in specific crops, e.g., horticultural produce such as onions—effective marketing approaches based on studies of supply and demand across the Region;
- Land-use planning that avoids the cutting off of key dry season grazing areas as a result of riverain irrigation development;
- Need to address land tenure issues where new lands are being brought under cultivation.

To mitigate the high cost of inputs, like fuel, to run water pumps that is responsible for the low benefits to agro-pastorals and subsequent drop outs, a few appropriate dams at suitable locations to cover as many beneficiary plots as possible might be a solution. When building dams on international rivers crossing borders, care should be taken, and consultation with the stakeholder country is essential.

Other alternative energy options like solar and wind could be used to replace the fuel-operated water abstraction options for the farms. Considering the fuel costs and rental costs of water pumps, the solar and wind options give a handy solution in pumping the water. Considering operational limitations in pump, pipe, and engine care, maintenance limitations, spare part limitations, and the shortage of skilled manpower for maintenance, solar and wind power are preferable. The disadvantage with solar power is in transporting the system and reinstalling it in a different location. It is far more difficult than transporting smaller diesel or petrol pumps, but far easier than transporting bigger capacity pumps.

Construction of a weir across a river at the best location can be useful in producing head that would be enough to reach to some of the small-scale irrigation fields without the use of pumping. This has another advantage, that of minimizing the silt that accumulates in the canals and blocks easy flow of water and leads to a subsequent loss of a considerable amount of water. The weir site also could be used as a pumping site to get a sufficient amount of water without the threat of silt and sand interfering with the performance of the pump.

Geo-membrane-lined canals could be advocated over concrete canals in the long run, depending on the cost and replicability of the technology. Geo-membrane-lined canals have an advantage over concrete or masonry structures in total seepage control, ability to host different qualities of water, ease of maintenance, transportability, and reusability. PVC pipes also could be used to replace the traditional earthen canals responsible for a huge loss of water. PVC has the same advantage as geo-membrane, but with the added advantage of inhibiting evaporation, taking water with pressure to far places, and avoiding damage caused by animals.

Hence, clear land tenure policy must be proposed and agreed between the government and the clan leaders. The government and the clan leaders should work together to draft a land tenure policy for discussion and ratification. Participatory land tenure policy in the Region would bring about the necessary development in basin irrigation in areas with potential for irrigation. Refer to Box 7 for development interventions examples that were designed and implemented without the involvement of communities

Box 7: Questions of land tenure

Large-scale irrigation projects planned for the Somali Region include the three Ethio-Italian irrigation projects in the Jijiga agro-pastoral area (Chinaksen, Biyo, and Elbahe), although they failed to be realized. Poor design and lack of clear land tenure policy at the time leading to the project being caught up in land tenure-related conflicts were implicated in the failure of the Jijiga dam and irrigation scheme. The local pastoral community demonstrated their displeasure with the project by breaking everything that was breakable and carrying away stones in the sluice-way; these stones are useful for other purposes.

Hence, the traditional institutions should not be overlooked when it comes to land occupation issues. Recent irrigation projects have taken traditional institutions and their leadership on board. Community elders were responsible for allocation of irrigation plots to project participants in the west Gode irrigation project.

Source: Azaria Berhe, Siti Reseach Report

3.4.2. Livestock

Somali Regional State is predominantly inhabited by pastoralists and agro-pastoralists whose livelihood depends heavily on livestock and livestock products. Strategies of the government and non-governmental organizations to reducing poverty in the Region need to seriously consider enhancing livestock productivity. The Region made water priority number one and is working hard to ensure water security for the people of the Region. However, livestock has been forgotten in the water development interventions of the Region as well as in its plans. In the current Five-Year Development Plan (2010–2015) of the Region, the water sector development direction and strategy of the Region failed to recognize water supply for livestock. The direction needs to change and livestock water supply be given appropriate recognition, as already outlined in the Water Development Policy of the country. The Policy recognizes that livestock water supply is an integral part of the overall water sector and incorporates into its development plan a comprehensive water resource management undertaking. This needs to be changed into clear directions and strategies, so that water supply takes priority in the Region.

The background study conducted for the development of this guideline showed that there are a number of gaps that need to be addressed before the Region develops a clear Livestock Water Supply Strategy; these include:

- Understanding the Region's livestock population; the development of livestock water supply strategy would very much depend on the number of livestock found in the Region. The latest livestock figures for the Region came out in 1999, i.e., almost thirteen years ago. These figures are outdated and need to be updated so that we understand what number of livestock need water supply, and their distribution;
- Understanding and having clear information on the age-structure, sex, and number of animals lactating each year is vital. This information is crucial in making water available for livestock;
- Also equally important is the livelihood system under which livestock production is taking place. Research has shown that the way water is supplied to livestock in sedentary communities and by nomadic pastoralists is quite different, and this affects the way we develop water points. Box 8 details a case study of the relationship between the pastoral livelihood system and the livestock production system.

Box 8: Case study: Harshin pastoralist experience

Harshin is one of the districts inhabited predominantly by pastoral communities. It is believed that 90% of the district's population depends on livestock production for their livelihood. In the past, these pastoralists stayed in the area only during the wet season and moved to areas with permanent water sources during the dry season. Under this system of production, livestock was forced to stay without water for days, which extended to more than a month for camels. The community in the district started to shift the way they produced livestock as more and more households started to settle.

Currently, statistics show that private enclosures have been established on almost all the land of the district, and each household owns a parcel of land. This sedentary livelihood has not made the community abandon livestock production, as the community still continues to depend on livestock production. The livestock has also adapted to the new production system as their movement is mostly limited to an enclosed parcel of land. The pastoralists in the area indicated that livestock resistance to water scarcity has completely changed as the livestock now need water more frequently and cannot walk for long distances to search for water as in the past. They pointed out that nowadays camels cannot go beyond ten days without water, while shoats can barely survive two days without water. This changed dynamic shows that we also need to consider the livelihood system under which livestock is produced.

Source: Abdurehman, et. al (2011)

Also, when considering water supply for livestock, we have to give due consideration to the kind of water scheme that best suits the animals. Boreholes, which are currently the most constructed water scheme in the Region, might not be appropriate for livestock. This is mainly related to the cost and environmental sustainability of this water scheme.

The basin development program is the biggest program in the Region, which the government uses as a way of sedentarizing pastoralists. The regional government started the settlement of poor pastoralists along Wabishabelle River, giving each household a hector of land. Unfortunately, river banks have traditionally been used by pastoralists as dry season grazing areas, and the intensification of small-scale irrigation might have adverse effects on the people still practicing pastoralism as a way of life. Therefore, we need to devise ways of accommodating seasonally migrating pastoralists in two ways. First, we need to develop livestock watering points along the river where people are settled. Second, we need to develop access points for livestock where they can enter the river area without affecting the farms. These two interventions would reduce confrontation between pastoralists and farmers during the dry season and improve water access for pastoralists.

Water security for livestock should not be based on a static notion of existing patterns of concentration and movement in wet and dry seasons, but on a broader region-wide policy on future development of the sector. One inherent danger is simply to respond to current problems by drilling more and more boreholes, which, poorly managed and overseen, could simply lead to unsustainable stocking practices in different parts of the Region that degrade key resources and lead to conflict. Development of water for livestock should be based on three core factors:

1. Enhancing the quality of the resources—where to avoid water provision to reduce the impact of diseases, pests, grazing, and other resource degradation;
2. Strengthening regional markets to help management stocking, offtake, destocking at other key livestock production decisions (refer to destocking guidelines);
3. Planning for the long term—using scenario analysis of livelihoods trends, climate trends, and environmental trends to plan for 5-, 10- and 15-year investment horizons based on assumed shifts in production patterns (including the opening/closing of markets and routes based on political and policy changes in neighboring states). These scenarios should include a range of low- or no-regrets solutions to water supply provision and environmental management measures. They should also include greater management of future birked development (see Box 9).

Box 9: *Birkeds*: The development challenge

Although initially the construction of *birkeds* was a logical response to alleviating water shortage, the numbers have increased to a point that *birkeds*-related problems now often exceed the earlier problem of water shortage. For example, in terms of *birkeds* expansion, Sugule and Walker (1998), citing Farah (1997), suggest that there were 12,000 *birkeds* in Gashamo District alone, arranged in 126 clusters, which corresponded to the number of permanent and semi-permanent settlements in the district. In 2010, increases were reported in the number of clusters, and the number of *birkeds* in each cluster, e.g., from 3 *birkeds* in Shimbiralle in 1974 to 48 today, with the number of *birkeds* in each settlement varying from less than 50 to several hundred. Large numbers of *birkeds* were also constructed in Warder, as local wells could not supply increasing livestock. These include Roba Nagaya, Jiren Dukale, Cheri, and Bati women trading associations in Yabello and Moyale.

Despite the sinking of new wells in Boh and Geladin from the 1950s onwards, the number of *birkeds* also increased substantially in these areas since the 1970s, with 65 villages having *birkeds* in Boh and 55 villages in Geladin District. While the other villages have as few as 20 *birkeds*, the highest concentration was recorded in Qualo'an village with 3,000 *birkeds*. In Aware, more *birkeds* were constructed in the area controlled by the Isaac clan (southwards from the border) compared to the Ogadeni-controlled area, which has more permanent water. *Birkeds* are associated with the wide-scale environmental degradation that has followed their construction and use in the Region.

Specifically, *birkeds* initiate problems such as: encouraging settlements that result in large-scale deforestation through firewood and charcoal production for home use and trade, including cross-border exports; the concentration of livestock in confined and *birkeds*-bound areas in both wet and dry seasons; mobility restriction through private ownership of the grazing resources around *birkeds*. According to Devereux (2006, p. 102), birkeds are "a common cause of conflict due to access restrictions."

3.4.3. Rainfed Farming

Rainfed farming is subject to the key constraints of high rainfall variability in volume and high evapo-transpiration. Having regional, strengthened weather prediction institutions with decentralized data collection units in the Region will help agro-pastoralists make decisions about starting farming in a certain season or not. Use of the available communication technology to disseminate the information on rainfall to agro-pastoralists will also help them make decisions on farming.

There are two types of rainfed farming in the Region. One is dependent on the direct rainall on a farm's land, with traditional diversion ditches to supplement the need. This is practiced in areas where there are no rivers. When the rain is not adequate, crops suffer from water shortage, leading to total failure. To compensate for this intermittent supply from rain, construction of micro-dams in strategic locations will help agro-pastorals utilize the water supply, using different lifting technology.

Special lifting devices that do not require fuel for running could be used when there is a need to supplement farms with reserved water. Pedal pumps or reciprocating pumps might be advocated for the purpose. These are simple technologies that could be fabricated in medium workshops within the Region (rope and washer pumps are discussed below).

The other type of rainfed farming is the one practiced in lowlands when floods come from highlands. The different types of water from different areas are responsible for failure of crops. Based on the water quality, suitable consumable crops, cash crops, or fruits could be identified based on research; this would help in tackling the failures that have led to loss of huge inputs in the past.

When an area exhibits an intermediate growing period ranging from 0 to 75 days, a decision should be made that the area is unsuitable for rainfed farming because it is unlikely that the crop water requirements will be fully met during this period. Where an area exhibits a normal growing period, it would be relatively suitable to support rainfed crop production, especially medium- and short-maturing crops. But focus could be given to cash crops that have a high return, crops resistant to climatic changes, and low water-consumption crops.

Special focus could be made on parts of the region getting "*Karan*" rainfall, which receive more than 700 mm of rain annually and have a growing season lengthy enough to support crop cultivation. Short-maturing varieties of wheat, barley, and maize could be cultivated during the short rainy season of *Karan*. Sorghum consumed by the agro-pastorals could be advocated where water is scarce. Cash crops like *chat* are also ideal during the short rainy season. The Somali Region Pastoral and Agro-pastoral Research Institute adaptation trials and tests on early-maturing wheat and barley varieties have found these varieties to be suitable for rainfed crop production areas.

Land preparation with animal power and with hand tools is tedious and wastes a lot of rain that could have been utilized earlier. Government provision of tractors on a credit basis in areas potentially identified for rainfed farming will ensure best use of the rain, and crops will have sufficient water until they mature. This government support will have the advantage of reducing the work load of the agro-pastorals and will ensure that the majority of agro-pastorals plots are cultivated, including those plots that otherwise would have been left uncultivated.

The main aim of rainfed farming should be to alleviate the condition of the agro-pastoralists and allow them to move from low-level-earning farming to medium-level-earning farming. This could only be achieved by supporting the agro-pastorals in utilizing the rainfall for farming as much as possible and supporting agro-pastorals to farm all their plots. This would require a coordinated effort in supplying enough seeds and require continued technical support through a strong extension program. The decline in the amount of cereals produced from 2004 to 2009 shows the need to provide the strong support necessary to increase productivity.

Improved market access will have a significant positive impact in improving the life of the agro-pastoralist. Government and NGOs and UN organizations that carry out food aid may endeavor to buy the surplus production at the market price from the nearby market or from associations of agro-pastorals, with the aim of improving the status of the agro-pastorals. Immediate buying of the crops by the government or others might eliminate the very traditional storage of the crops, which usually is responsible for damage to the crops. Improvements to traditional storage systems for crops above the ground may be envisaged by the government or all concerned through consultation with the agro-pastoralists and through visits to other similar arid and semi-arid areas.

The invasion of prosophis and other weeds is responsible for competing with the agro-pastorals and for taking land that would otherwise be used for agriculture. These weeds also use water that would have been used by crops. This depletes the moisture content of the soil rapidly. Hence, the invasion of the weeds should be prevented from expanding and covering more irrigable lands, and coordinated efforts should be made to completely eliminate this enemy of agro-pastorals.

3.4.4. Domestic and Industry Consumption

Many water points in SRSE are managed ostensibly by Water Management Committees called Water Sanitation and Hygiene Committees (WaSHCO). However, in spite of the collection of relatively high charges per jerry can of 0.5 to 1 ETB for 20 liters (equivalent to $3 a cubic meter), many such water systems are left in a state of disrepair because of a simple failure in operation and maintenance.

The national policy argues that rural tariff settings are based on the objective of recovering operation and maintenance costs, while urban tariff structures are based on full cost recovery. It is also important that the Region establishes a "social tariff" that enables poor communities to cover operation and maintenance costs. This is particularly important during periods of shortage, when profiteering from scarcity may lead to severe challenges for the poorest and most vulnerable. Box 10 explains a broader example in East Africa.

There are areas with high water potential that could pump water to areas of low water potentials. This type of intervention has the advantage of addressing the needs of pastoralists in sub-kebeles between the source and the destination. The environmental impact, acceptability, susceptibility to conflict, and the sustainability of the project should be studied very carefully before rushing into implementation.

Electric grid connection to most of the motorized schemes will eliminate dependency on fuels that are at intermittent supply and will improve the accessibility of water. Shallow water sources could utilize the natural energy like sun and wind by solar- and wind-driven technology. These systems require limited operation and low maintenance cost.

Water for industry should be governed by the following principles. Principles are taken from the Ethiopian Water Sector Policy:

1. Promote the "**User Pays**" principle in the supply of water for industrial and other users.
2. Recognize that industrial and other water uses are integral parts of the water sector and incorporate industrial and other users' water supply plans with comprehensive water resources management undertakings.
3. Ensure that the industrial water demand forecast is based on the future industrial development plans.
4. Ensure that when industries develop their own water supply systems, they will be accountable for the water supply services costs only.
5. Control and ensure that water bodies are protected from pollution by waste water and other wastes indiscriminately discharged by industries and other institutions.

Box 10: Strategic guidance from a wider study on water development and pastoralism in East Africa

1. Understand the broader natural resource base and livestock grazing patterns/seasonal movements before beginning any water point development: Water development needs to be part and parcel of natural resource management as a whole, recognizing the way that water access and use affects how the broader natural resource base is used and managed.

2. Understand local contexts and dynamics, including the social, economic, political, legal, and cultural aspects of a given location: Research into the local context should include, but not be limited to: all the potential water resource users (e.g., downstream and upstream users along rivers); water access patterns; water needs/demand; particular concerns relevant to the area—including conflict over resources; customary institutions and their role in water/resources management; interactions with other governance institutions and stakeholders; and gender considerations. A comprehensive stakeholder analysis should be conducted at the local level to enhance the process.

3. Identify the existing water points first and explore options for their rehabilitation by upgrading the water supply system before designing new ones: Identify why the existing water systems are non-functional or performing poorly as a first step. Improving the performance of what is already there is not only cost effective, but researching the existing water supply system can help identify problems and the level of user responsibility.

4. Thoroughly evaluate the need for and potential impacts of introducing new water points, and identify remedial measures to tackle negative impacts: This can be carried out through an Environmental and Social Impact Assessment process.

5. Select the water development option based on choice of technology, cost considerations, as well as on the expressed needs and capacity of the community: A technical feasibility study and a cost-benefit analysis can identify certain choices, but the community should make the final decision on design. Planners should explain the technological options available and help communities—through a process of dialogue and knowledge sharing—to select the most suitable technology and design that will satisfy their local needs.

6. Integrate water development design with other pastoral development interventions: Water development should be linked with efforts to improve access to markets, rangeland rehabilitation, etc. in order to address vulnerability and poverty effectively over the long term—supporting and improving livelihoods.

7. Promote meaningful engagement with communities throughout the project identification and planning phases: The intervention should promote the use of participatory/consultative methods. Using participatory methods will enable planners to understand and benefit from local knowledge systems, and allow dialogue between communities and planners on the most suitable type, placement, and size of water points.

8. Ensure constructed water structures are of good quality by focusing on proper design and construction: Guidelines on the construction of most water structures are available and should be used to guide their development. Community/local capacity should be developed in the construction of the water sources for sustainability.

9. Promote the contribution of cash and/or labor-in-kind in the construction or rehabilitation of water points: Not only will this reduce project costs, but it will instill a sense of ownership, enhance community commitment to maintaining the water point, and ensure that it is sustained beyond the lifetime of the project.

10. Strengthen the capacity of water users in management, operation, and maintenance: Communities should be assisted in establishing water management committees (or variations thereof), which include representatives of all groups with a stake in the development. The committees that help and manage the water interventions should be built upon existing customary resource management systems.

11. Provide training to local community members in construction, management, and maintenance to embed capacity at the local level: Develop a training curriculum with approaches appropriate to the target community, guided by a training needs assessment.

12. Continue to assist communities to manage water systems for some time after completion of the project: Adequate follow-up and mentoring may be required for some time. The community may engage private entities like a local entrepreneur, a CBO/NGO, women, or youth groups to run the water supply on their behalf to ensure sustainability. However, the plight of the vulnerable groups should also be considered.

13. Undertake knowledge sharing, exchange, and cross-learning among implementing partners and relevant government agencies: Exchange visits by communities, to see properly working and successfully managed water supplies, is an important way to demonstrate what is possible, and to raise community expectations. This will enhance the adoption of good practices in the region.

14. Water sector development actors need to agree on common approaches to development/financing, which avoid undermining good governance: Misguided donations of equipment and spare parts can promote the unsustainability of community water projects. Often such donations, although well meaning, promote dependency by freely bailing out communities that have failed to manage their water supplies well, thus rewarding mismanagement. Relief should be linked to development, i.e., by adopting a long-term livelihoods approach to humanitarian interventions.

http://www.disasterriskreduction.net/fileadmin/user_upload/drought/docs/22%20March%202012_Good%20practice%20principles%20on%20water%20development.pdf

Chapter 4: Enhancing Water Productivity—Using the Resource Effectively

4.1. Brief Summary

When any resource is limited it is natural to use it efficiently. The pastoral community has a tremendous amount of knowledge on the efficient use of water. This indigenous knowledge has to be supported with academic knowledge and technology. A lot is expected from all stakeholders in both introducing efficient uses of water and instilling knowledge and habits of efficient and effective use on those who are the end users.

There are competing activities that require water to thrive in the Region. Livestock production, irrigation, and domestic and industry consumption all require water and their needs sometimes clash. A wise and correct approach will ensure water development that best fits the competing uses. Cheap and sustainable source development should be given priority for irrigation and livestock production use, so that it does not compete with the development of an expensive water source for human consumption.

In the past, due to inefficient use of the water, precious and expensive water was lost before bringing the required change in the lives of agro-pastorals. Common irrigation practices are responsible for a huge loss of water, leading to unimproved livelihoods for those dependent on agriculture. Improved approaches and innovations in all water use types should be encouraged to bring about the intended changes.

Coordinated efforts of stakeholders and an integrated approach are both essential and necessary in using the water resources available in the Region effectively. The roles and responsibilities of all stakeholders interested in water should be clearly defined and disseminated for easy coordination and support.

4.2. Efficient Allocation

The establishment of allocation efficiency is a key part of effective water management in drylands environments. This entails choices between different—and usually competing—uses to which water can be put. In the SRSE case, this is between domestic (human) consumption, livestock consumption, and agriculture, whether rainfed or irrigated.

In most cases in the SRSE, the capacity to allocate water between competing uses is lacking, given the rudimentary management structures that exist. In practice, efficient allocation needs to be established as a principle at all scales. The basic concept of efficient allocation is that water is directed towards uses that maximize social and economic benefits, rather than perpetuate low-value uses that provide negligible wider benefits at the community or regional scale. The argument is often applied to use of groundwater for the production of simple, low-value foodstuffs in highly water-scarce environments, where cheaper alternatives exist through trade. The principle that should be practiced in the Somali Region is that decisions on water allocation should be undertaken at the lowest appropriate level through participatory processes and that ultimate decisions should be consensus-based.

4.3. Enhancing Value and Impact

A basic stage in enhancing water productivity is understanding the value of the resource between different uses—including the impact that this different value has to livelihoods security. The box below helps through illustrating from a TWGs study different water values within specific livelihoods systems.

Box 11: Understanding the competing values of water: An example

While not seeking to understand water resources as simply a commodity with a set of values, the value of water to different uses is critical in setting tariff rates and in determining the cost-benefit ratio of different investments.

Beer-caano kebele in Beer-caano District is remote from the river, without permanent water supply for inhabitants of the keble. The kebele has one *birked*, which is used to collect water and is insufficient. During the dry season, the price of water goes up to 200 Birr a barrel, according to the district administration, reflecting high demand for the resource. In the wet as well as dry season, the inhabitants, particularly women and children, travel to the river—which is more that 15 km away—to fetch water. This process takes an average of eight hours, denying their households the multiple benefits of their other activities, including agricultural production and child care.

Water constraints in this kebele also cause social costs in the form of disputes and violence. Women who spend time and energy to bring water from faraway places prefer the economic use of water, usually for essential purposes such as cooking and drinking, while the husbands use water for bathing etc. There may even be intra-household disputes. The kebele chairman in Dabafayd said that women spend most of their time fetching water and purifying it for drinking. From a 20-liter jerry can, only 10 liters of pure water is produced for drinking, according to him (presumably due to evaporation and other losses during the process).

Kebeles which are on the edge face water problems due to the lack of safe drinking water for humans as well as livestock. The Shebelle River is the only permanent water source and carries water that is largely muddy during the rainy season. Inhabitants in Dabafeyd, Kunka, Yihas Jabal of Shabelle District said that the river water is completely muddy for six months during the year, rendering it unsuitable for both humans and livestock. There is no purification system available. The losses to livestock value in search of better water sources (or the costs in terms of *birked* water purchase) may be substantial. Having to take water from the Shebelle in all seasons also poses significant risks from the crocodiles inhabiting the river banks.

Siti Zone: "Most of the pastoralists in all the three woredas pay 50 cents for water consumption per jerry can, which is equal to 25 birr per m^3 of water. This obviously is too expensive for pastoralists to pay.

Hence, poor households prefer to use open and unprotected sources, despite the negative health impacts. Due to the considerably high water cost, most pastoralists could not afford to water their livestock at motorized schemes even if water were available. Hence, they prefer to move with their animals until the drought comes. During drought times, pastoralists need to congregate around motorized schemes only to pay a lot of money to save their animals. In order to cover the cost, they have to sell some of their animals as a sacrifice for the rest. At the end, pastoralists will be left with a dwindled number of livestock population, due to either selling of animals or livestock death. Others prefer to take their animals to a far place to find more sustainable water sources and which cost them nothing or have a small cost. The intense hot weather together with limited pasture would then be the fate of the moving animals. Due to this, animal body weight will be lost and in extreme cases loss of animal would result."

TWG Agriculture Report; Siti Zone Research Visit

4.4. Linking Sectors and Approaches

The Regional Water Resource Development Bureau is in charge of the management of regional water resources. However, other actors are also involved, including the DPPB in emergency interventions, the Agriculture and Livestock Bureau, and the Basin Development Office. There is little coordination and major fragmentation of activities. Other regional government agencies with a direct interest in the development of water resources include the Regional Meteorological Office, the Somali Region Works and Construction Enterprise, and the Somali Region Water Design and Supervision Enterprise. A number of other UN and non-governmental agencies are also involved, both in funding and developing schemes, often without effective coordination with regional government. There is a pressing need to improve coordination. The corridor-based approach to development offers one option (see box below).

Box 12. Corridor-based coordination

Managing and developing water resources effectively to enhance productivity requires collaboration across institutions and at different levels. This will establish a principle of more collective and informed management, enabling decision makers to iron out problems that arise and prevent their institutionalization, to address and share potential management and water development innovations, and to create more sustainable programs and projects. In SNRS, effective coordination will be required in both planning and budgeting and in implementation. At present there are five development corridors:

Siti Development Corridor: This corridor covers part of the Somali Region in Awash Basin; Shebelle Basin Development Corridor: This corridor covers most parts of the Shebelle Basin in the Region; Liben Development Corridor: This corridor covers most parts of the Dawa Basin and partly the Ganale River; Afder Development Corridor: This corridor covers part of the Genale Basin in Somali Region; East Somali Development Corridor: This corridor covers the Eastern part of the Region and south of Siti.

Water: Availability of water in most parts of the corridors will be in a bottleneck for at least some time. Water development for irrigation, be it underground water, river diversion, or runoff catchments will all need huge investments and management capacity. Taking water as entry point of development in all corridors, water supply should be the number one priority. This could be a critical entry point for the proposed CLPAs. Basin development is one priority for regional government and should be built upon, including basin-wide coordinated land-use and water development planning.

4.5. Development Options

4.5.1. Irrigation

Water is a precious and expensive input for irrigation. Recent developments in irrigation have shown that the soil-crop-water regime is affected by climatic, physiological, and soil factors. These conceptual developments have led to technical innovations in water control that have made possible the maintenance of near-optimal moisture and nutrient conditions throughout the growing season. More often than not, the fault lies in the unmeasured and generally excessive application of water to land, with little regard either for the real cost of extracting the water from its source and delivering it to the farm, or for the cost of restoring the water resource after it has been depleted or polluted. “Just enough is best” should be the motto of the Region when irrigation is practiced, and by that is meant a controlled quantity of water should be used that is sufficient to meet the requirements of the crop and to prevent accumulation of salts in the soil. There should not be less water used, and certainly no more water than is necessary should be used. The application of too little water is an obvious waste of all the inputs including water, as it fails to produce the desired benefit. Excessive flooding of the land is, however, likely to be still more harmful, as it tends to saturate the soil for too long, inhibit aeration, leach nutrients, induce greater evaporation and salinity, and ultimately raise the water-table to a level that suppresses normal root and microbial activity and that can only be drained and leached at great expense.

To bring about real changes in the life of those who practice irrigation and to allow them to be strong contributors to the economy of the Somali Regional State, the water they depend on should not be wasted. Wasting water in excessive irrigation contributes to its own demise by the twin scourges of waterlogging and soil salinity. Instead of achieving its full potential to increase and stabilize food production, irrigation in such cases is in danger of becoming unsustainable. The ultimate economic and environmental consequence of poorly managed irrigation is the destruction of an area's productive base. The cost of rehabilitating the land after it has been degraded may be entirely prohibitive. Hence, proper irrigation methods that are relevant and practical to different agro-ecological zones have to be tested and adopted.

When using water for irrigation, it is wise to recognize that water is an important and valuable resource, one which contributes significantly to production of high quality crops to specification and on schedule. Both crop performance and efficient use of the available water can be optimized by:

- Knowing the water-holding capacity of the soil in each field and the water requirements and response of each crop grown;

- Using an effective soil moisture monitoring system and using it to schedule irrigation accurately;
- Choosing the right application equipment for the situation and knowing how to get the best out of it in terms of uniform and timely delivery;
- Managing water application for maximum economic benefit with minimum impact on the environment;
- Auditing performance afterwards to seek ways of improving the efficiency of water use and application.

It has been noticed that in the Somali Regional State, some large-scale irrigation projects operate in an inherently inefficient way. This is largely attributable to poor management, poor extensive technical knowledge about the soil, poor knowledge on crop water requirement and types of crops, and poor linkage with different sector bureaus and institutions including the Research Institute. The poor management practices that lead to waste arise not necessarily because of insurmountable technical problems alone or lack of knowledge, but simply because it appears more convenient or economical in the short term to waste water rather than to conserve it. Also, in small-scale irrigations where water is delivered to agro-pastoralists on a fixed schedule or according to the fuel they can provide, irrigators tend to take as much water as they can until the next schedule or fuel supply. This typically results in over-irrigation, which not only wastes water but also takes the moisture content of the soil to well below the acceptable standard. Such situations occur when the price of irrigation increases. Newer irrigation methods should be adapted to apply a small, measured volume of water at frequent intervals to where the roots are concentrated. The aim is to reduce fluctuations in the moisture content of the root zone by maintaining moist but unsaturated conditions continuously, without subjecting the crop either to oxygen stress (from excess moisture) or water stress (from lack of moisture). Moreover, applying the water at spatially discrete locations rather than over the entire area has the effect of keeping much of the soil surface dry, thus helping not only to reduce evaporation but also to suppress proliferation of weeds; both are the main problems in the Somali Region.

Coordinated efforts of all the stakeholders are necessary to achieve optimization of soil moisture, while learning from the traditional flood irrigation methods. To bring about the intended changes in the irrigation sector and bring about water security, these changes should happen in the Region. For these changes to gain ground gradually, their progress should be encouraged and accelerated wherever appropriate.

Where the field is far from the water source, the water could be conveyed to the field in concrete-lined channels so as to avoid seepage losses, or preferably in closed conduits that avoid pollution and allow pressurizing of the water thus delivered. In the field, the water can be distributed via low-cost, weathering-resistant plastic tubes, and be applied to the root zone by means of drip emitters, microsprayers, or porous bodies placed at or below the soil surface. Human labor and local materials may substitute for industrially produced devices where such are unavailable or too expensive, while retaining the principles of efficient irrigation.

In no case can blind acceptance be assumed of any technology or methodology designed and introduced entirely from the outside. Local trial and error (guided, to be sure, by sound basic principles) will be necessary, as systems must be proved in practice to fit the circumstances and preferences of their intended users. Local experience will evolve gradually and will take time to become local expertise. The Region’s own agro-pastorals should be involved from the outset and encouraged to participate and innovate. Local entrepreneurs may then develop the capability to improvise essential components and service irrigation systems.

A number of criteria are used in selecting irrigation systems. Some of the most common (as explained in the previous sections) include: the efficiency of the system, the capital investment required, the suitability to different crops and different soils, the labor requirements, and the operation and maintenance cost. Field and Collier (undated) provide two classes of factors: technical factors and scheme development factors. Tables 6 and 7 present their selection criteria.

There can be no short cut to the process of adoption and adaptation; it should not be rushed and must not be imposed from above. Rather, it should be nurtured by means of positive incentives. Extension services can provide information, demonstrations, and guidance to agro-pastorals where needed, while financial institutions can offer them credit on favorable terms to invest in appropriate irrigation technology. Such technology will only be accepted if it produces adequate returns; that is to say, if its benefits clearly justify the costs. Since the benefits will depend in each case on marketing opportunities and other local factors, they cannot be predicted ahead of time by outsiders.

When there is a need to increase the frequency of irrigation, the infiltration period becomes a more important part of the irrigation cycle. With small daily (rather than massive weekly or monthly) applications of water, the pulses of added water are damped down within a few centimeters of the surface, so the flow below that depth is essentially steady. The moisture content of the root zone should be controlled, as well as the rate of internal drainage, by adjusting the rate and quantity of application according to the soil's permeability, the soil solution's concentration, and the climate-imposed evaporative demand. This practice of optimization brings about change by both increasing yields and conserving the water.

The long-accepted notion that the entire volume of the root zone must be wetted to full capacity at each irrigation has been contradicted by recent experience proving that a crop can fare well when the wetted zone is restricted to a fraction of the soil volume—50 percent, or even less. This is on condition, of course, that the supply of moisture and nutrients in that partial volume is sufficient to satisfy full crop needs. This new development will help the Somali Region to meet its goal of achieving water security across the Region.

Since a high-frequency irrigation system can be adjusted to supply water at very nearly the exact rate required by the crop, those practicing irrigation no longer need to depend on the soil's ability to store water during long intervals between irrigations. Hence, water storage properties, once considered essential, are no longer decisive in determining whether a soil is irrigable. New lands, until recently believed to be unsuited for irrigation, can now be brought into production. Examples are coarse sands and gravels, where moisture storage capacity is very low and where the conveyance and spreading of water by surface flooding would cause too much seepage. Such soils can now be irrigated, even on sloping ground, by means of drip or soil-embedded porous emitters that apply the water frequently or continuously to the root zone at a controlled rate.

Table 6. Technical Factors Affecting the Selection of Irrigation Methods

Irrigation method	Crops	Soils	Labour (hrs/ha irrigated)	Energy demand	Potential efficiency (%)	Capital cost
Surface:					60	Low
- basin	All crops	Clay, loam	0.5-1.5	Low		
- border	All crops except rice	Clay, loam	1.0-3.0	Low		
- furrow	All crops except rice and sown/drilled	Clay, loam	2.0-4.0	Low		
Sprinkle	All crops except rice	Loam, sand	1.5-3.0	High	75	Medium
Trickle	Row crops, orchards	All soils	0.2-0.5	Medium	90	High

Table 7. Scheme Development Factors Affecting the Selection of Irrigation Methods

Irrigation method	Design	Construction	Operation	Maintenance
Surface	Simple	Simple	Complex	Simple
Sprinkle	Complex	Complex	Simple	Complex
Trickle	Complex	Complex	Simple	Complex

Though they offer many advantages, high-frequency partial-volume systems have shortcomings too. With only a fraction of the potential root zone wetted, there is less moisture storage in the soil, so the crop depends vitally on the continuous operation of the system. Any short-term interruption of the irrigation (whether caused by neglect, mechanical failure, or water shortage) can quickly result in severe distress to the crop. The imperative to maintain continuous operation is difficult to meet if the system depends on costly and vulnerable equipment imported from abroad. The system must therefore be simplified so as to make the local agro-pastorals self-reliant.

Irrigation needs to be done before the yield is reduced by insufficient soil moisture, which is what happens in many irrigation fields due to a shortage of water or fuel. Irrigating frequently enough to prevent excessive soil moisture depletion but also not to induce high moisture content should be taken care of. A standard approach called the water balance or checkbook method could be used to determine how much soil moisture can be depleted between irrigations without reducing crop yield. The percent of moisture depletion acceptable for different crops is different;

hence, site studies have to be carried out considering the evapo-transpiration. Allowing the crop to use all the available soil moisture will cause permanent wilting; hence, the irrigation interval has to be decided based on allowable moisture depletion.

The procedure for determining when to irrigate based on an allowable depletion is:

Step 1: Determine the total allowable soil moisture depletion by multiplying the available soil moisture by the root depth, then multiplying by 0.5 (which is the allowable depletion expressed as a decimal fraction);

Step 2: Determine the daily ETo for a given time period and location;

Step 3: Determine the Kc;

Step 4: Calculate the daily ET for the crop in question;

Step 5: Determine the interval between irrigations by dividing the total allowable soil moisture depletion by the daily crop ET.

In general, it is vital to change the pre-existing pattern of human behavior and institutional norms that are prevalent in the Region. An infrastructure designed for one mode of operation cannot readily be converted to another. Habits and traditions, once established, acquire inertia, with vested interests in maintaining the status quo and a resistance to reforming it. Instituting efficient practices needs to be planned from the outset when new irrigation are proposed to be started in order not to fall in the same trap again. As Box 13 shows, some communities have established traditional water water management systems.

Box 13: Community Water Management: The case of Baraq kebele

In Siti Zone, Beraq kebele, there is a gravity system of irrigation. All community members are agro-pastorals with different sizes of plots for irrigation. The traditional law allows each household to get an equal amount of water irrespective of crop types and plot size. Also, the water is delivered at 19-day interval irrespective of crop type and soil type. This leads to large plots being uncultivated and crop failures.

Combating pests, crop diseases, and wild animal attacks could be taken as part of conserving water resources effectively. A crop that is lost due to pests and diseases has wasted a lot of water, including the value of the crop and the labor and other inputs invested. One cost-efficient technique to combat pest and disease infestation is the synchronized approach of neighboring agro-pastorals. *Goob* collective farming culture (see Box 14 below) could be replicated efficiently to fight all unwanted pests, diseases, and attacks collectively. Individual efforts are threatened by other plots where infestation is possible. Eliminating wild animal attacks should not be left to the agro- pastorals and should be controlled in a coordinated manner in order not to waste resources like water. Synchronizing crop cultivation therefore is an alternative adaptation option to reduce the risk of crop infestation and encourage long-term water use efficiency and assure additional income to agro- pastorals.

Composting systems that are easily replicable, with the aim of using the huge amount of animal dung in the different areas where irrigation is practiced, should be promoted. The end result of composting will be used as a fertilizer which is economical and user friendly. Enhancing the fertility of the soil will ensure productivity and high return for the same volume of water used.

Advocating and planting high-value oil crops and cash crops will have a return value for the same volume of water and hence need to be practiced, supported by research and trials. Fodder production to support pastoralism is one way of allowing the two livelihoods to thrive together. But this has to be linked with market opportunity so that post-harvesting storage that would otherwise damage the production is avoided, and agro-pastorals benefit from the return immediately. Reinforcing markets not only in the country but also in neighboring countries would build the economic capacity of the agro-pastorals, which in turn would build their resilience to any future crisis that may occur due to continued drought or climate change.

The Somali Regional Government is drilling boreholes with the purpose of introducing irrigation and creating alternative subsistence to pastoralists and sedentarizing them based on their willingness. Irrigation using groundwater is not a new technology, but should be practiced with care considering the depletion of groundwater potential in arid and semi-arid areas. The concept of efficient utilization of water by introducing new irrigation technologies comes in here as well.

Before introducing any irrigation system, either from rivers or boreholes, an environmental impact assessment should be made and approved by the regional environmental body, declaring no negative environmental impact. This assessment should be carried out every five years, and the report should be approved by the environmental body. If at any point in time the reports declare bad environmental traits developing, the irrigation activity should be suspended, and the government should employ its contingency plan for the beneficiaries of the system.

The potentially negative environmental impacts of irrigation development may occur off-site as well as on-site. The off-site effects may take place upstream of the land to be developed, for example where a river is to be dammed for the purpose of supplying irrigation water. Another set of problems may be generated downstream of the irrigated area by the disposal of excess water that may contain harmful concentrations of salts, organic wastes, pathogenic organisms, and agrochemical residues.

Box 14: Useful labor practices

Some agro-pastoralists deliver agricultural activities together in a rotation. This collective agricultural activites approach is called *goob* in the local language. This approach is a good practice that could be replicated in other areas to control weeds and pests in addition to harvesting and other activities.

Agricultural Working Group Litrature review

4.5.2. Livestock

Water Requirements of Livestock

Water contributes up to 80% of an animal's body weight. Deprivation of water more than any other nutrient quickly leads to reduced feed intake, production, and reproduction. It can also lead to poor health and eventually death. Water intake depends upon the size of animal, the amount of feed and salt ingested, the presence of lactation, ambient temperature, and an animal's genetic adaptation to its environment.

For example, indicative water intake by dairy cows could be estimated by the following equation: $y = 16.0 + 0.71i + 0.41m + 0.05s + 1.2t$, where y is the daily water intake (liters per day assuming l liter, and weight = 1 kg), i is the daily dry matter feed intake (kg/day), m is the daily milk production (kg/day), s is the sodium intake (g/day), and t is the mean weekly mean minimum temperature (°C).

Indicative water intake levels of livestock range from about 5 liter/TLU in cool wet weather to about 50 liter/TLU in hot dry conditions. Although much effort has been devoted to the important task of providing drinking water for animals, the actual water required to produce daily feed for livestock is about 100 times the actual daily requirements for drinking water. Livestock typically require daily feed intake of dry matter amounting to about 3% of their weight, but about 1 m^3 or 500 liters of water is required to produce 1 kg dry matter. One TLU of small livestock such as sheep and goats would require up to 5,000 liters of water a day to produce the feed required, and larger animals such as camels will require at least half of this amount.

Water Productivity—General Principles

Popular literature often criticizes the use of livestock in agricultural production because of their apparently high water requirements. Water requirements of various agricultural commodities vary, with beef production reportedly requiring 200 times more water than potatoes. Many details are missing from such summaries. For example, many food items have highly variable water contents. The figures do not take into account market values of the commodities. The requirements do not clearly explain how the water was used in the production process and how much could have been re-used for other purposes. Understanding the implications of livestock in agricultural production and managing the use of livestock for integrated natural resource management requires analysis of innovative new research on the water productivity of livestock.

Water productivity of livestock is a measure of the ratio of outputs such as meat, milk, eggs, or traction to water depleted (i.e., used as an input and subsequently not available for other uses). When multiple outputs such as milk (liters), meat (kg), and traction (ox-days) are involved, productivity must be expressed using a common measure such as US dollars or Ethiopian Birr per unit of water depleted. Degraded water can be viewed as water depleted for high value purposes. Water productivity can be estimated by the following equation:

$$\text{Water Production of Livestock} = \sum \left[\frac{\text{Livestock Outputs and Services}}{\text{Depleted Water}} \right]$$

Water productivity measures are scale dependent, and water considered depleted at one scale may not be considered as such at a different scale if it has been or can be used for additional purposes. At the level of the individual animal, water lost through evaporation and respiration are no longer available to the animal or to any other users. This is depleted water. Losses such as those in urine and milk have no further value to the individual, but may be of use to other users. Degraded water is partially depleted water that can have lower value uses. A clear research challenge is to develop livestock management practices that increase water productivity and reduce depletion and degradation. Applicability of interventions will be scale-specific as suggested above. For example, urine provides nutrients to the forage crops on which animals feed and contributes to soil moisture. This is depleted water from the perspective of the individual animal but not to larger systems (e.g., a pasture).

Estimating water productivity of livestock can be tricky. For example, Goodland and Pimental (2000) suggested that 100,000 liters of water are needed to produce 1 kg of beef. In contrast, let us assume that one head of cattle consumes 25 liter/day over a two-year period to produce 125 kg (the approximate dress weight of one TLU). This implies that it will drink up to 18,250 liters over a two-year period. Let us also assume that all of the feed comes from crop residues for which no additional water input was required. Then productivity of beef production would be about (18,250 liters)/(125 kg) or 146 liters/kg, an amount far more efficient than the figure given for potatoes. In addition, much of the water consumed by livestock is released into the soil as urine, providing soil nutrients and soil moisture. From this example, it is clear that livestock production could be viewed as either one of the most efficient or inefficient means of producing food for people, depending on the system in which the livestock are raised. The difference between the two water productivity scenarios of 100,000 and 148 liters/kg of beef assumes that we know very little about the true water productivity of livestock keeping. Understanding of the water productivity of livestock is lacking, especially at a watershed or river basin level, and must be given priority in future research and development.

Water Quality and Livestock

Water is an essential nutrient which is involved in all basic physiological functions of the body. However, it is important to note that water, relative to other nutrients, is consumed in considerably larger quantities. Therefore, water availability and quality are extremely important for animal health and productivity. Limiting water availability to livestock will depress production rapidly and severely, and poor quality drinking water is often a factor limiting intake. Considering that water is consumed in large quantities, if water is poor quality, there is an increased risk that water contaminants could reach a level that may be harmful.

The water requirement and intake in livestock may vary depending on species and breeds of livestock, animal status, production mode, and environment or climate in which livestock are raised. All these variables are directly or indirectly relevant to several aspects of water metabolism and physiology. In this context, it is necessary to understand water quality issues from the perspective of water intake physiology.

Cleanness of Water

People in the Region do not seem to worry about water cleanness for animals, but this is a serious issue, especially with the new water technologies. Care needs to be taken in the provision of water to animals. All water troughs should be cleaned frequently. Livestock never should be forced to drink dirty or contaminated water. Stale water can cause reduced water consumption. Even when clean water is available, animals may continue to consume dirty water if it is available. Dirty water is a host for disease organisms. Disease can spread rapidly if animals drink from the same trough, so sick animals should be isolated from the trough, and the trough cleaned and disinfected. A good disinfectant is a dilute bleach solution after the trough has been cleaned thoroughly. Sprinkling baking soda into the fountain periodically may reduce algae growth. Tip tanks sometimes are installed in larger dairy free-stall barns to simplify cleaning. Have an elevated base around automatic waterers. Make the base wide enough so animals can put their front legs on it easily when they are drinking, but not their hind legs. Animals normally will not place only their hind legs on this base and, therefore, will not defecate in the water. Placement and height of the base are the keys to avoiding fecal contamination. Make the surface rough so animals will not slip.

Water Quality

If uncertain about water quality, it should be tested. The following chemical properties should be considered when evaluating the quality of water for livestock.

Salinity

Salinity refers to salt dissolved in water and is expressed as parts per million (ppm) or as milligrams per liter (mg/L). The expression “total dissolved solids” (TDS) often is used to denote the level of water salinity. TDS is a nonspecific indicator of water quality. TDS levels should not be used as the only measure of water quality. Specific water components should be measured to determine suitability for specific applications. Salts commonly present include carbonate, bicarbonates, sulfates, nitrates, chlorides, phosphates, and fluorides. Highly mineralized waters (high solids) do not have much effect on health as long as specific ions, such as sulfate, have no objectionable effects, and as long as normal amounts of water are consumed. One gram of sulfate per liter (1,000 ppm) may result in scours. High levels of sulfate in the water also may reduce copper availability in the diet. The limiting health concern is often sulfate because the acceptable sulfate level will be exceeded before TDS levels are high enough to be a concern.

Salts, such as sodium chloride, change the electrolyte balance and intracellular pressure in the body, producing a form of dehydration. Salts also place a strain on the kidneys. High salt concentrations that are less than toxic actually may cause an increase in water consumption. Animals may refuse to drink high saline water for many days, followed by a period when they drink a large amount. Then they may become sick or die. The tolerance of animals to salts in water depends on factors such as water requirements, species, age, physiological condition, season of the year, and salt content of the total diet, as well as the water. Animals have the ability to adapt to saline water. However, abrupt changes from water with low-salt to water with high-salt concentrations may cause harm, while gradual changes do not.

Other minerals

Water hardness is caused by calcium and magnesium. Softening the water through exchange of calcium and magnesium with sodium may cause problems if water is already high in salinity. When a significant amount of calcium is in water, it should be considered as a part of the total mineral intake. However, many mineral salts are relatively insoluble and pass through the body without being absorbed. Even in hard water, the amount of mineral ingested from the water is not likely to be substantial.

4.5.3. Rainfed Farming

"Loss of crops including maize due to lack of supplementary water when the rain is unpredictable is a challenge that affects the livelihood of the residents. Reduced milk production during drought season also is another factor affecting their livelihood. Jedene community whom are mostly agro-pastoralists face those problems. Their rainfed agriculture is affected due to insufficient rain that resulted from long dry seasons. Also crop diseases like Donishar, Stalkborer, and cut worm challenged their agropastoralism livelihood" (Shinile Report).

Rainfed farming has suffered from water shortage due to the unpredictable rain pattern affecting the Region due to climate change and deforestation. Rain start before or after the anticipated time makes rainfed farming risky work. Land preparation could be made before the start of the rainy season that would help utilize the rain water effectively.

Construction of micro-dams to retain the flowing water during rainy season might be used to balance the water need during long gaps between rains and to supplement the agriculture after the rain stops. Lining the micro-dams with geo-membrane will help in retaining the water for a long time by preventing seepage. If the soil is clay to a large proportion and its permeability is below $8x10^{-7}$ cm/sec there will be no need to provide geo-membrane

A basin irrigation system and flooding system with best crop selection could be used in rainfed farming to retain the water in the field for a longer time, even if the rain interval is long.

4.5.4. Domestic and Industry Consumption

Water collection has not been easy or cheap in the Somali Region which necessitates the efficient use of it. Surface water collection, where water is trapped only in the rainy season, should be used effectively, discouraging losses due to many reasons. "Women are seriously affected in spending long time on collection of water. In Giliso sub-kebele during dry season they spend eight hours for water collection. This affects their livelihood as well as their household chores. This creates disputes in the households and cause students to miss class. In Arabi (Dembel) women spend long hours at water collection points and lost opportunities that could have been used for other activities. For six months the community spends four hours every day to collect water and three months two hours and another three months three hours. The sub-kebeles around Arabi spend seven hours every day to collect water for six months" (Siti Research Report extract). It is clear that when the collected water is depleted, women are forced to go longer distances in search of water, affecting their health and exposing them to attacks by wild animals.

Water is wasted in most water sources like boreholes, hand dug wells, *birkeds*, and Haffir dams, water that otherwise could be used for drinking or hygiene. A large volume of water is lost in leakages in reservoirs, pipes, faucets manholes, and fittings in borehole systems. The water lost without use is water that has been pumped out investing money, time, and energy. In *birkeds*, either water is lost due to traditional collection methods or due to poor workmanship through cracks. In Haffir dams and ponds, due to poor design and workmanship, a considerable amount of water is lost to seepage. By ensuring standardization, improving water-fetching methods, and improving workmanship by reinforcing monitoring, water loss could be abated.

Industries require a large volume of water for production. The by-product of production is unsafe water or even polluted water that either pollutes the soil or water sources. Reasonable waste water treatment attached to industries would allow the recycling use of water for production or for irrigation.

Chapter 5: Ensuring Water Sustainability—Reducing Future Uncertainty

5.1. Brief Summary

Sustainability with respect to water is achieved by understanding the demand and supply, by improving groundwater recharge, by doing basin development, and by promoting soil and water conservation activities. Controlled water development supported by detailed study and environmental impact assessment should be promoted.

Water is a resource that if misused will get polluted and require investment to remove pollutants and to make it safe again. Protecting rivers from industrial wastes and other toxic wastes and the groundwater reserve from the poor application of irrigation water that is responsible for polluting it should be conducted through a coordinated effort.

A regional Learning and Practice Alliance is an essential first step in improving coherence among multi-sectoral agencies. Contingency plans that will be used during shocks and crisis should be developed through participation. Both emergency interventions and development programs should be done in a controlled manner. Boreholes should be protected from over-pumping, and strategic water sources should be used only during periods of need.

A centralized database of information about water sources that is controlled and owned by the regional government-designated bureau will help achieve water sustainability. Improved coordination and informed decision-making will help alleviate the risks to the sustainability of the water reserve of the Somali Region.

5.2. Protecting the Resource

Resource protection is the key to reducing future uncertainty. While water security can be achieved through supply structure development, this will only provide for future supply sustainability if there is a balanced supply-demand equation. Water security will be determined not just by the "hydraulic mission" of supply improvements to meet demand, but by the management of demand.

Protecting the resource requires a demand-management approach that is shaped around the 5-Year Regional Development Plan. Techniques of demand management include appropriate tariff setting and the establishment (and enforcement) of permit-based systems, for example to manage extraction of water from private boreholes.

5.3. Buffering against Shocks and Trends

Table 8, Box 15, and Box 16 detail how water buffering is determined against shocks.

Table 8: Advantages and Disadvantages of Buffering and Prepositioning to Mitigate Drought Impacts

Advantages	Disadvantages
Provides security in case of severe water shortages.	Fixes responses in pre-determined locations based on best available information at the time (which may prove wrong).
Fixes locations according to a planned approach in agreement across agencies and local authorities—enables a structured, more coordinated, approach to development.	Locations may not be the most appropriate given other changing contexts, e.g., repeated conflict and insecurity.
Enables communities to maintain key assets (livestock in particular) in case of loss of water availability in key grazing areas.	Success in protecting and in some cases restoring livelihoods will be based on length of emergency and the relationship between water availability and other resource access, including grazing and browse.

Box 15. Climate change: pastoralists ahead of the game

"Pastoralist production systems have evolved and adapted over generations as a response to marked rainfall variability and have used mobility to access limited water and grazing resources in large ecosystems. Additional strategies include the rearing of different livestock species and utilizing different types of vegetation because each species has different watering requirements. Pastoralists have selectively bred their livestock to emphasize traits such as drought resistance and milk production. They have also altered species composition of their herds in the face of rainfall and other trends, such as market opportunities.

In Africa, assessments of climate change are themselves highly variable, with different assessments predicting very different climate scenarios and related outcomes. …While some analysts claim that drought is worsening in pastoralist areas, it is also important to distinguish between drought as defined by rainfall, and drought as defined by its impact on human livelihoods. Where consensus exists, it is more on the increasing impact of drought on pastoralists which in turn, can be explained by increasing human population, decreasing livestock holding among poorer herders, and declining access to productive rangeland."

AU. 2010. Policy Framework for Pastoralism in Africa: Securing, Protecting and Improving the Lives, Livelihoods and Rights of Pastoralist Communities. Addis Ababa, October, p. 21.

Box 16. Boreholes: Proceed with caution

Boreholes are a major non-traditional source of water. According to the government, there are some 384 borehole-based water systems in SRSE, some supplying towns, others point-source structures. These boreholes provide about 2.8 m people (some 60% of the population), with water, based on an assumed average of about 7,200 people per borehole. Functionality rates are said to be in the region of 80%. Most are handed over for operation and maintenance to user committees. However, functionality rates for motorized systems are poor, with as few as 70% working at any one time. More significantly in terms of long-term investment strategies, the SHAAC study carried out in 2008 established that over 40% of new boreholes drilled in the Region failed for a variety of reasons.

One key question related to this failure rate is whether the Region should continue to pursue its current strategy and learn more effectively about the nature of groundwater in the Region, or whether greater hydro-geological mapping should be carried out in advance of further borehole drilling in order to enhance future success rates.

It is clear that future borehole-based supplies will only be feasible economically if tariff structures provide for the recurrent costs of lifting water from some depth. By extension, this will determine the uses to which water of different depths can be put. In many cases other, cheaper, surface water capture and storage options should be considered before further expensive drilling operations.

5.4. Strengthening Water Quality

The long-term quality of water in the Region is determined both by environmental and human factors. Water quality issues cover both drinking water supply and the use of water in agriculture. Water quality in the former is determined by base quality (from aquifers, static surface water sources, and streamflow). In the latter case, the development of water in agriculture may have significant impacts on water quality in the long term. For key months of the year, surface water quality in SNRS is very poor, whether rainfall capture or heavily silt-laden streamflow.

Sustaining a level of resource quality that is appropriate for different types of consumption requires regular monitoring and source development appropriate to use. Some groundwater resources in SRSE are high in salt content—particularly gypsum—which renders supplies unsuitable for domestic consumption, though they may be useable for animal consumption and other non-human consumptive uses. For irrigation purposes, however, they will cause longer-term salination of soils.

5.5. Building Institutional Coherence and Strategic Direction

At present, there are important efforts in the Region focusing on water development, but little coherence between them. The long-term guarantee of sustainability will only be achieved under a more coherent institutional set-up.

One of the major sources of current incoherence is a development versus emergencies context. Cyclical droughts and the impacts of insecurity exacerbate management challenges; however, this has allowed an institutional fragmentation pattern to emerge. One overarching water development authority is required that will take the initiative in coordinating, supporting, and meshing together actions within the water sector and between water and non-water sectors, including agriculture and livestock, health, energy, and urban planning and industrial development. It is proposed that the RWRDB take this role, but that it establishes in inter-sectoral working group convened by BoFED in order to do so.

While it is tempting to suggest that the whole Region is in some form of long-wave emergency with respect to water, this would imply that there is a lack of response and inadequate measures. This is not true; rather, responses are un-integrated and lack central management and support. The causes are a mixture of inadequate formal institutional definition of roles, the uncoordinated actions and approaches of non-governmental agencies in SRSE, and the difficulties of coordinating and information-sharing across such a large and remote Region.

A regional Learning and Practice Alliance is an essential first step in improving coherence between emergency coordination and development activities, and across sectors. There is evident willingness for this kind of institutional set-up, the "executive arm" of which could be the intersectoral working group suggested above. This will enable a stepped approach to moving to a longer-term development agenda from a more immediately responsive emergency agenda.

5.6. Development Options

5.6.1. Irrigation

Development of irrigation in SRSE will only be sustainable where there are cost-effective means of lifting water into command areas and appropriate support to agro-pastorals in developing more productive and sustainable irrigation practices. At present support is piecemeal. A regional strategy for supporting irrigation should focus on on-farm improvement in practices, market development for food and cash crop marketing (including fodder), and longer-term development of more efficient irrigation techniques, including drip irrigation.

If irrigation is to be developed and sustained in the long term as part of the Region's wider development approach (particularly if associated with broader settlement and urbanization), then a water balance study will be required to assess the feasibility of greater water withdrawal from key surface water systems. This will be based on more detailed data on streamflow within and between years, anticipated withdrawals based on crop water requirements, and anticipated future long-term trends in crop development. It will also need to factor in impacts downstream within and beyond the Region.

Increasing the recharging potential of boreholes should be given great attention if borehole-dependent irrigation is to triumph. Afforestation supported by soil and water conservation programs and water shed management which includes construction of water conservative structures and soil bunds will help in increasing the local recharges that will have positive effect for groundwater potential. Working closely in environmental protection with neighboring regions like Oromia, which take the lion's share in regional recharge of the groundwater in Somali Region, will bring increased potential of groundwater reserve.

Large-scale irrigation projects could be planned and practiced by deploying the necessary expertise and equipment based on a comprehensive study on how they can enhance and support the small-scale irrigation practiced by the local community. Large-scale irrigation projects could be planned away from river banks so that small-scale irrigation thrives near the banks, getting technical backstopping and farm inputs from the large-scale irrigation easily. The market for small-scale irrigation practitioners could be linked with the large-scale irrigation productions. Government services need to strengthen to sustain the system and reverse the past failures. Access to fertilizer (with great emphasis on natural fertilizer), irrigation equipment, input credit, and agricultural extension services need to be strengthened. Centers of SORPARI located in major river banks of the Region can serve as testing grounds and as locations for dissemination of adaptable technologies. See Box 17 for challenges of irrigation.

Box 17: Challenges of irrigation

Along the Shabelle River, farmers use irrigation to produce cash crops such as sesame and onion, usually on relatively small plots of land (0.5 to 5 ha) very close to the river where irrigation is easier. However, because of the hot, dry climate, even farmers practicing irrigated agriculture tend to focus production in the rainy seasons, either because traditional gravity-fed irrigation channels are full and it is easy to irrigate using buckets, or, if they are using pumps, because they can save on the cost of fuel. The dry season (*hagaa*) is also known for strong winds that create dust and sand storms, making farm work difficult. In Kelafo and Mustahil woredas, regular flooding allows farmers to engage in uncontrolled or controlled (channels or pumps) floor recession production of staple crops back from the river. Although yields can be good, flood-recession farming is risky, as floods can return before crops are harvested.

The irrigation system identified for one location could consider extreme seasonal variations with erratic dry periods, the available water, crop type, the size of the command area, and post-irrigation complication due to quality of water and type of soil. In Somali Region, the arid and semi-arid weather conditions mean most of the water used for irrigation is evaporated before reaching the plant. Therefore, any method of irrigation that minimizes evaporation (but not transpiration) is likely to increase the efficiency of water utilization by the crop. Some of the irrigation methods introduce water directly into the root zone without sprinkling the foliage or wetting the entire soil surface. Such partial-area irrigation methods offer the additional benefit of keeping the greater part of the soil surface (between the rows of crop plants) dry. This discourages the growth of weeds that would otherwise not only compete with crop plants for nutrients and moisture in the root zone and for light above ground, but also hinder field operations and the control of pests.

It is possible to have the best irrigation system but still get it wrong. Optimizing the use of water for both crops and the environment still depends on recording rainfall, checking equipment, and scheduling application. A range of increasingly sophisticated techniques and tools is available to measure soil water content and to help prioritize irrigation choices. Conducting surveys on irrigation practitioners across the Region will help to gather important information on how decisions are made to plan irrigation that helps to prepare a standard operational guideline. It is important that responsibility concerning irrigation decisions is clearly defined between sector. No irrigation method or technology in itself guarantees the attainment of high efficiency. How the system is operated is all-important. With poor management, even the most sophisticated system can result in water loss and inefficiency.

Several water monitoring methods can be used, based on different technologies. There are three broad categories: indirect methods, which rely on environmental measurements to estimate crop water loss; direct methods, using various techniques for measuring the soil water content or tension; and plant-based methods, which are still largely at the experimental stage and rely on measurements of the crop plant water status or water stress.

In the short run, selection of appropriate pumps for water lifting for any type of irrigation system is one concern affecting the small-scale irrigation. Among the simple approaches in the selection of appropriate pumps, the Equivalent Annual Cost (EAC) approach is more appropriate than others. See Table 9. It considers interest rate, useful life of the equipment and capital recovery factor.

Table 9: Case Study on the Selection of Appropriate Pump

No.	Description	Diesel engine pump	Petrol engine pump
1	Capital cost	**12,500**	**7600**
2	Useful life expectancy	10	5
3	Annual operating cost	6840	7560
4	Interest rate	11	11
5	EAC	0.17	0.27
6	Capital cost * EAC	2125	2052
7	6 + 3	8965	9612

Pump selection criteria that will help decision makers and implementers in their effort to support agro-pastorals is detailed in the following, Table 10.

Table 10: Water Pump Selection Criteria

Engine power kW (hp)	Pump size (mm)	Estimated highlands irrigable area	Estimated lowlands irrigable area
1.5 (2)	25	1.5 ha	1.2 ha
3.7 (5)	50	5.0 ha	4.0 ha
5.2 (7)	75	9.0 ha	6.5 ha
6.7 (9)	100	12.0 ha	9.0 ha

In the long run, rope and washer pumps, which are simple and affordable technology and can meet the needs of small-plot agro-pastorals, could replace the petrol and diesel pumps which consume huge resources of the agro-pastorals. The pump could lift water from a depth of up to 40 meters for drinking water purposes, but a depth of 18 meters for irrigation purposes considering the large volume of water needed to be lifted for irrigation. The rope pump has a relatively lightweight construction. It is made of locally available materials and can be produced and repaired locally. With access to a rope and washer pump, a small-plot owner agro-pastoral can tap into groundwater deep below the surface to irrigate fruits, vegetables, and other high-value crops. The sale of these crops generates income for many and is the first step to alleviate poverty and ensure the overall objective, i.e., food security in the Region. One such pump could be used for 10 households, and the system of *iskasheto*, which is the collective use of water pumps, could be adopted for the rope and washer pumps.

Traditional diversion systems to divert water into command areas have witnessed the disadvantage of high work load every year, canals which cannot convey enough water, no systematic distribution layout, and no proper controlling structures with a great loss of water in between. But modern diversions have the advantage of consideration of floods, estimation of base flow, construction of permanent head work, a properly designed conveyance system, systematic distribution structures, and controlling structures that indicate when to stop the water because the soil has enough water.

Many irrigation practices did not succeed due to poor management of irrigation systems. Agro-pastorals who are organized into cooperatives should take the role of canal management and silt control and gradually take over all the management issues. The irrigation user cooperatives would be useful in helping small-scale water users obtain desired benefits or in providing needed services in areas like saving, finance, irrigation, and market support. The ultimate goal of the cooperatives will be to make small-scale irrigation user-owned, user-controlled, and user-beneficial.

Under flood irrigation as commonly practiced in river diversion schemes, excessive water application often results in considerable runoff, evaporation from open water surfaces, and transpiration by weeds. These losses commonly amount to 20 percent or even 30 percent of the water applied. In addition, the loss of water due to percolation below the root zone may be of the order of 30 percent or even 40 percent of the water applied. Consequently, the fraction actually taken up by the crop is often below 50 percent and may even be as low as 30 percent. Hence, water sustainability could be achieved if the following points are considered:

- Reduce conveyance losses by lining channels or, preferably, by using closed conduits;
- Reduce direct evaporation during irrigation by avoiding midday flood irrigation;
- Reduce runoff and percolation losses due to over-irrigation;

- Reduce evaporation from bare soil by mulching (covering soil with straw or by-product) and by keeping the inter-row strips dry;
- Reduce transpiration by weeds, keeping the inter-row strips dry and apply weed control measures where needed.

Enhancement of crop growth will be achieved by:

- Selecting the most suitable and marketable crops for the Region;
- Using optimal timing for planting and harvesting;
- Using optimal tillage (avoiding excessive cultivation);
- Using appropriate insect, parasite, and disease control;
- Applying manures and green manures where possible and fertilizing effectively (preferably by injecting the necessary nutrients into the irrigation water);
- Practicing soil conservation for long-term sustainability;
- Avoiding progressive salinity by monitoring water-table elevation and early signs of salt accumulation, and by appropriate drainage;
- Irrigating at high frequency and in the exact amounts needed to prevent water deficits, taking into account of weather conditions and crop growth stage.

Horticultural crops that are perishable within a short period of time should be avoided unless a strong market system and a coordinated effort of the Trade and Market Development Bureau exists. The Trade and Market Development Bureau is responsible for provision of market information, the development of market infrastructure, the provision of credit for post-harvest technology, and the facilitating of market linkage. The involvement of the Agricultural Bureau, which is responsible for extension service, coordinating input provision, and distribution and coordinating production of quality and demanded volume is also necessary.

Agro-pastorals learning forums will help to instill good resource utilization habits. Social mobilization initiatives like an agro-pastoral field day, focusing on results of demonstration sites on selected agro-pastorals' plots would help the surrounding agro-pastorals be exposed to the technologies that best conserve resources.

The private sector has been dynamic and has contributed significantly in the development of irrigation in the Region. The potential role of the private sector in facilitation of pastoralists' transition to irrigation-based livelihoods is immense. In Somali Region of Ethiopia, private individuals have started irrigation farms along the banks of major perennial rivers. These initiatives have to be strengthened with meticulous follow-up on the negative effect they might have on sustainability of irrigation. Due to high capital investment in the sector, NGO's contribution to the sector should be encouraged and streamlined with clear roles and responsibilities and coordination between sector bureaus defined.

5.6.2. Livestock

There are complex issues with respect to provision of water over the long term for livestock production in SRSE. These relate to the interaction between demand for grazing and browse availability and the provision of water. A strategy is required to protect rangelands when new permanent water sources are put in place. One option to explore as a standard practice in drylands environments is the removal of borehole headworks in the wet season to prevent permanent settlement.

In some instances, the provision of water in environments can lead to rapid environmental scouring, with concentrations of livestock outstripping available grazing and browse. The dangers of this over-concentration can be long-term environmental damage and loss of soil fertility. Over-concentration of livestock can rapidly deteriorate the soil profile, causing susceptibility to soil loss in the rainy season.

Water provision therefore has to be on the basis of land-use planning that takes into account concentrations of livestock populations versus support to migration patterns that are established and seasonal. There are key strategic decisions affecting future settlement that can be affected directly by decisions on water provision in rural areas. The framework for such decisions needs to be the three SOs in this report in combination with effective collaboration between catchment management and corridor development.

The following sections are areas that we need to give due consideration to ensure sustainability of both water and the livelihood of those depending on water.

5.6.3. Keeping Rangelands Safe

Pastoralists rely on extensive grazing and manage their rangelands systematically in such a way that they graze different areas during the different seasons of the year. This allows the regeneration of grass and other shrubs and protects the rangeland from degradation. In the past, permanent water sources were located only in a few areas, and these were used as dry season grazing areas. However, the available new technologies have allowed people to construct water points in almost any area where they are required. The success of new water points in pastoral areas depends on human organization and management of grazing and livestock resources. In Somali Region, the pastoral organization has become weak and in such a situation leads to overgrazing, in which case the provision of additional water points becomes a liability. We have to clearly understand that if pastoralism in any form is to survive, the range resource must be protected above all else.

Therefore, we need to properly consider whether an area is a wet season or dry season grazing area when developing water points. Experiences could be drawn from West Africa, where proper management has been introduced for boreholes. An example from Niger shows that rangeland degradation was avoided in a borehole area by managing the borehole correctly. The pastoralists use the area only during the dry season and the borehole is opened only during this time. Though not prescribing the same methodology, ways of managing water points need to be developed with the participation of pastoralists so that the negative impact of water points on the rangeland is minimized.

5.6.4. Pastoral Community Participation and Capacity Building

Allowing pastoral communities to participate in water point development, starting from the assessment stage, will help us understand where best to locate the water point without affecting rangeland and grazing patterns. It will also help us understand how the development of water will affect community relationships and access issues determined for different pastoral groups/communities.

The other area that needs to be focused on is the development of the capacity of pastoralists in relation to the management of water points. This is mainly related to the borehole technology, which is expanding in the Region (almost 400 boreholes currently exist in the Region). The technical sophistication of boreholes and the specific techniques and skills required in order to operate and maintain them do not exist in pastoral areas. This results in long delays in the maintenance of boreholes, even for minor breakages. We therefore need to develop capacity at the community level, with better management systems, so that the community is able to handle the operation and maintenance of boreholes.

5.6.5. Rainfed Farming

Ensuring water sustainability in rainfed farming involves sustaining the availability of soil moisture content—stretching the capacity of green water to contribute to plant growth. There are two aspects to this that require a specific and deliberate set of actions by government, non-government, and the private sector. The first is the development of more effective and comprehensive water harvesting techniques. These should include the development of bunding to help capture and maintain runoff, where possible sand and check dams, and the development of specific recharge areas. This capture of water, however, needs to be accompanied by a reduction in evapo-transpiration. This can be achieved through propagation of improved soil texture, mulching, and the creation of tree-lined windbreaks that reduce the wind effect on water evaporation after rainfall. Measuring overall increases in soil moisture content as a result of these interventions will need to be carried out to ensure cost effectiveness. It is likely that this could be a function performed by Jijiga University and other universities with such capacity, including Haramaya in neighboring East Hararghe.

Basin development initiatives through the Basin Development Bureau and coordinating with the regional water bureau and agriculture bureau has to be encouraged and supported to regain the on-ground and underground resource and the fertility of the soil, which is being lost through poor planning, uncoordinated use, and little knowledge of the ecology system. Linking soil and water conservation works with water harvesting will help in conserve rain water, mitigate soil erosion, keep rain water in the basin, and improve groundwater recharge. Linking this with proper selection of crops that are needed in the market will improve the lives of agro-pastoralists.

Crop water requirements should be studied before introducing any crop, especially for rainfed farming. The crop's resistance to diseases in the area, its resilience to drought, and fluctuating moisture content should be carefully studied before introducing it in another area. Demonstration plots are handy for this kind of trial and error study, if coordination with a research institute cannot not be achieved in the short run. Dry harvest crops could be advocated for rainfed farming. where during the late-season stage these crops are allowed to dry out. Thus, their water needs during the late stage are minimal. So no irrigation is given to these crops during the late-season stage. Where rainfall is erratic and unpredictable this type of crop is ideal. Demonstration sites on each farming plot will be monitored by experts assigned to help a particular plot. Upgraded crops and drought resilient seeds will be tested on the demonstration sites of each agro-pastoral selected for the demonstration. All proven successful seeds and techniques will be disseminated by successful agro-pastoralists on to the other agro-pastoralists in a coordinated fashion.

Strong linkage with a meteorological agency with the aim of helping rainfed farming could be considered. The installation of wind vanes, rain gauges, and evaporation measurement pans in different parts of the Region having good rainfed farming potential should be advocated. Using GIS technology to prepare land-use maps will help decision-makers in their effort to help agro-pastoralists for whom rainfed farming is an appendage to pastoralism.

In flood-prone areas near dry river beds, climate change adaptive technologies could be employed, with great focus on planting drought-resilient fruits with tough stems rather than crops that are affected even by a small inundation. The stem of the drought-resilient fruits are strong enough to withstand the flood. Far from the flood zone, crops of selected types based on a set of criteria, including but not limited to the crop's water requirement, could be cultivated without great danger of a flood. The fruit trees also could serve as wind breaks that would minimize the evaporation losses.

The current trend of assigning DAs per woreda to technically support the farming in the area has not proven successful. Hence, a swift change into another support system must be planned:

- A college in Jijiga under Jijiga University mainly focusing on rainfed farming and irrigation in low lands may replace or upgrade the DA and introduce intensive extension support to the agro-pastorals practicing irrigation;

- The major duty of the expert could be: collection, evaluation, and dissemination of market information; assistance in the planning and scheduling of production; advice on the best practical post-harvest practices; and coordination of inputs, transport, storage, credit, and post-harvest facilities.

- Linking the DAs with the research institute (SORPARI) will have a positive impact in sustainable crop production.

For agriculture and pastoralism to stand together in the Region, one should not be a threat to the other. It is becoming a practice in parts of the Region that a by-product of agriculture is supplementary food for livestock. Irrigation is also used to produce fodder, typically for sale to pastoralists. Considering dwindled rangeland, fodder production will be a booming business for those producing it. Also, pasture lands and rangelands should not be used for any type of agriculture before consulting the detailed land-use map to be prepared for the Somali Regional State.

5.6.6. Domestic and Industry Consumption

The long-term development of urban centers in SRSE will be contingent on provision of affordable and reliable water supplies. This will also be critical to supporting non-rural livelihoods and the provision of wage-labor occupations in support of wider regional economic development. At present, there is a substantial water vending presence in urban centers, particularly Jijiga town. This provides a key service to households and communities, but is poorly regulated for quality and price. At a minimum, woreda and zonal-level authorities should support the licencing and formalization of this service until there is substantial development of reticulated systems. It would be unwise to try to shut down these operations, given their importance in providing livelihoods to key parts of the population. An association of vendors should be formed with support of the regional government and agencies. This would enable regulation and also provide an easy "go-to" stakeholder group.

It is suggested that part of the first Annual Review (AR) be a consultative process over future water development options, particularly as these impinge on water trucking and vending, given that these groups may be supplying as much as 70% of the water consumed in towns. As part of this increased formalization of management, particularly but not exclusively in urban areas, the regional authorities should place a priority on standardization, including both technical and non-technical aspects. At present, water developments in the region provide for multiple approaches to common problems and challenges. Standardization creates an enabling environment not just for agencies and government working in the Region, but critically for the private sector too. In future, the capacity of traders to stock what is needed will support operation and maintenance as well as easing the complexities of future monitoring and evaluation. A study on the sustainability of motorized boreholes carried out by one agency across seven woredas revealed the use of 15 different generator makes. This complicates supply chains for private sector stockers of spare parts, not to mention adding unnecessary complexity to the skills required to support future scheme technical and social sustainability. A specific guideline on standardization should be prepared to complement this broader set of guidelines. A suggested format would be as follows:

Technical standards:

- Common makes and models:
    - Submersible pumps
    - Generator sets
    - Hand pumps

Participatory M&E standards

- Impact assessment
- Management of resources
- Institutional learning
- Accountability

Operational standards:

- Community engagement
- Siting
- Environmental appraisal
- Social appraisal

Due to simple failures in water supply systems or due to overuse, water supply schemes become nonfunctional, especially in the drought season, when they are needed most. Poor operation and lack of preventive maintenance are responsible in most cases for the failures. There must be proper selection of WaSHCO with predefined criteria, an assurance of women's involvement in leadership positions, proper training on management, bookkeeping with the development of by-laws, and strong monitoring by Woreda Water Offices and regional bureaus. Ensuring WaSHCO has bank accounts for minor maintenance, regular auditing of WaSHCO'S financial expenditures, encouraging spare parts shops at the woreda level, standardization of electromechanical equipments and faucets, full package operation and maintenance training of operators and handing over of tools, a database of operators in the regional water bureau to discourage replacement by kebele officials are also necessary to ensure the continued success of water supply schemes.

Industries should be encouraged to develop their own water sources with the "**User Pays**" principle because they are using the Region's resources. Their water use should be controlled vis a vis the water potential of the source. Allowing by-products to water sources and dug pits should be prohibited, unless treatment of the waste to an acceptable degree is achieved. Industries and companies developing their own resources could consider the surrounding beneficiaries' water demand.

Sustainability of water schemes could be achieved by involving beneficiaries from the planning stage, putting women at the center of the project, and through strong links with the regional water bureau, which has the ultimate ownership of the resources, ensuring sustained operation and maintenance, and increased and meticulous quality control.

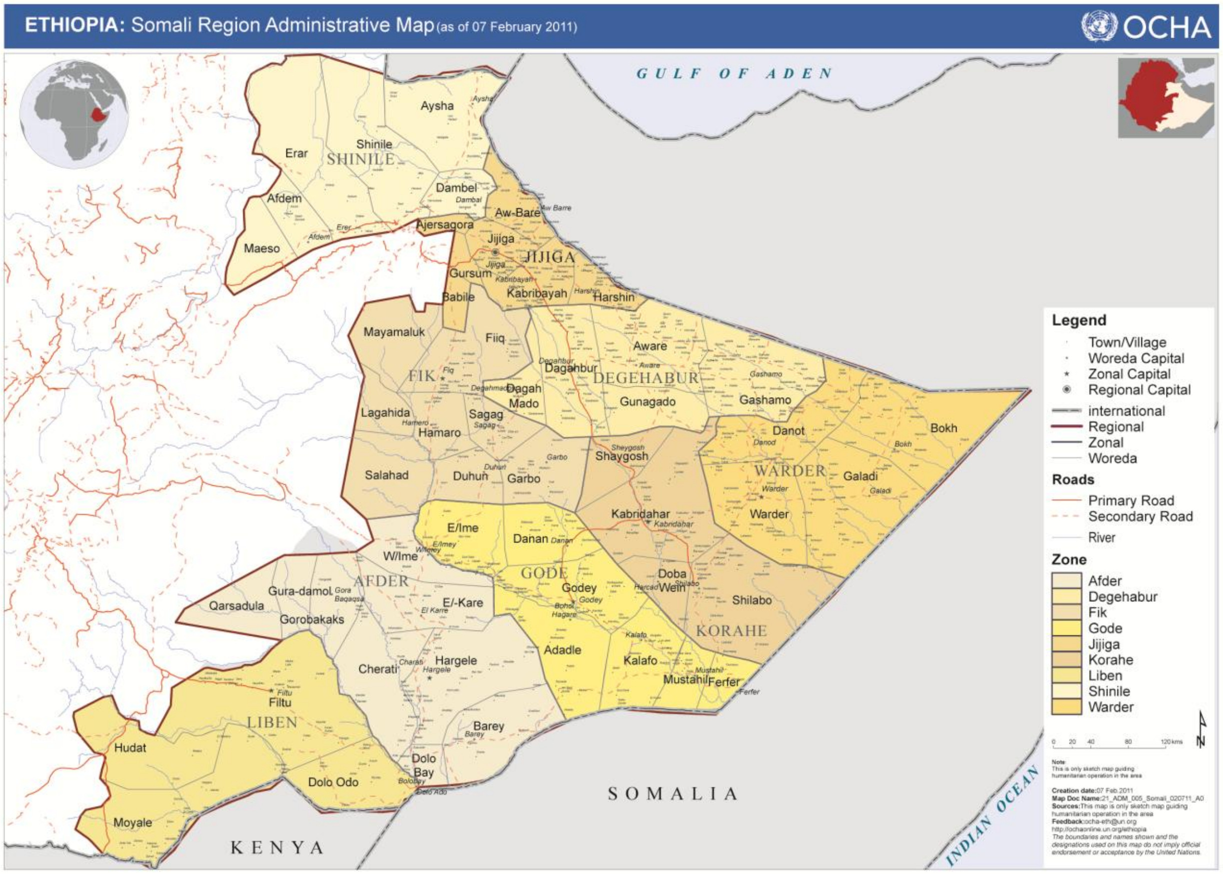
Encouraging borehole controlling technology installed inside boreholes to control over-pumping during drought season will help in protecting the aquifer in particular and the water resource base in general.

Ensuring that all water supply developments in the Region for industrial purposes remain under the ownership of the Regional Water Bureau both during development and upon phasing out of the industry will help with proper control of the resource.

It must be recognized that water resources development, utilization, protection, and conservation go hand in hand. Ensuring that water supply and sanitation, irrigation and drainage as well as hydraulic structures, watershed management, and related activities are integrated and addressed in union is vital to the sustainability of water supply schemes in the Somali Region.

List of Annexes

6.1. Map of the Region



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