Prefeasibility study for specific drought risk adaptation measures in Afar and Somali Regions, Ethiopia

Admasu Shibru[1], PhD and

Simeneh Admasu (PhD candidate)

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Addis Ababa

[1] One may reach Dr Admasu Shibru through admasukeraga@yahoo.com and Mr Simeneh Admasu through simeneh2009@yahoo.com

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AEZ	Agro-ecological zones
AfDB	African Development Bank
APARI	Afar Pastoralists and Agro pastoralist Research Institute
CBD	Convention on Biological Diversity
CRGE	Climate Resilient Green Economy
CSBs	Community seed banks
DRSLP	Drought Resilience and Sustainable Livelihoods Program
ECA	Economics of Climate Adaptation
EFAP	Ethiopian Forestry Action Program
EIAR	Ethiopian Institute of Agricultural Research
ESMF	Environmental and Social Management Framework
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GGWI	Great Green Wall Initiative
GTP II	second Growth and Transformation Plan
IGAD	Intergovernmental Authority on Development
IDDRSI	IGAD's Drought Disaster Resilience Sustainable Initiative
ITPGRFA	International Treaty on Plant Genetic Resources for Food and Agriculture
KfW	Kreditanstalt für Wiederaufbau (German Development Bank)
LLRP	Lowland Livelihood Resilient Project
Mamsl	Meter above Sea Level
MoA	Ministry of Agriculture
NAP	National Adaptation Plan
NbS	Nature-based Solutions
NGO	Non-governmental Organization
PCDP	Pastoral Community Development Project
PSNP	Productive Safety Net Program
RPLRP	Regional Pastoral Livelihoods Resilience Project
SDGs	Sustainable Development Goals
SDR	Strengthening Drought Resilience Drought Resilience
SoPARI	Somali Pastoralists and Agro pastoralist Research Institute
SLMP	Sustainable Land Management Program
UNCCD	United Nations Convention to Combat Desertification
UNU-EHS	University Institute for Environment and Human Security

Executive Summary

1. The Government of Ethiopia recognized the climate change risks in the country, and has developed a national adaptation plan in 2009. Following this, a number of policy frameworks and sectorial climate resilient strategies were developed (outlined below in Chapter 1 Introduction). Moreover, a number of regional and international level programs and projects that have related goals of reducing land degradation and drought risks, etc., and enhancing agricultural productivity, reducing food insecurity and resilient livelihood development were implemented in the country.
2. In Ethiopia, particularly the lowland areas of Afar and Somali regions have been recognized globally among the most vulnerable regions to climate change. Therefore, this prefeasibility study has been conducted focusing on the shortlisted adaptation measures for Afar and Somali regions in Ethiopia building on the preceding Vulnerability Report[2].
3. Key informants discussions were made with vital stakeholders at federal and region levels, including vital partners who have practical experience in implementing climate risk adaptation measures in the regions, and financing bodies.
4. A total of 37 long list adaptation measures were initially identified both for Afar and Somali regions of Ethiopia. The long list was shortened to a short list of 13 adaption measures by using technical as well as cost-effectiveness criteria. The potential impacts of the measures were justified in terms of reducing vulnerability of the key assets and population groups, by reducing either the number of assets expected to be affected, the intensity of the impact, or in some cases both. The selected adaptation measures are discussed below. The most cost-efficient adaptation measures among the shortlisted measures according to the quantitative analysis conducted are for Afar region *Improved forage storage and treatment*, *Management of protected environmental areas*, and *Establishment of community seed banks*; while that of Somali region include *Establishment of community seed banks*, *Wetland restoration and rehabilitation*, and *Establishment of fodder tree and grass nursery sites*[3].

5. Improved forage storage and treatment

Investments in improved forage storage as cost-intensive climate risk adaptation measure is very important in terms of the social, economic and environmental aspects. Such investments can help ensure the safety and health of animals during the harsh drought months (particularly February, March and April). Improved forage storage is to be established financing roofed trench (bunker) silos in combination with the use of storage polythene bags (e.g. 50 kg capacity) that can serve for about 20 years period. Investments in this measure involve the following investments and investment-accompanying activities including elaborating/considering a livestock development map of the region; considering project based development of forage/ fodder production initiatives supplying forage to the respective improved storage facilities; agreements with the community (clan) leaders and respective

[2] Waldschmidt, F, Behre, E, Daou, D, Rojas, A, Arce Mojica, T, Koirala, P, Sebesvari, Z, Kreft, S, Souvignet, M. (2021). *Vulnerability Report – Ethiopia – Drought Risk*. Report 03. Bonn/Frankfurt. United Nations University Institute for Environment and Human Security /Frankfurt School of Finance and Management

[3] Ibid.

political and sector level officials; developing a manual on how to store and treat the forage and how to utilize hay. The investments should be done on sites placed in moist areas to be nearby the forage banks to be developed; development of a plan indicating how the stored forage/hay is to be distributed to the respective communities. Accordingly, investments in two concrete trench silos are suggested to be constructed in Afar region, where each trench silo has a capacity of 2,000 tons.

6. Management of protected environmental areas

In drought situations, people are forced to overuse/overgraze the available forage and water resources, resulting in land degradation. Such condition calls for protection of the environmental areas from humans' and domestic animals' interferences with the goal of promoting natural regeneration of vegetation/plants and reducing land degradation.

Impactful management of protected environmental areas involves activities including: discussion and agreement with clan leaders, politicians, and implementing office heads and experts including those at the Woreda and Kebele level about the importance of the measure; develop bylaws at community level, describing the roles and responsibilities of individuals and the communities, and the framework of using resources in the protected areas; operating vital technical activities in the areas, including over-sawing of grass seeds as required; create awareness of the community to practice cut-and-carry from the protected areas; record data on the damaged areas and time series changes of land degradation requiring adoption of climate adaptation measures. Such area closures are to be developed in the lowlands of Afar region up to 1,000 ha.

7. Establishment of communal seed banks

Establishment of community seed-bank as a measure of climate change risk adaptation measure involves integrating seed production and collection, and ex-situ conservation of grass/ fodder seeds. Effectiveness and impactful operation of grass/fodder seed bank requires vital activities, including: agreement with the community and creating awareness about the benefits of the community forage/fodder seed development and the seed-banks; training of the community clan leaders, staff, bureau heads and political leaders; create market based incentive mechanism attached to it and organizing interest groups in communities to engage in forage seed development activities; collection of suitable seeds from locally or elsewhere; developing modality of community participation and benefit sharing mechanisms; collaborate with regional research institution for continuous improvement of alternative forage/fodder seeds, etc. Accordingly, it is planned to build 50 Community seed banks in each of Afar and Somali regions where each has a capacity to store 4-6 tons of seed supply, able to support about 1,200 households.

8. Wetland restoration and rehabilitation

Wetland protection and restoration is among necessary measures in Somali region as wetlands are getting degraded. Particularly, the Shebele river and Ayisha basins are potential focus areas in Somali region requiring restoration. Impactful management of wetland restoration and rehabilitation involves activities, including: selection of model site, assessment of the conditions and causes of wetland degradation; develop awareness of the community leaders to help protect and develop by-laws or modality of their participation and user manual, convince the political leaders and implementing office management; specifying activities to operate that may include closure and protection of the areas from human and

animal interference, restoration and management of wetland hydrology and associated forests/shrub land, Improved agricultural practices and alternative livelihood options in wetland catchments, and enhancing knowledge management and information sharing to facilitate community-based wetland restoration activities; define and implement an ideal land-use plan of the area. Accordingly, it is proposed to develop about 150 ha of wetlands in the region.

9. Establishment of fodder tree and grass nursery sites

The importance of this adaptation measure can be justified as there are no such nursery sites exclusively established for the purpose of fodder tree or grass species, and the degradation of rangelands and wetlands requiring raising of seedlings and plantation. Impactful implementation of fodder tree and grass nursery sites involves including assessment of vital species; the demand for the seedlings and awareness creation with community and political leaders; capacitating regional and federal office management, including staffs at Woredas and Kebele levels; site selection; production of seedling and fodder seeds; media based promotion of plantation of grass and fodder species by the communities; benefit sharing mechanism, etc. It is intended to implement 100 ha of nurseries in Somali region with 12 species and two types of germplasm.

10. Implementation modality

The common approach of implementing such measures or projects is provision of financial support - including financing of investment related accompanying measures (like capacity building in operation and maintenance, etc.) - to the respective public sector, and let the project be implemented by the public or government structure, linking the federal ministry of Agriculture to regional bureaus and Woredas level development office structure. This approach can ensure effective implementation of projects, if strong advisory/ consultant services are being provided. This is, given the limited competence of staff, and weak capacity and governance system from federal to the Kebele level governance structure. Therefore, capacity building needs to be considered as additional investment accompanying component of such development projects.

An alternative modality is establishing an independent third-party body that can handle the whole project implementation (as well as potentially post-implementation operation), as alternative to the government system. This approach can make the implementation more feasible due to its flexibility and the better capacity of project management staff and its independent governance system. However, this approach requires buy-in by the government system and requires strong scaling-up and exit strategies as it can be challenging for the government system to continue its sustainability without its prior engagement.

Considering the local experiences observed in the regions with related projects, a scenario of budget is estimated for an initial 5 years based phase of the project and for long years based adaptation measures implementation.

11. Social, Economic and Environmental aspects

The current economic value and social and environmental aspects of the adaptation measures matter most with the feasibility and sustainability of the benefits or the measures. With respect to environmental aspects, all the measures that are related to forage development are very important in the regions as they help for sustainable productivity of forage/rangeland and livestock development that is the vital livelihood strategy of the people.

12. Institutional aspects and sustainability

The government, international donors, and different NGOs (supported by donors) have been financing and developing forage banks, constructing forage storages, financing community based seed bank development, and nursery establishment, and investing in restoring degraded areas, constructing different irrigation and sand dams in the regions. Sustainability may be compromised unless and otherwise the communities are given to handle the lion share of these development initiatives that are of value for their livelihood means. Most of the identified drought risk adaptation measures require engagement of the private sector, and finally handle majority of the operations using business model through time.

13. Beneficiaries

Livestock sector and pastoralists are vital political elements in the regions, as almost all the population and the economy of the regions depend mainly on livestock. Therefore, the climate adaptation measures are very important economically for livestock development, as a source of job opportunity and food security. The measures are important for related social, environmental (fertility of soil, reduction of degradation) and political purposes. The beneficiaries include the local population in intervention area (pure pastoralists and agro-pastoralists) and institutions that receive capacity building, and the population of the regions at large, local business firms, etc. The measures have impact on gender development, poverty reduction, and peace and both, conflict creation and resolution, aspects.

14. Stakeholder analysis

Stakeholders and actors' partnership is found important for different purposes, including to improve the design and content of the project/ measures, to ensure consideration of vital local elements, and ensure feasibility and long term sustainability in terms of getting buy-in, acceptance and responsibility by vital actors; to strengthen the implementation capacity by pooling resources and capacities from the vital partners/ actors; to ensure sustainability of the project/ adoption of the measures after completion of the projects. Among others, the local communities and clan leaders, regional political leaders and implementing bureaus, region level research institutes, federal government Ministry of Agriculture, KfW, the private sector, other interest groups, such as the World Bank, IGAD, GIZ, etc are found vital stakeholders.

15. Project implementation

Implementation of each measure requires ensuring its potential impact onto the communities' livelihood and the environment. This demands integration of the adaptation measures with complementary components. The implementation process may follow the existing government structure, i.e. the federal and regional administrative structure. A strong model of an advisory team can be established with independent decision making power on vital steps in the project implementation, such as procurement and purchase of vital assets, monitoring and evaluation, etc. The financing body, such as e.g. KfW, may use the advisory team as influential part for implementing the project. In this case, the linkage with the public body would better be established with key mid-level experts rather than higher level executives, as it may contribute to delays in critical decision making stages. In addition, the financial assistance partner/ donor, such as KfW, would take part as member of the Steering committee to have a clear follow-up of project implementation, and contribute and support in vital decisions.

An alternative modality aims to organize the activities and to outsource its implementation to a third party body; given the body has organized staff and institutional capacity to be able to implement the project as planned.

For effective implementation of project activities, implementation of the adaptation measures shall ensure synergy with other projects; prepare a monitoring and evaluation plan; ensure the presence of capacity of experts or development agents, particularly at Kebele level and Woreda level who handle the day-to-day operations; and ensure presence of minimum incentive to the project staff.

16. Budget

The project based budgets are estimated based on past experiences of implementing related climate risk adaptation measures, by considering the devaluation of local currency, and adding 10% for capacity building and management cost. Budgets for the initial five years period of the project and for the long project period are estimated. This estimate can be considered in comparison with the exhaustive global level estimates made in the Vulnerability study[4] in the regions by using global level standard estimates as reference, and a suggestion can be made to take the larger budget estimate for better confidence.

[4] Waldschmidt, F, Behre, E, Daou, D, Rojas, A, Arce Mojica, T, Koirala, P, Sebesvari, Z, Kreft, S, Souvignet, M. (2021). *Vulnerability Report – Ethiopia – Drought Risk*. Report 03. Bonn/ Frankfurt. UNU-EHS/ Frankfurt School of Finance and Management

1 Introduction

1.1 Background and Objective of the assessment

The Ethiopian National Adaptation Plan (NAP-ETH) was developed in 2019 to reinforce the ongoing efforts of addressing climate change risks in the country. The vital policy frameworks implemented in this regard include the Climate Resilient Green Economy (CRGE) strategy, the Productive Safety Net Program (PSNP) and the second Growth and Transformation Plan (GTP II) as well as sectorial climate resilience strategies and regional and municipal level adaptation plans. Moreover, there are a number of regional and international level programs and projects that have related goals of reducing land degradation and other climate change risks, such as drought, pests, etc., and enhancing agricultural productivity, reducing food insecurity and resilient livelihood development in the country, including in the risk prone areas of Afar and Somali regions. Such initiatives that are implemented in Afar and Somali regions include the international programs of the Sustainable Development Goals (SDG) and the United Nations Convention to Combat Desertification (UNCCD); regional programs of the Great Green Wall Initiative (GGWI), Intergovernmental Authority on Development (IGAD), IGAD's Drought Disaster Resilience Sustainable Initiative (IDDRSI) and the Lowland Livelihood Resilience Project (LLRP), etc. In addition, the Environmental policy of Ethiopia, the Ethiopian Forestry Action Program (EFAP), the Drought Resilience and Sustainable Livelihoods Program (DRSLP I and DRSLP II), the Environmental and Social Management Framework (ESMF), the Regional Pastoral Livelihoods Resilience Project (RPLRP), the Strengthening Drought Resilience projects (SDR I and SDR II) have had so related goals of reducing the vulnerability to the impacts of climate change by building adaptive capacity and resilience[5].

In Ethiopia, particularly the low land areas of Afar and Somali regions have been recognized globally among the most vulnerable regions to climate change. Ethiopia is a disaster-prone country and the people, especially in the Afar and Somali low land areas, are exposed to natural hazards, on top of poverty and food insecurity challenges as well as impact from national and local conflict they are facing. There is growing evidence of the significant impacts of climate change on nature and people across the regions. The international community, particularly, the United Nations University Institute for Environment and Human Security (UNU-EHS) in collaboration with Frankfurt School of Finance and Management, has put visible effort in developing effective, efficient and sustainable methodologies to reduce the vulnerability and environmental risk of the people with its exhaustive study on climate change risk vulnerability and the Economics of Climate Adaptation. The study analyzed and shortlisted more important adaptation measures for Afar and Somali regions. However, it requires a feasibility study to help decide on the options and select implementable option for the areas. Therefore, this is a prefeasibility study conducted by focusing on the shortlisted adaptation measures for Afar and Somali regions in Ethiopia. The purpose of the

[5] Federal Democratic Republic of Ethiopia (2019). Ethiopia's Climate-Resilient Green Economy – National Adaptation Plan. Addis Ababa.

prefeasibility study is therefore to describe the measures, and to identify vital factors determining the feasibility of the selected adaptation measures.

More specifically, the objective of the assessment is to support the application of the Economics of Climate Adaptation (ECA) framework developed for Afar and Somali regions through assessing the feasibility of the specific drought risk adaptation measures identified. The prefeasibility assessment of the adaptation measures helps to determine and consider the measures for further detailed feasibility analysis by taking into account technical, economic, environmental, social and regulatory aspects. In addition, the assessment considers the capacity of the implementing and supportive partnering organizations and stakeholders to determine, analyze, and select the best scenarios.

1.2. Methodology

1.2.1. The project area

Afar and Somali regions are extended from north-eastern to south-eastern tips of Ethiopia (see Figure 1). The estimated population is about 1.8 million in Afar and 5.7 million in Somali, which is about two and six percent of the Ethiopian population, respectively. The regions cover a total area of 410,000 km^2 (Afar region - 95,000 km^2 and Somali region - 315,000 km^2), in combination, both regions cover about 37.2% of the country's land.

The regions exhibit a physical feature that is mostly plain with altitude of less than 1,500 meters above sea level. The altitude further falls to the east, where the Dallol depression lies 126 meters below sea level. The climatic condition in both regions is mostly hot, desert type and partially dry. As a result, the regions exhibit high temperature and low rainfall with variable distribution. The majority of the rural populations of Afar and Somali are rural pastoralist and agro-pastoralist communities. In general, they are leading a communal life (using natural resources commonly) and are mobile in search of water and pasture for their livestock.

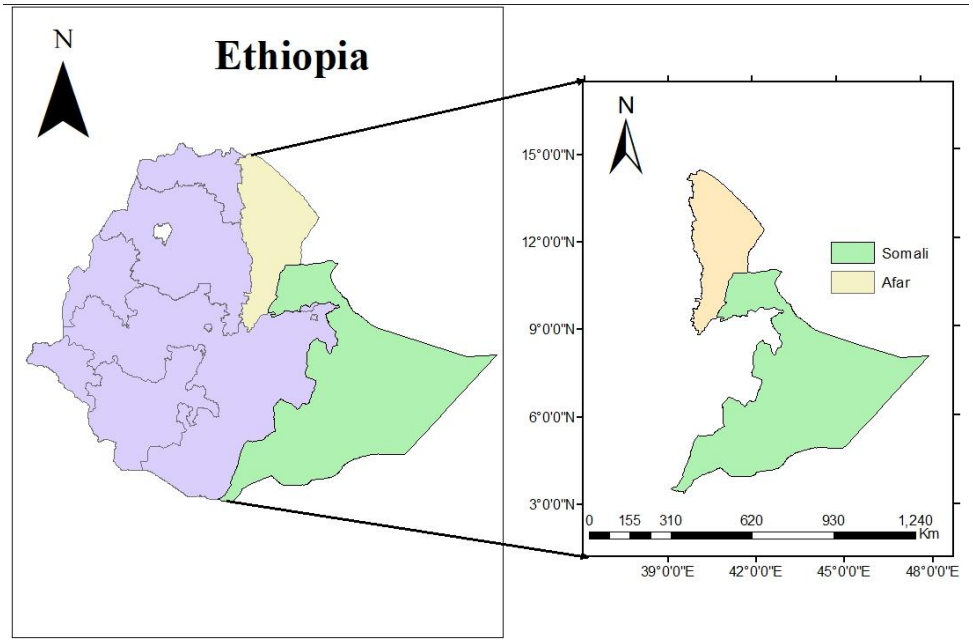

Figure 1: The ECA project regions (Afar, yellow, and Somali, green) in Ethiopia

1.2.2. Data and Analysis of the measures

Key informant discussions were made with related project leaders at the Ministry of Agriculture, Ministry of Peace, region level bureaus, experts and key persons from the federal MoA and regional Pastoral development bureau, implementing and consulting organizations, project coordination units of the KfW funded projects of SDR I and II, the DRSLP I and II projects of the African development Bank, the lowland resilient projects of the World Bank; key persons from KfW, GIZ, GITEC consultants by considering technical and practical aspects. The shortlisted adaptation measures are critically evaluated for their feasibility with respect to the actual or potential climate change risks and their relevance to manage the risks, the required design, material and other resource requirement, the relevance and sustainability, etc. Moreover, the adaptation measures are assessed as to how to organize project activities in line with the adaptation measure and their implement-ability, and the capacity gap of implementing bodies. In addition, harmonious collaboration and integration of related activities or projects, and strengthening of stakeholders networking and partnership is also assessed.

2. Regional context

Afar and Somali regions are among the current 10 regional states in Ethiopia with relatively unique nature due to the pastoral nature of majority of the rural population. In both regions, the government system is influenced more by indigenous cultural network of values that unite, coordinate and protect the people altogether. The clan and tribal leadership system that stayed un-changed for generations has strong and more influential institutional governance than the formal government system.

Both Somali and Afar regions have experienced incidences of conflicts and interactions between the populations and low-land highland interactions that influence the nature of land use system. It is important to consider such interactions in deciding on interventions on land in Afar and Somali regions.

These regions are also unique from other regions in that the implementation capacity of the public institutions is weak, as they were called "emerging regions" before, where the federal government usually has been directly supporting in implementing different projects. Therefore, capacity building is supposed to be demanding component of development projects and programs.

Afar and Somali regions are categorized as relatively underdeveloped regions in Ethiopia[6] and they experience an arid climate and described as typical lowland regions. In response to the extreme climatic conditions, low rainfall, sparse arable land and limited access to water, larger shares of the population in Afar and Somali regions depend on pastoralism and agro pastoralism[7] and their livelihood highly depends on natural resources and the people are living in poverty[8]. Lack of quantitative data on the lowland regions of Ethiopia is hampering the overall development efforts especially in areas which make up most of Afar and Somali regions.

The important biophysical and socio-economic characterization of Afar and Somali regions are presented below:

2.1 Afar Regional State

The regional and local institutions in the Afar region include governmental and local development organization, as well as academia and private sector stakeholders for potential cooperation and collaboration. Governmental organizations including Afar Pastoral, Agro-pastoral and Rural Development Bureau, Bureau of Water and Irrigation Development, Bureau of Land Administration and Use and Bureau of Environment Forest and Climate Change at various levels from region to Kebele, the Afar Pastoralists and Agro pastoralist Research Institute (APARI) and Semara University and local development are among the important organization in Afar region.

Geographically, the Afar regional state is located in the northeastern part of Ethiopia, covering an area of over 95,000 km^2. It is geographically located between 39°34' and 42°28' East Longitude and 8°49'and 14°30' North Latitude. The region shares common international boundaries with the state of Eritrea in the north-east and Djibouti in the east, as well as regional boundaries with the regional states of Tigray in the north-west, Amhara in the south-west, Oromia in the south and Somali in the south-east. The Afar regional state is

[6] National Planning Commission. (2017). Ethiopia's Progress towards Eradicating Poverty: An Interim Report on 2015/16 Poverty Analysis Study. Addis Ababa.

[7] Birch, I. (2018). Economic growth in the lowlands of Ethiopia. K4D Helpdesk Report. Brighton, UK: Institute of Development Studies.

[8] Ibid

comprised of five administrative zones, 32 Woredas /districts, 28 towns administrative and 401 rural and urban Kebeles.

Its uneven topography oscillates around the mean of 550 mamsl and reaches up to 2,900 mamsl at the border with the Wollo highlands to the West of the region and the lowest point in Africa below 155 mamsl is also found in the region. The Awash rives is the major river which cross the region, it is originating from Mount Warqe to the west of Addis Ababa and disgorging in Lake Abbe around the border with Djibouti. The important perennial rivers include Mille, Kesem Kebena, Awura, Gulina, Dewie, Borkena, Telalak, and numerous seasonal rivers that flow to different basins are occurring in the Afar region. Other essential water bodies such as Lake Caddabassa along the river Awash, Lake Asahle, Lake Afrera in the North of the region, Lake Gemeri, Lake Karum, a salt lake close to the border with Eritrea are important water bodies in Afar. The vegetation is predominantly dominated by Acacia species. The fast spread of invasive *Prosopis juliflora* and bush encroachments are severely invading the rangelands[9,10]. The Awash and Yangudi-Rasa National Parks and Halledighe Wildlife Reserve are among globally valued protected areas system which are possessing charismatic wild animal species including Wild ass, Grevy's zebra, Beisa oryx, Soemmerring's gazelle, Greater and lesser kudu and the rare carnivores including Lions, Wildcat, Cheetah are occurs in the vast rangelands of Afar region.

The annual average rainfall ranges from 220 mm (in a drought year) to 400 mm [11]. There are two rainy seasons, Belg and Kiremt, peaking in April and August respectively, the latter being a monsoon-type rainy season and the former a smaller springtime rainfall[12]. Afar has the lowest level of precipitation in the country, presenting ever drier conditions the further it gets from the mountainous areas and the closer it gets to the border with Eritrea and Djibouti[13]. Average temperatures in the region range between 25°C to over 32°C, with lower values during December and warmer ones during June[14]. The Dallol is one of the hottest places year-round anywhere on Earth, reaching temperatures of up to 48°C and having average annual rainfalls of as low as 100 mm. The national census conducted in 2007 revealed that around 90% of the rural population in Afar depended on pastoralist activities, while the remaining 10% are agro pastoralists[15]. These numbers have been changing considerably during the last years, as livestock farming is becoming increasingly challenged due to the privatization of natural resources in the region, which has significantly restricted the access of pastoralists to water and feed for their livestock[16]. This phenomenon is referred to as rangeland fragmentation and it has been driven by the government's

[9] Guinand Y. (1999). Afar Region Awash River Floods, Rapid Assessment Mission 1999 UNDP-EUE Addis Ababa.

[10] François Piguet (2001). Assessments Missions report: UN-Emergencies Unit for Ethiopia Multi-Agency June and August Addis Abab

[11] Fazzini M, Bisci C, Billi P (2015). The Climate of Ethiopia. Landscapes and Landforms of Ethiopia, World Geomorphological Landscapes. Springer Science

[12] Wakie TT, Evangelista PH, Jarnevich CS, Laituri M (2014). Mapping Current and Potential Distribution of Non-Native Prosopis juliflora in the Afar Region of Ethiopia. PLoS ONE

[13] Ibid

[14] Ibid

[15] USAID and the Government of Ethiopia. (2010). An Atlas of Ethiopian Livelihoods. The Livelihoods Integration Unit. USAID and the Government of Ethiopia, Disaster Risk Management and Food Security Sector, MOARD.

[16] Birch, I. (2018). Economic growth in the lowlands of Ethiopia. K4D Helpdesk Report. Brighton, UK: Institute of Development Studies.

perception of a low economic contribution of pastoralist activities to the region[17]. This has moved large financial resources from the state into more profitable projects like irrigation systems for industrial crops including cotton and sugar, even though per hectare returns for pastoralism are higher than for industrial agriculture[18]. Efforts from the government to increase productivity and reduce land degradation have led to land titling campaigns that aimed at boosting sedentarism amongst pastoral communities[19]. The policy has not resulted in the expected outcomes and has widened the poverty gap as not all parcels have the same quality and not all families are used to agriculture as means for their livelihood[20]. This policy has built a market for investors coming from the highlands to rent land for their projects given that only the residents of the agro-pastoral Kebeles are awarded with land titles[21]. The sedentarization approach has therefore benefited the top income minorities in Afar but has pushed the majorities further into poverty as their options for income diversification are little, given the arid conditions of the area and the low levels of technical and academic training amongst the local population[22].

2.2 Somali Regional State

The regional and local institutions in the Somali region includes Governmental organizations including Somali Pastoral, Agro-pastoral and Rural Development Bureau, Bureau of water and irrigation development, Bureau of Land Administration and Use and Bureau of Environment Forest and Climate Change from regional to Kebele levels, the prime research institution in the region Somali Pastoralists and Agro pastoralist Research Institute (SoPARI) and Jigjiga University and local development can be the principal governmental and local development organizations for potential cooperation Somali region of Ethiopia.
The Somali regional state covers an area of around 315,000 km^2. Somali region shares common international boundaries with the state of Djibouti in the northeast, Somalia in the east and Kenya in the South as well as regional boundaries with the regional states of Afar in the northeast, Oromia in the south-west. The Afar national regional state is comprised of nine administrative zones, 96 Woredas /districts, 28 towns administrative and 401 rural and urban Kebeles. The major rivers crossing the region are the Shebelle, Genale and Dawa in the South, there are some smaller rivers more to the center of the region, e.g. the Fafem. The average elevation of the region is 720 masl. The Somali regional state is mostly flat as it extends through the Afar Depression and the western and southern lowlands, but since it also meets the final segment of the Hararge highlands it reaches up to 2,500 masl to the north-east of the region. Rainfall patterns in Somali region vary significantly with the topography. The average rainfall during the spring (Belg) is 250 mm and during the

[17] Lind, J., Sabates-Wheeler, R. & Kohnstamm, S. (2016). Changes in the dry lands of Eastern Africa: implications for resilience-strengthening efforts. Brighton: Institute of Development Studies.
[18] Ibid
[19] Pearson, 0. (2017). The Multifaceted Commodification Processes and Transformations of Pastoralists in Lowland Ethiopia. Faculty of Applied Computer Sciences University of Augsburg, Germany
[20] Birch, I. (2018). Economic growth in the lowlands of Ethiopia. K4D Helpdesk Report. Brighton, UK: Institute of Development Studies.
[21] Ibid
[22] Ibid

monsoon-type season (Kiremt) is 330 mm, these numbers fall for the dry season (Bega) to 140 mm in areas close to the Hararge Highlands. However, the precipitations during Belg and Kiremt are 135 mm and 9 mm respectively, with a raise for Bega to 95 mm in the lowlands of the region. Precipitation patterns in northern and southern Somali present different peak seasons, with stronger rainfall during Kiremt in the north but during Belg in the south[23]. Similarly, temperatures differ throughout the region, with average values of 26°C on the highlands and 35°C in the lowlands during the hottest months of the year March and April and 23°C and 12°C in the same areas during the coldest month of December[24]. The national census conducted in 2007 reported that around 55% of the rural population in Somali depends on pastoral activities, 15% on crops, while 30% are agro-pastoralists[25]. With over 2 million people living from pastoralism, Somali is the region with the highest population depending on pastoralism in the country, having around 55% of the total pastoral households in the country[26]. These numbers have declined while other sources of income are rising as pastoralism is increasingly challenging to undertake[27]. Unlike the Afar region, the growing urban economy in Somali region is driving a regional flow of remittances supporting the efforts to reduce poverty throughout the rural areas in the region[28].

3. Previous and current ongoing projects

There are several programs implemented by governmental and non-governmental organizations in the regions. The most relevant programs and projects include the Pastoral Community Development Project (PCDP II) which mainly focuses on the implementation of effective modules of public service delivery. Livelihood diversification and investment in disaster management and the Sustainable Land Management Program (SLMP) is also an important government initiative in the regions. Non-governmental programs include Strengthening the drought resilience of the pastoral and agro-pastoral population in the Afar Region (SDR I and II), the Drought Resilience and Sustainable Livelihood Program (DRSLP I and II), Regional Pastoral Livelihoods Resilience Project (RPLRP) and the newly launched Lowland Livelihood Resilient Project (LLRP). The Ministry of Agriculture (MoA) is the lead executive agency for SDR, DRSLP and RPLRP projects, while the newly LLRP is implemented by the Ministry of Peace.

The programs have various components in common these are sustainable watershed management to enhance water availability for human and livestock population, restoration of degraded lands to improve sustainable natural resource management and accelerating

[23] USAID and the Government of Ethiopia. (2010). An Atlas of Ethiopian Livelihoods. The Livelihoods Integration Unit. USAID and the Government of Ethiopia, Disaster Risk Management and Food Security Sector, MOARD

[24] Fazzini M, Bisci C, Billi P. (2015). The Climate of Ethiopia. Landscapes and Landforms of Ethiopia. World Geomorphological Landscapes. Springer Science

[25] USAID and the Government of Ethiopia. (2010). An Atlas of Ethiopian Livelihoods. The Livelihoods Integration Unit. USAID and the Government of Ethiopia, Disaster Risk Management and Food Security Sector, MOARD.

[26] Birch, I. (2018). Economic growth in the lowlands of Ethiopia. K4D Helpdesk Report. Brighton, UK: Institute of Development Studies.

[27] Waldschmidt, F, Rojas, A, Behre, E, Daou, D, Sebesvari, Z, Kreft, S, Souvignet, M. (2020). *Inception Report – Ethiopia – Drought Risk. Report 01*. Bonn. United Nations University Institute for Environment and Human Security.

[28] Ibid

sustainable economic growth through enhanced rural incomes are the prime focus of the programs. The implementation of these projects provides sound experience and lesson that are invaluable and considered in the feasibility of the drought risk adaptation measures selected in this prefeasibility study. The brief summaries of description of the main projects are presented in Annex 1.

4. Prefeasibility analysis of selected climate adaptation measures

The prefeasibility study aims to complement to the Economics of Climate Adaptation (ECA) study's results that help to reduce the impact of drought in Afar and Somali[29]. The eastern lowlands of Ethiopia are highly vulnerable to drought and there have been notable droughts in this part of the country throughout human history[30] [31] [32] [33] [34]. Previous droughts and the frequency of rainfall deviation from the average suggest that drought occur every 3-5 and 6-8 years in the arid and semi-arid regions of Ethiopia, respectively, and every 8-10 years for the whole country. Drought has thus been widely recognized as a major climatic hazard and a key development and environmental challenge in the Afar and Somali regional state of Ethiopia. The community elders in Afar and Somali can easily make lists of major droughts over the past 30–50 years, with detailed accounts of the effects and implications. While opinions vary on the severity and frequency of drought in the historical past, recent reports and community opinions show that drought hazards have increased in frequency, intensity and magnitude over the recent decades and have adversely impacted food, feed and water security and the sustainable livelihoods of pastoralists and agro pastoralists.

Drought is an event of prolonged shortages of rainfall, it occurs when rainfall is absent during the main rain and short rain seasons. The resulting prolonged dry season gives rise to severe drought conditions. Although drought is not a new phenomenon in the eastern and northeastern lowland regions of the Afar and Somali communities, there have been more frequent and catastrophic droughts in the last ten years.

4.1. Description of climate change adaptation measures

The selected drought risk adaptation measures have been suggested to the respective agro-ecological zones (AEZ) of the Afar and Somali regions. Five different AEZs have been identified in both regions, these are: Hot arid lowland plains (A1), Warm semi-arid lowland plains (A2), Very cold sub-moist mid highlands (A3), Warm moist lowlands (M2) and Warm sub-moist lowlands (SM2). A total of 37 long listed adaptation measures were initially identified for both Afar and Somali Regions of Ethiopia. The adaptation measures were selected based on a comprehensive literature review, a consultation process with key experts and government representatives, and quantitative analysis. The long list was reduced to 13 short listed adaption measures. The process of reducing the list of measures

[29] Please see Waldschmidt, F, Behre, E, Daou, D, Rojas, A, Arce Mojica, T, Koirala, P, Sebesvari, Z, Kreft, S, Souvignet, M. (2021). Vulnerability Report – Ethiopia – Drought Risk. Report 03. Bonn/Frankfurt. United Nations University Institute for Environment and Human Security /Frankfurt School of Finance and Management

[30] Haile, T. (1988). Causes and characters of drought in Ethiopia. Ethiopian Journal of Agricultural Sciences. 10, 85 – 97.

[31] Tafesse Mesfin (2001).What should a pastoral development strategy constitute towards poverty reduction among pastoral communities in Ethiopia?" in poverty reduction strategy and pastoral development. Proceedings of national conference on pastoral development in Ethiopia, May 22-23, 2001. Pastoralist Forum Ethiopia. Ethiopia, Addis Ababa.

[32] Getachew Kassa (2001). Resource conflicts among the Afar of north-east Ethiopia. In: Mohammed Salih et al. (eds.), African pastoralism, pp.145-171. London: Pluto press.

[33] Pankhurst, R. (1985). The History of Famine and Epidemics in Ethiopia Prior to the 20th Century. Relief and Rehabilitation Commission (RRC). Ethiopia, Addis Ababa.

[34] Webb, P. & Braun (1994). Famine and food security in Ethiopia: Lessons for Africa. John Wiley & Sons Ltd.

from 37 to 13 was transparent and participatory including the engagement of relevant stakeholders through e.g. validation workshops and a Multi-Criteria Analysis. The potential impacts of the measures were justified in terms of reducing vulnerability of the key assets and population groups, by reducing either the number of assets expected to be affected, the intensity of the impact, or in some cases both. The benefit of each measure was linked to the potential averted damage. The measures include nature/ eco-systems based solutions (NbS), technical and engineering solutions (grey measures), measures drawing from both categories (hybrid), as well as risk transfer/ insurance solutions (Insurance). The selected adaption measures are discussed below. The shortlisted most important adaptation measures for Afar are: *Improved forage storage and treatment*, *Management of protected environmental areas*, and *Establishment of communal seed banks*; while that of Somali region include *Establishment of communal seed banks*, *Wetland restoration and rehabilitation*, and *Establishment of fodder tree and grass nursery sites*[35].

4.1.1. Improved forage storage and treatment

The lowland rangelands of Ethiopia are important livestock feed centers; but provide inadequate year-round feed to support large livestock population as these areas have been facing many challenges as a result of changing climatic conditions. It has resulted in shortage of livestock feed supply leading to decreased pasture availability, water resource shortage and adverse impacts on the environment such as land degradation due to overgrazing practices. Therefore, livestock feed needs to be supplemented with preservation of fodder and grass resources in order to provide sufficient feed for livestock during the dry season.

Intensification of forage production systems is necessary to maintain and expand livestock production. This practice implies more forage storage and haymaking to overwhelm the dry season periods of forage scarcity. Forage storage has been practiced for ages as one of the adaptation mechanisms to bridge the livestock feed shortages in rangelands[36]. However, a lot of care should be paid to minimize loss of quantity and quality during harvesting, storage, and feeding.

4.1.2 Management of protected environmental areas

Land degradation is the adverse trend of land condition resulting in long term reduction and loss of the biological productivity of land. The growing population and increasing socio-economic necessities in Ethiopia have created pressure on land cover. The phenomenon has been aggravated by severe soil loss, deforestation, low vegetative cover and unbalanced crop and livestock production. Inappropriate land-use systems and land-tenure policies enhance desertification and loss of agro biodiversity[37]. Ethiopia has committed to restoring

[35] Please see Waldschmidt, F, Behre, E, Daou, D, Rojas, A, Arce Mojica, T, Koirala, P, Sebesvari, Z, Kreft, S, Souvignet, M. (2021). Vulnerability Report – Ethiopia – Drought Risk. Report 03. Bonn/Frankfurt. United Nations University Institute for Environment and Human Security /Frankfurt School of Finance and Management

[36] Ndathi AJ, Nyangito MM, Musimba NK, Mitaru BN (2011) Climate variability and dry season ruminant livestock feeding strategies in Southeastern Kenya

[37] Taddese G 2001. Land degradation: a challenge to Ethiopia. Environ Manage, 27(6):815-24.

15 million ha of degraded forest and savannah in response to the 2011 Bonn Challenge[38]. Exclosures often established by using so-called social fences in Ethiopia, are widely recognized as effective in restoring landscapes and local communities recognize the role of exclosures in increasing site productivity and vegetation cover[39].

Although activities were mainly planned and implemented using a top-down approach exclosures were started in 1980s during the Derg regime mainly regarded as forceful community engagement and resource utilization, which in turn adversely affected the sense of ownership[40]. Exclosures are areas closed from humans' and domestic animals' interferences with the goal of promoting natural regeneration of plants and reducing land degradation of formerly degraded communal grazing lands. Exclosures are a type of land management, implemented on degraded land for environmental restoration[41]. Exclosures have the potential to reduce water erosion[42] and are considered as economic and effective landscape restoration mechanism[43].

In the pastoralist and agro pastoralist communities of the Afar and Somali lowlands, the prime mandate of customary institutions is concerned with the management of natural resources. They have their own customary rules and regulations serving as local level strategy which is widely accepted by the community. Effective natural resources management and pastoral development could be achieved through integration of the indigenous institutions with formal government. In Afar region typical natural resource conservation practice could be cited as good example, where the traditional leaders are assigned as advisors at Woreda level to establish good links to the communities they represent. The traditional institution "Mad'aa" governs the proper management and fair utilization of rangeland and water sources[44,45,46]. The traditional institutions encourage the community to undertake range enclosures in denuded grazing areas. Grazing reserves (Desso) are useful means of sustaining pastoral livestock during dry and drought periods when the support capacity of other normal year rangelands decline.

[38] The Bonn Challenge is a global goal to bring 150 million hectares of degraded and deforested landscapes into restoration by 2020 and 350 million hectares by 2030.

[39] Birhane E., Mengistu T., Seyoum Y., Hagazi, N., L. Putzel,. Mekonen M Rannestad and Kassa, H.(2017). Exclosures as forest and landscape restoration tools: lessons from Tigray Region, Ethiopia International Forestry Review Vol.19(S4).

[40] Dessalegn, R. ,1994. Land Policy in Ethiopia at the Crossroads. Working papers on Ethiopian Development No. 8.University of Trondheim.

[41] Tucker, N.I., Murphy, T.M., 1997. The effects of ecological rehabilitations on vegetation recruitment: some observations from the wet Tropics of North Queensland. Forest Ecology and Management 99: 133 – 144.

[42] Mekuria W., EdzoVeldkamp E., Mitiku H., Kindeya G., Muys B., Jan Nyssen J.,2009. Effectiveness of exclosures to control soil erosion and local community perception on soil erosion in Tigray, Ethiopia. African Journal of Agricultural Research Vol. 4 (4):365-369

[43] Emiru B., Demel T. and Barklund P, 2004.Actual and potential contribution of exclosures to enhance biodiversity of woody species in the drylands of Eastern Tigray. Journal of the Drylands 1(2): 136-141

[44] Diress Tsegaye, Mitiku Haile and Tegegne Teka (2004).Research and Development Experience on Dryland Husbandry in Ethiopia.Dryland Husbandry Project (Dhp) Ethiopia

[45] Federal Democratic Republic of Ethiopia Environmental Protection Authority (EPA) (2011). State of Environment Report, Chifera and Mille Rangeland in Afar Regional State

[46] Yayneshet Tesfay and Kelemework Tafere.(2004). Indigenous Rangeland resources and Conflict Management by the North Afar Pastoral Groups in Ethiopia. A Pastoral Forum Organized by the Drylands Coordination Group (DCG) in Ethiopia, June 27- 28, 2003, Mekelle, Ethiopia.DCG Report No. 31November 2004.

4.1.3 Establishment of community seed banks

Community seed banks (CSBs) are locally governed and managed collective action institutions whose core function is to maintain seeds for local use[47]. They have been designed to conserve, restore, revitalize, strengthen and improve plant genetic resources for food and agriculture, especially but not solely, focusing on local varieties of crops. CSBs handle major and minor crops as well as neglected and underused species. CSBs are helping agro pastorals and communities regain, maintain and increase their control over the seeds they use around the world. Many of them have led to stronger cooperation among and between agro pastorals and with others including plant breeders, researchers and gene bank managers, who are involved in the conservation and sustainable use of agricultural biodiversity[48]. Globally, sufficient recognition for CSBs in policies and laws have lagged behind[49]. An important reason for this inadequate attention is that CSBs operate under diverse political regimes and in varied policy and legal contexts. Conservation and sustainable use of plant genetic resources is among the main functions of CSBs. These are also core objectives of two international agreements: the Convention on Biological Diversity (CBD) and the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA).

The rich biological resources of plant genetic diversity of the country experienced serious genetic erosion over the past decades due to natural and human-induced factors. The rate of erosion varies considering different parts of the country and crop species. Though there are no detailed studies quantifying the loss for each crop, the level of diversity observed currently on farmer's field is generally low. As a result Ethiopia has recognized the establishment of CSBs as the national strategy to support conservation, management and use of crop genetic resources and as a biodiversity strategy. The CSB intended to that support the agricultural sector by contributing towards ensuring seed security. As such, CSBs provides seed supply service to food producing small scale agro pastoralists by providing diversity of locally adapted seeds within easy access to the community. In case of season variations due to climate change related impacts, CSBs fill gaps of seed shortage by offering access to diversity of short maturing sequential crops as alternative. Having diversity allows agro pastoralists to replant their farm plots in case when the first planting fails and strengthens the resilience capacity of agro pastorals to climate change induced shocks.

A CSBs associations are an invaluable instrument to ease the operation of the CSBs. CSBs associations can be formed by volunteer agro pastoralists who are committed to continuing conserving and utilizing varieties of food crops, improving food security through seed security and solving common problems jointly by making use of their own knowledge and potentials at hand. The roles of a CSBs association include the following:

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[47] Development Fund.2011.Banking for the Future: Savings, Security and Seeds. Oslo: Development Fund.

[48] Vernooy, R., P. Shrestha, and B. Sthapit, eds.2015.Community Seed Banks: Origins, Evolution and Prospects. London:Earthscan.

[49] Ronnie Vernooy, Teshome Hunduma Mulesa, Arnab Gupta, Jahangir Alam Jony, Kouablan Edmond Koffi, Hilton Mbozi, P.B. Singh, Pitambar Shrestha, Thabo T. Tjikana & C.L.K. Wakkumbure (2020). The role of community seed banks in achieving farmers' rights, Development in Practice, 30:5, 561-574.

- To conserve and enhance local crop and fodder plants genetic diversity and associated community knowledge
- To prevent loss of crop and fodder plants varieties and threat of genetic erosion
- To promote and strengthen local farming practices and
- To collectively solve production challenges

However, prior to the establishment of a CSBs association, intensive community awareness raising workshops need to be organized for the larger community in the regions. The focus is to inform the community members about CSBs, the purpose and its function. Then individuals need to be consulted at household level and registered by making formal and informal application after they agreed to participate in the association.

4.1.4 Wetland restoration and rehabilitation

According to the Ramsar Convention wetlands are defined as areas of marsh, fen, peat land or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meters[50]. The Ramsar Convention provides a framework for national and international action for the conservation of wetlands. In the Ethiopian context, floodplains, irrigation fields, valley bottoms, lake fringes, shallow vegetated areas, mountain seepages, plantations, and irrigation field areas are categorized under 'wetlands'[51]. They are highly productive, complex, dynamic, ecologically sensitive and adaptive systems, supporting significant biological diversity and significantly contribute towards achieving sustainable development while enhancing benefits of people. Many of the benefits that people derive from ecosystems are dependent on water and wetlands are integral to the global water cycle upon which all of life depends. The complex interactions of wetlands with the surrounding landscape underpin important ecosystem functions and processes. They provide, regulate and purify water so that it can be used for domestic purposes (drinking, cooking, cleaning etc.) and for industry. Wetlands also contribute to local climate control, erosion reduction and underpin a suite of economic industries such as inland fisheries, harvesting of raw materials, tourism and agricultural production which rely on the provision of water (Table 1).

Wetlands, either in their natural state or otherwise provide ranges of ecological and socio-economic benefits contributing in one way or another toward food security and poverty reduction. The role of wetlands is unique and vital with respect to food security as they save lives of humans, livestock and wildlife in the dry season and drought time[52]. Wetland edge springs are usually the only reliable sources of water both for domestic use and livestock especially in the dry months of the year, when many streams dry up.

[50] RAMSAR Convention, Art 1.1 and 2,1

[51] Giweta, M., & Worku, Y. (2018). "Reversing the Degradation of Ethiopian Wetlands": Is it Unachievable Phrase or A Call to Effective Action?. International Journal of Environmental Sciences & Natural Resources, 14(5), 136-146.

[52] Jigar, N., Gebru, N., & Ayalew, N. (2016). Socio-economic values, threats and legal protection aspects of wetland ecosystem in Afar region, Ethiopia. International Journal of Engineering Development and Research, 4, 221-229.

Table 1: Inland wetland ecosystem services[53]

Ecosystem services	Role of wetland structure / function
Erosion control	Capture of sediments and soil retention
Flood protection	Regulation of the flow of water; water storage capacity
Water provision	Regular supply of water due to ability to store water in a reservoir; groundwater recharge
Water purification	Natural filtration through nutrient uptake; retention of particles and pollutants
Food	Habitat for fish, molluscs, other plants and animal species used for food
Raw materials (fibre, fuel)	Habitat for grasses, and other plants used for fiber and fuel
Spiritual / cultural values	Many cultures have spiritual values and religious practices associated with wetlands
Nature-based recreation and tourism	Aesthetic features of wetlands; open water; habitats for biodiversity
Carbon storage and sequestration	Vegetation and soils capture carbon dioxide and other greenhouse gases from the atmosphere
Local climate regulation	Water bodies are able to stabilize local temperatures. The microclimate at wetlands is often lower than surrounding areas

Generally, lack of awareness, draining for agriculture, overexploitation, deforestation, siltation, erosion and urbanization can be mentioned as major threats to wetlands in Ethiopia[51]. Many pastoral people and livestock herds flock and graze over the dry season in the wetland areas. The continued degradation and conversion of wetlands to other land uses is not just impacting only biodiversity but also the livelihoods of people living in and around wetlands. For instance, one of the major drivers of degradation in the Awash river basin are excessive drainage of wetlands for agriculture purpose, e.g. for the expansion of development programs such as sugar or commercial cotton plantations and population and livestock increase. Additionally, groundwater abstraction, overgrazing, deforestation in the uplands and intensive agriculture in the lowlands and surface runoff are also the major causes for the decrease in the water table in the majority of wetlands that are found in the country[54].

The Awash basin wetlands consist of a total area of 11 million ha[55], includes five regional states: Afar, Amhara, Oromia, SNNP, and Somali, and two administrative councils: Addis Ababa and Dire Dawa. In the Afar region the Awash basin includes Lake Besaka, Gedebassa, Afambo, Gamari and Abbe. The Lake Abe wetland complex comprises several saline lakes such as Gamari, Afambo, Bario and Abe. On the other hand, the Shebelle River rising

[53] Russi D., ten Brink P., Farmer A., Badura, T., Coates D., Förster J., Kumar R. and Davidson N. 2013. The Economics of Ecosystems and Biodiversity for Water and Wetlands. IEEP, London and Brussels; Ramsar Secretariat, Gland.

[54] Giweta, M., and Worku, Y. (2018). "Reversing the Degradation of Ethiopian Wetlands": Is it Unachievable Phrase or A Call to Effective Action?. International Journal of Environmental Sciences & Natural Resources, 14(5), 136-146

[55] Atesmachew Bizuwerk, Girma Taddese, and Yasin Getahun. Application of GIS for Modeling Soil loss rate in Awash River Basin, Ethiopia. International Livestock Research Institute (ILRI). Addis Ababa, Ethiopia (https://www.iwmi.cgiar.org/assessment/files/pdf/publications/WorkingPapers/GIS%20for%20modeling%20soil.pdf)

between the Arsi and Bale mountains is the major wetland in in central Somali region. Both the Awash and Shebelle basins cover vast areas of the Afar and Somali rangelands rich in various fauna and flora life-forms and are the prime source of biodiversity and livelihoods in the regions. The rivers and their floodplains are a rich source of biodiversity and have regulatory functions to maintain rainfall and moderate climate[56] and are source of water for people and domestic animals and habitat for charismatic wildlife including crocodile and fish.

Table 2: Lakes in the Afar regional state[57]

Lakes	Area (ha)	Geographic location
Abe Lake	11,300	Zone 1
Afdera Lake	11,200	Zone 2
Yardi/Diaribet Lake	7,500	Zone 3
Gemeri Lake	6,200	Zone 1
Asahle Lake	3,600	Zone 2
Afambo Lake	3,000	Zone 1
Dalol/ Humigebet Lake	3,000	Zone 2
Adobed Lake	2,400	Zone 1
Hertale Lake	1,100	Zone 3
Dalay Lake	410	Zone 3
Laido Lake	350	Zone 3
Suwata/Eeta Lakes	100 – 250	Zone 1

Therefore, wetland protection and restoration can enhance climate adaptation and resilience, and stabilize and maintain local water cycles, water supply, and microclimates. Thus, it is vital to incentivize local communities to apply sustainable wetland management practices in alignment with relevant institutions to facilitate appropriate planning for the implementation of wetland conservation and restoration interventions in the regions (See Figure 2 and Figure 3). Actions to restore and sustainably manage wetlands for resilient livelihoods and sustain ecosystems include:

I. Restoration and management of wetland hydrology and associated forests/shrub land
   a) Strengthened wetlands management practices, such as control of invasive species vegetation
   b) Small-scale water storage and detention facilities designed and constructed or rehabilitated in critical waterways for communities to benefit from enhanced ecosystem functioning
   c) Degraded catchment areas rehabilitation and land productivity improvements (e.g. with controlled and prevented pollutions)
   d) Effective wetland laws and policies

[56] Mengistu, W. (2018). A First Directory of Ethiopian Wetlands: Description, Ecosystem Services, Causes of Degradation & Recommendations for Restoration and Sustainability.
[57] Afar National Regional State, BOFED (1999). Regional Conservation Strategy, Volume-I, Ayssaita, Ethiopia.

II. Improved agricultural practices and alternative livelihood options in wetland catchments.
   a) Crop diversification and resilient agricultural best practice adopted
   b) Economically viable and sustainable agro-based livelihood and income-generating interventions introduced, promoted and supported in the wetland and immediate catchment
   c) Controlled extraction of environmental goods (harvesting)

III. Enhancing knowledge management and information sharing to facilitate community-based wetland restoration activities
   a) Good practices and lessons learned in sustainable wetlands restoration, management and innovative livelihood options documented and disseminated

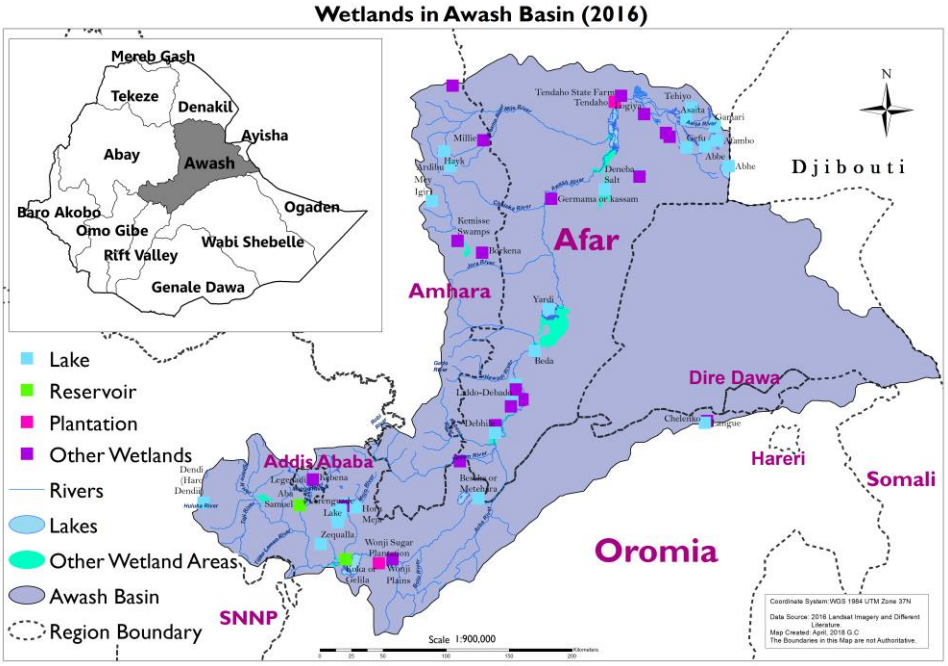


Figure 2: Wetlands of Afar basin. Source: Mengistu Wondafrash (2018)[58]

[58] Mengistu Wodafrash (2018). A First Directory of Ethiopian Wetlands: Description, Ecosystem Services, Causes of Degradation & Recommendations for Restoration and Sustainability.

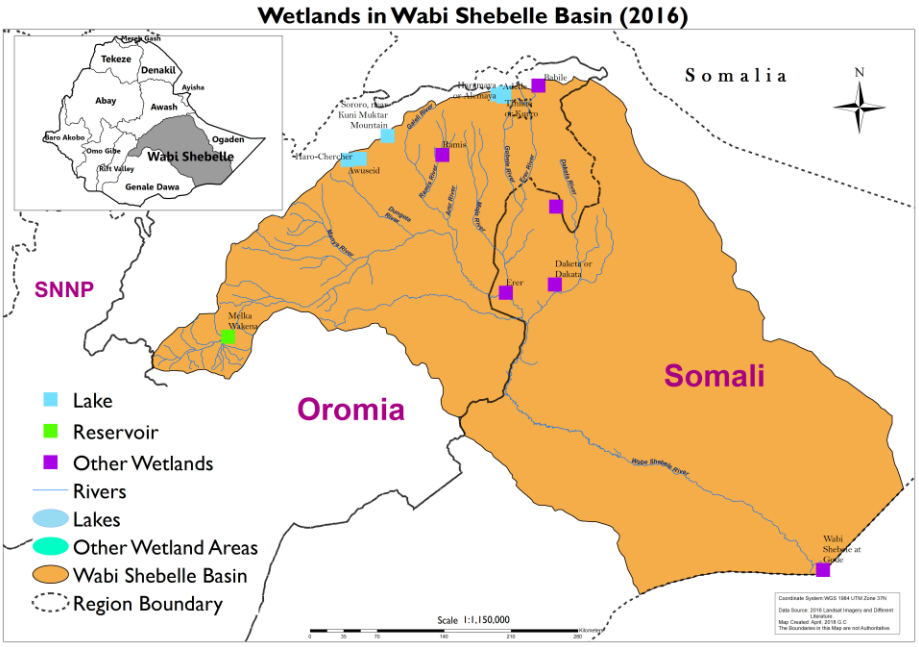


Figure 3: Wetlands of Wabi Shebelle Basin. Source: Mengistu Wondafrash (2018)[59]

4.1.5 Establishment of fodder tree and grass nursery sites

The seasonal fluctuation in forage yield and quality from grasses is the major constraint to livestock production where long drought periods frequently occur in the lowlands of Ethiopia. There is usually adequate forage of fair to good nutritive value in the wet season but in the dry season available forage from natural pastures are usually inadequate both in terms of quality and quantity to meet the maintenance requirements of livestock. The movement of livestock during wet and dry seasons in grazing areas is vital to pastoral and agro pastoral livelihoods. More recently, the agro pastoral communities in the regions have started growing forage crops for on-farm use as well as sale to local householders. Sudan Grass and other improved varieties are becoming the major forage seeds to thousands of agro pastoral communities (Table 3). Increasing food availability with locally grown varieties is favored as they have proven to be cheaper and easily distributed which allows for better quality of forage and producing improved forages locally in lowland areas, tend to be fresher and more nutritious

In Afar region, over the past two decades several forages have been tested in different ecological zones; and considerable efforts have been made to test the adaptability of different species of pasture and forage crops under varying agro-ecological conditions[60]. As a result, quite a number of useful forages have been selected for different zones. Improved pasture and forages have been grown and used in government ranches, state farms, farmer's demonstration plots and dairy and fattening areas. Forage crops are commonly grown for feeding dairy cattle with oats and vetch mixtures, Fodder beet, Elephant grass

[59] Ibid.

[60] Alemayehu, M. 2001. Forage and Seed Production. MoA, Addis Ababa, Ethiopia. Alemayehu, M. 1998a. Natural Pasture Improvement Study around Smallholder Dairy Areas. MoA Small Dairy Development Project (SDDP), Addis Ababa, Ethiopia.

mixed with Siratro and Desmodiums, Rhodes/lucerne mixture, Phalaris/Trifolium mixture, hedgerows of Sesbania, Leucaena and Tree- lucerne being commonest. In suitable areas yield of oat-vetch mixtures are commonly 8-12 tons dry matter per hectare. Yield of improved pasture and forage grasses and legumes ranges from 6-8 tons and 3-5 tons dry matter per hectare respectively; and for tree legumes 10-12 tons dry matter per hectare. Due to land scarcity and crop-dominated farming there has been limited spontaneous introduction of improved pasture and forages. There are different strategies and species for pasture and forage development[61]. These strategies and forages have been promoted widely into the crop-livestock system, traditional grazing areas, and around homesteads, within soil and water conservation structures and under plantation crops and forestry.

Table 3: Recommended improved pasture and forage strategies and species[62]

Strategy	Species
Backyard Forage	Leucaena leucocephala,Sesbania sesban, Cajanuscajan, Chloris gayana,Setaria spp., Panicummaximum, Pennisetumpurpureum, Desmodiumuncinatum, Medicago sativa
Under sowing	ILablab purpureus, Vignaunguiculata, Macroptiliumatropurpureum, Desmodiumuncinatum, Stylosanthesfruticosa, Vicia dasycarpa,Cassia spp.
Forage Strip	Leucaena leucocephala,Sesbania sesban, Cajanuscajan, Panicum maximum,Setaria sphacelata
Over sowing	Stylosanthes fruticosa,Macroptiliumatropurpureum, Cassia spp.,Desmodium uncinatum
Livestock exclusion areas	Cenchrus ciliaris, Leucaenaleucocephala, Sesbaniasesban, Macroptiliumatropurpureum, Stylosanthesfruticosa, Macrotylomaaxillare, Desmodiumuncinatum, Paspalumplicatulum
Conventional forage and pasture	Stylosanthes fruticosa, Macroptilium atropurpureum, Desmodium unicnatum, Chloris gayana, Panicum maximum, Setaria sphacelata

4.2 Technical feasibility

4.2.1 Improved forage storage and treatment

This measure is vital to ensure the safety and health of animals during the harsh drought months (particularly February, March and April), as forage is one of the most important inputs for livestock development in Afar and Somali regions. Storing forage is required as the forage in forage banks can be harvested every three or four weeks in the growing season, to be used during the drought months. In the past, forage storage structures have been built for Dupti, Awash, Amibara, Hadlela and Dalifafa districts in Afar region. The

[61] Alemayehu, M. 2002. Forage Production in Ethiopia: A case study with implications for livestock production. Ethiopian Society of Animal Production (ESAP), Addis Ababa, Ethiopia.

[62] Alemayehu Mengistu, 2004, Pasture and Forage Resource Profiles Of Ethiopia. Alemayehu Mengistu and Associates, Addis Ababa, Ethiopia.

importance of this measure can also increase with expansion of business investments in animal production, fattening, dairy, etc. as forage, hay or concentrates are the basic inputs. Forage development is a pre-requisite for forage storage development. There are certain government projects developing forage, such as the Tendaho 700 ha forage farm in Afar, and almost all communities do have community level uncontrolled natural rangeland forage sites, even though overgrazing reduces the forage potential.

The society lacks business motivation and has an undeveloped culture of market based supply of forage as input for their livestock rearing, despite the majority of livestock herd owners have the capacity to pay. The demand for forage can be developed through demand creation through time, as this can benefit livestock owners and reduce much cost in terms of the weight loss of animals while travelling long in search for forage. Development of forage storage at areas where we find much livestock resources and where there is free communal land to establish forage development would be beneficial. The forage development activities should therefore consider both the community owned ones and the project based developments that can also be used as demonstration site, which ultimately can be transferred to the private sector to institutionalize business models that can enhance sustainability of forage development, forage storage and marketing of hay through time.

The people have a well developed sense of cooperation to have wiser use and conservation of community pasture land; despite the fact that they have limited structured knowledge and skill to efficiently and sustainably use the forage resource. This calls for the need to develop cut-and-carry systems, and to have standard forage storage that can keep the quality of the forage for some four months.

Accordingly, the improved forage storage is proposed to be established using roofed trench (bunker) silos in combination with storage polythene bags (e.g. 50 kg capacity). The storage does not need electricity power. Trench (or bunker) storages are permanent structures constructed above ground and are commonly used in flat areas. Above ground walls are constructed using concrete, earth, or steel. Bags are suited to crops where fluctuating amounts harvested can be sealed. For Afar region, two concrete trench silos are suggested. Each trench silo will have a capacity of 2,000 tons. This measure involves the following activities:

- The need to consider livestock development mapping of the region that indicates the concentration of livestock and forage resources,
- The need to consider project based development of forage/ fodder development initiatives with all vital basic materials and services under provision, including irrigation, machines to cultivate the land, harvest, belier, and transport trucks to distribute to the distant areas.
- Communicating and agreement with the community (clan) leaders and respective political and sector level officials, and together identify sites to establish forage storage structure.

- Ensuring local community participation is essential in order to develop sense of ownership and easily transfer the responsibilities of operations which guarantee the continuation of operation after the completion of the project;
- Prepare or adopt ideal fodder storage design, and manual on how to store and treat the forage and how to utilize hay.
- Construction of the forage storage structure with standard design. The storage is an open space structure with proper ventilation
- It is better to pilot in moist areas of the region as the forage banks under development are more successful in such agro-ecologies of the regions. In Afar region, forage storage structure better be piloted in Dubti (Zone 1) and Awash district (Zone 3), where the areas are moist, according to discussions made with region level bureau experts (See Annex 4 and Annex 5)
- It requires a plan indicating how the stored forage/ hay is to be distributed to the respective communities
- Treatment: except hay making there is no expected treatment of the forage

Animal feed is the most important constraint of animal production in Ethiopia. In order to make the forage storage a sustainable measure, the initiative would need to formulate a business model, through time, in such a way that motivated youth business groups can be organized to invest on forage development with forage storage facility, where the forage can be marketed to pastoralists/ farmers, animal farm investors and the regional government.

4.2.2 Management of protected environmental areas

In drought situations, people are forced to overuse/ overgraze the available forage and water resources, resulting in land degradation. Such condition calls for protection of the environmental areas from humans' and domestic animals' interferences with the goal of promoting natural regeneration of vegetation/ plants and reducing land degradation. This measure has been practiced in different districts in the regions – Zone 1 (Chefra, Adaar), zone 2 (Kuneba, Erebti), zone 3 (Amibara, Haruka, Geane, Gelealu), Zone 4 and Zone 5. The effects of such exclosures on the recovery of woody species diversity, population structure, and regeneration status, restoration of soils, and restoration of ecosystem carbon stocks have been well studied in the past. Exclosures are often managed within a rotational system, which define the closure and accessibility for livestock activities. This measure involves activities including:

- Discussion with communities, particularly the clan leaders, politicians, and implementing office heads and experts including those at the Woreda and Kebele level about the importance of the measure, and ownership of the community to handle the main tasks of area protection using the social or community engagement and resource use bylaws (in Afar called Medda). Develop bylaws at community level, including the roles of the communities, and the framework of using resources in the protected areas. It is necessary to use the area closure manual developed and adopted by the federal and regional bureaus.

- Site selection and obtain community clearance for the protection of the area. The site shall be selected using criteria, including degradation of the forage land, accessibility of the area to be used as demonstration in order to help scaling up, etc. (see Annex 4). In Afar, such measure may better be piloted in Cheifra and Adaar (Zone 1); Kunbebu Dallol, Erebti Megale (Zone 2); Gelealu, Gewane, Haruka Awash (Zone 3) districts, etc.
- Clearing of *Prosopis* (machine cost of Birr 5,000/ha), Over-sawing (in case required after checking absence of its seed reserve) and pasture development, water potential resources development, and soil and water conservation, fencing the area using local material. Local names of forages that are valuable for cattle include Durfu, Melif, Serdoita, Asaeso, Esisu etc. These are supposed to be both for browsing and for grazing
- Create awareness of the community to practice cut-and-carry from the protected areas
- Define and enforce land-use plan of the regions
- It also requires recent data on the damaged areas and time series changes due to climate that require adoption of climate adaptation measures, i.e., climate information system that can be communicated to all vital stakeholders
- The community could contribute labor wage at a reduced wage rate of about Birr 100 per day (while the common daily wage rate is about birr 250/day). Participation of the community, such as through cheaper labor supply, would have significant effect on the ownership, protection and sustainability of the measures. Labor contribution of the community can be in the activities, such as fencing, soil and water conservation structures, security, purposes, etc.

Such area closures are to be developed in the lowlands of the Afar region up to 1,000 ha, with the agreement of the communities and officials, and with clear modality of resource use in the closed areas. Protection of environmental areas is a common practice in Afar and Somali. The communities have a strong culture of trust and cultural framework of protecting areas closed for the purpose of restoration and developing the areas. However, it requires strengthening the group cooperation to protect and have a binding framework of utilizing products and services that are found in the protected areas, rehabilitation of the area, etc.

4.2.3 Establishment of community seed banks

This measure involves integrating seed production and collection, and ex-situ conservation of grass/fodder seeds at seed banks. Effectiveness and impactful operation of grass/ fodder seed bank requires integration of grass/ forage seed development, possibly with community level production. This measure has been practiced in Afambo and Ayssitta districts in Zone 1 of the Afar region. These require vital activities, including:

- Discussion with the community and creating awareness about the benefits of the community forage seed development and the seed banks,
- Training of the community clan leaders, senior and lower level technical staff, bureau heads and political leaders on how to develop community level forage seed banks,
- Market based incentive mechanisms attached to organizing interest groups in communities (such as groups of agro-pastoralists, each with about 10 members) to engage in such forage seed development activities,

- Identification of sites, collection of suitable local seeds or from elsewhere (other regions of the country or from abroad),
- Developing modalities of community participation and benefit sharing mechanisms,
- Access for water/ irrigation, procurement of materials, including machineries, such as tractors, harvesters, and packaging materials, and harvesting. When considering 5-6 ha of grass/ fodder production fields for the community seed banks, the community can handle the lion share of operations. Certain support, including capacitating development agents at Kebele level, provision of farm tools, verification of selected sites, supply of seeds, and follow-up of activities may be required. In Afar region, this measure may better be piloted in Dupti (Zone 1) and Awash (Zone3) districts. In Somali region, the measure could be piloted in moist areas of Shebele, Afder, Liben zones, while it could also be piloted in Dawa and Fafen zone too
- Construction of proper seed bank/ storage and handling of the forage seeds (with ideal cooling system of seed storage). This can be owned by the regional government bureau of pastoralists and livestock development.
- Mechanism on how to create market demand for the harvested forage seeds locally and regionally
- Institutionalize a research unit ensuring the suitability of the sites, handle continuous improvements on the relevance of alternatives of forage seeds, where and how to ensure sustainable forage seed development in the regions, the relative importance and collection of grass, forest or agro-forestry seeds, etc. Somali Pastoralists research institute (SOPARI) in collaboration with the national EIAR evaluated and identified and released about 14 grass/ fodder species for such dry land areas.
- Scaling-up and exit strategies on how to ensure sustainability of community seed bank development.

Forage seed supply shortage is an important constraint both in Afar and Somali regions. The forage development programs are affected by the lack of local seed supply systems; considerable seed has been supplied from highland areas, where some of them have suitability problems and are vulnerable to diseases. Forage seeds used to be procured also from other regional states, such as SNNP and Amara regions. The local communities have a practice of supplying local grass seeds. There were certain practices of community level seed bank development by projects and Afar Pastoralists Research Institute (APARI).
Accordingly, it is planned to build 50 community seed banks in each of Afar and Somali regions where each has the capacity to store 4-6 tons of seed supply, which is enough to cover at least 1200 households[63]. With the same assumption, about 60,000 households (each obtaining 5kg seed) or 30,000 households (each obtaining 10kg seed) can benefit from 50 seed banks in each region.

[63] Assuming seed production amounting about 4-6 tons/seed bank; benefiting about 1200 HHs; where the yield per hectare is assumed to be about 500kg seed/ha or 0.5ton seed/ha. With the same yield of seed per hectare, a seed bank requires 12ha of seed production, and each 1200 HHs can obtain about 5ks of seed to help cultivate 0.5ha of grass land.

4.2.4 Wetland restoration and rehabilitation

In Somali region, wetland protection and restoration is among the necessary measures as wetlands are degraded and getting reduced in area and water potential, including around the Ayisha and Shebelle Basin. For instance, fish reproduction halted in Shebelle River (Somali region) that was known for ample fish resource before years. The degradation of wetlands is enhanced by factors including encroachment of people, water abstraction for irrigation, and over grazing, which also resulted in loss of biodiversity. In dry-land areas, climate change may push people to move towards such moist areas during the dry season. In this regard, no considerable operation has been conducted in the region either to protect wetlands from adverse degradation or to rehabilitate degraded wetlands. Particularly, the river side wetlands are potential focus areas in Somali that require restoration, develop and prepare for pastoralists for the dry season and drought season grazing. It involves:

- Selection of model sites (see criteria of selection in Annex 4), assessment of the conditions and causes of wetland degradation, as this is needed to specify the detail activities of the particular measure.
- Develop awareness of the community leaders to help protect and develop by-laws or modalities for their participation and user manuals, convince the political leaders and implementing office management. Clarifying the benefits to the communities and its link with their livelihood is important for the feasibility and sustainability of the measure.
- Specifying activities to operate that may include closure and protection of the areas from human and animal interference, fencing using local material, soil and water conservation, earth dams to protect sedimentation. It may also involve clearing of Prosopis[64] and Lantana camara that invades the wetlands. Moreover, it involves: I. Restoration and management of wetland hydrology and associated forests/ shrub land, II. Improved agricultural practices and alternative livelihood options in wetland catchments, and III. Enhancing knowledge management and information sharing to facilitate community-based wetland restoration activities
- In addition, it is necessary to clearly and officially define and implement an ideal land-use plan of the area

4.2.5 Establishment of fodder tree and grass nursery sites

The importance of this adaptation measure can be justified as there are no such specific nursery sites for fodder or grass species, and the degradation of rangelands and wetlands requiring raising of seedlings and plantation. In Somali region, there are about 134 nursery sites where majority are of forest and fruit trees; about 55% and 45% are forest and fodder trees, and fruits, respectively, and about 90% are exotic species. The measure is practiced by DRSLP project in Ararso and Ayisha districts of Somali region. There are some private

[64] Prosopis is the most hatred tree in the lowlands and an officially classified invasive species. It invaded many parts of Afar and Somali, compromising the forage and agricultural lands. The SDR project is trying to uproot and replace the area with grass. As a fortunate complement, the biomass of the prosopis is found to be a source of energy as a coal for the cement and other industries in Ethiopia, which can somehow reduce the invasion, provide the land for forage development, and provide additional incentive for beneficiaries.

enterprises raising seedlings for business purpose. There are also nursery sites that are developed by NGOs, rising up to 20,000 seedlings. However, there is a shortage of capable experts, financing and a shortage of water to ensure adequate supply of fodder/ forage seedlings to the communities. The common fodder trees include: *Sesbania sesban, Panicum, Rhodes, Acacia polysantha*, pigeon pea, cow pea, papaya, bamboo, elephant grass, various acacia species (*Acacia Abysinica, Acacia Tortois, Acacia Seyal*, etc.).
Establishment of fodder tree and grass nursery sites involves:

- Assessment of vital species and the demand for the seedlings,
- Awareness creation with community leaders, political leaders, and capacitating regional and federal office management, including staffs at Woredas and Kebele levels.
- Site selection, fencing and construction of shade to protect from sunlight with local material, access to water smart technology (underground or surface water) for the nursery site or construction and rehabilitation of irrigation canals and water storage ponds to enable a permanent production of seedling and fodder seeds, procurement of farm tools and planting materials.
- It also requires media based promotion of plantation of grass and fodder species.
- Moreover, it requires continuous research to identify adaptability and resistance to different climate change risks in the different areas of the regions, palatability and nutritional contents of the species, data record system such data on location specific plantation, survival rate, associated risks, etc. SOPARI can handle the research and supply of basic seeds. Although each district needs to have a nursery site, the pilot measure would better be practiced in moist areas.
- It is intended to implement 100 ha of nurseries in Somali region with 12 species and two types of germplasm.
- It requires to clarify the benefit sharing mechanism and sharing of planting activities of fodder seedlings/ grass, as otherwise people cannot be motivated to support the initiative.

4.3 Implementation System

In terms of effectiveness or efficiency of project management, project based financing arrangement, i.e., independent of the existing public institutions would be more feasible than leaving the project to be implemented by the public sectors. Given the weak competence of region level staff, and weak capacity and governance system from federal to the Kebele level governance structure, public institutions are too weak to handle the management of larger projects. Therefore, capacity building needs to be considered as additional component of such development projects. Such government implementing projects are found to be lacking effectiveness and efficiency, as observed with the experiences of SDR, AfDB projects, even in the presence of independent consulting or advising teams.
An alternative modality of establishing an independent body handling the whole project implementation, as alternative to the government system would make it more feasible due to its flexibility and the better project management staff and standard governance system

to be established. However, the later requires strong scaling-up and exit strategies as it can be challenging for the government system to continue its sustainability.
Community contribution can be about 5% of the budget, following the experience of the ongoing projects, such as the RPLRP in the regions. Community contribution is more important for projects that are implemented for pastoralists and agro-pastoralists, as development interventions without the knowledge of the society, and without adequate ownership and matching resource/ costs could compromise effectiveness and sustainability of the project implementation.
Considering the local experiences and expenditures observed in the regions for the adaptation measures, a budget scenario is estimated for 5 years based on the initial phase of the project as well as longer term (20/30) based adaptation measures project implementation (See Annex 2).

4.4 Social, Economic and Environmental aspects

Above all, the current economic values, and social and environmental aspects of the adaptation measures matter most with the feasibility and sustainability of the benefits or adaptability of the measures. The proper consideration of the link among the economic, social and environmental aspects needs to be ensured. Critical understanding, respect and participation of the community/ indigenous people that also considers long-term operations, acceptable modalities for resource use ensuring the equitable distribution of benefits, and viability of investments need to be considered. Especially social values of the indigenous people need to be incorporated in the process of project implementation phases. The indigenous people should be actively involved in order to ensure the presence of transparent project planning and management system. Similar to other tribes in Ethiopia, the Afar and Somali communities have strong social morals. With respect to environmental aspects, all these forage development related adaptation measures are needed in the regions as they help sustainable of forage/ rangeland development that is necessary for livestock production. Management of protected environmental areas is a complementary measure especially for pastoralists as it helps to restore and rehabilitate the degraded areas. Establishment of community seed bank systems is also basic for forage/ grass seed supply system protecting the indigenous forage and fodder species from degradation, creates access for seed, and is an alternative technique of conservation of seeds. Forage storage also helps to efficiently utilize the forage resource whose scarcity is aggravated by drought.

Wetlands have been threatened by encroachment by people and overgrazing, and are vulnerable to degradation of its life species, calling for protection and restoration. Wetlands are also invaded by Prosopis. Environmentally, wetland restoration is very much needed especially along river lines in the Somali region. Establishment of fodder and grass nursery sites is necessary to conserve the endangered fodder trees and grass species and to enhance the vegetative cover of degraded areas. This is also supported by absence of

fodder trees and grass species nursery in the regions, which are all vital in terms of their economic, social and environmental aspects.

Another environmental element is sustainability of the system to ensure provision of basic services to the people both now and continuously in the future. Sustainability of the measures in managing risks requires novelty of the adaptation measures for the specific sites to be considered, effective piloting of the measures so that the society understands the benefits of the measures, creating awareness in the communities about the measures and ensure ownership of the structures by the respective community, development of the capacity of government offices and staff, effective exit strategy to handover responsibilities of maintaining the piloting and scaling up of the operations onto larger areas in the regions. In this regard, the Productive Safety Net Program (PSNP) could help to ensure that the measures are to be scaled up into the larger area. Sustainable management of climate change can be enhanced through ensuring that the adaptation measures are linked with livelihood interests of the people. Engagement of the private sector in different activities developing business models, through time, including establishment of forage storage, establishment of fodder nursery and seed banks, etc. is another vital mechanism that calls for social, economic and environmental aspects.

4.5 Institutional Capacity and Policies

The national policies and practices do have vital implications on the feasibility of the adaptation measures as adaptation program collectively. Despite the government having a national climate risk adaptation strategy, sustainability of such interventions has been a common challenge as experienced with related projects. Given the limited financial and institutional capacity of the government, scaling up and sustainability of adaptation practices used to be challenged by the weak financial resource allocation system of the government. The institutionalized development experience in the country, in general, and the governance in lowland areas, in particular, considers free supply of vital services and inputs. The government has been, for example, financing and developing forage banks, constructing forage storages, financing community based seed bank development, financing nursery establishment, and investing in restoring degraded areas, constructing different irrigation and sand dams in many parts of the low land areas, among others. Most NGOs also provide such services for free. This culture of free supply of such vital services and products (forage, forage seeds, water services, ponds, etc.) in the presence of certain capacity to pay by the side of the users may affect sustainability of managing the risks and scaling up of the pilots projects, as people tend to follow the already institutionalized development culture.

Sustainability of adaptation practices can be compromised if the community and individuals cannot take the lion share of development initiatives established for their livelihood strategy. This is also linked with the poor development of market systems and lacking private sector development. Most of the identified drought risk adaptation measures

require the engagement of the private sector to take part, and finally handle the majority of the long term operations. For example, modalities for sharing of costs of forage storage by the livestock owners, market modalities for seed or seedling exchange, incentives for communities to allow or sacrifice their pasture land for closure or wetland restoration protection, etc. would determine the scaling-up and sustainability of the risk management measures.

5. Benefits and beneficiaries of the Adaptation measures

5.1 Benefits

The overall benefits of projects associated to the adaptation measures shall be linked with SDGs, national adaption plans, poverty reduction and other related resilience and development initiatives. The benefits associated to the measures established in any of the locations will benefit the people located anywhere in the regions, as the people usually move from place to place in search for water and feed for their livestock. More specifically, the benefits of each measure are described below.

Benefits of Improved forage storage and treatment

- The traditional open space pile of grass is characterized by problems, including wastages due to fungus, host locust eggs, and becoming dusty. The storage development has multiple socioeconomic and environmental benefits, including reducing death rate of animals due to lack of forage as the feed value of grass/ forage cannot stay long without such storage; helping to save cost of moving animals long distance in search for forage; reduction of disease transmission following movement of animals from place to place, etc. These collectively improve livestock productivity, and production. This helps to improve the food- and income security status of pastoralists and agro-pastoralists.
- Moreover, engagement of private sector vendors of forage storage service with a sustainable business model can provide employment opportunities to the youth, and be used as a means of sustainable forage supply in the regions. A trench silos with a capacity of 2,000 tons can serve about 4,444 cows for three drought months assuming a demand of 5kg forage/ hay fed to a cow per day, i.e., 888 households with 5 cows each.

Benefits of Management of protected environmental areas

- It improves the land productivity and biomass production due to conservation of the soil and water that can be used through cut-and-carry, and restoration of the degraded areas following overgrazing of animals, which can enhance the potential livestock production, and conservation of genetic resources.
- It has the benefit of demonstration effects of area protection that communities can learn and scale-up for more and sustainable benefit. This has significant socio-economic benefits, particularly for the following years, although it may seemingly compromise temporary protection of people to encroach into such areas.
- It can also be a source of economic livelihood such as with apiary business.

Benefits of Establishment of communal seed banks

- In the situation of erosion of indigenous grass species, and absence of organized in-situ- or ex-situ gene bank, germplasm conservation and sustainable access for forage

seed is so important in both regions. It helps to plant and cultivate more palatable forage species, such as panicum, rodus, citrus, baffle, elephant grass, Sudan grass, and legumes, such as cow pea, lablab, susbania, etc.

- It provides employment opportunities. The local market value of one kg of grass seeds is between Birr 400-1,000.00. One hectare of forage yields between 3-5 quintals of seed. The initiative here developing 50 seed-banks in each region, where each seed-bank has a capacity of about 4-6 tones to help support about 1,200 households. The maximum level would be to provide about 5kgs of seeds for each household that can help them develop half a hectare of forage land. 50 seed banks seems too much for each region, and may need to reduce the number of seed banks to be established in each region.
- The seed can be demanded by individuals who are rearing animals/ livestock to help develop backyard forage development, or investors on modern animal production, dairy or fattening, and the regional bureau of pastoralist's development in order to expand forage development in the regions, etc. which are of great value for social and economic aspects.

Benefits of Wetland restoration and rehabilitation

- It is to restore about 150 ha in Somali region, around Shebelle river and Ayisha basins. It has benefits of conserving wild genetic resources
- It helps to stabilize and maintain local water cycles, and water supply potential of the area, which can save animals that are affected by water stress
- It helps to increase the grass potential of the area, saving animals that are affected by shortage of feed
- It protects the nearby river from degradation, etc.

Benefits of Establishment of fodder trees and grass nursery sites

- This measure is to establish 100 nurseries in Somali region.
- It can help to maintain endangered species in the communities from local extinction
- It helps to increase the area of fodder and grass lands and forage development,
- Play an important ecological role in enhancing ground cover and reducing soil erosion
- It helps to enhance the quality of feeds by integrating fodder and grass, and gives lesson to herd owners about animal feed types and their nutritional values, etc.

5.2 Beneficiaries

Beneficiaries of the implementation of the adaptation measures include the local population in intervention area and institutions that receive capacity building. Moreover, the population of the regions at large, local business firms, etc. also benefit from the measures. As forage is an important resource, which people are competing for, its adequate supply can address potential conflicts associated with the resource competition. Easy supply of forage resources also reduces burdens of family members, particularly the women who are also responsible for dairy cows, while the pastoral men used to move to distant places.

Gender, poverty, and peace and conflict aspects should also be taken into account. The livestock sector is the most important element in the regions, as almost all population and the economy of the regions depend mainly on livestock. It has been affected by drought risks, and therefore the climate adaptation measures are of high importance economically (food security), socially, environmentally. The pure pastoralists and agro-pastoralists can benefit from the improvements of the rangelands for their livestock production. The improvement of the fertility of soil and reduction of degradation are also vital benefits of the measures. The improvement in the livestock production (cattle, sheep and goats and camels) particularly helps to improve the poverty status of households. A number of youth can get motivated to engage in off-farm activities through marketing of different products and by-products. Moreover, the business model of forage harvesting, forage storage or seed development can ultimately be advanced to be handled by individuals, which can ensure the sustainability and as market solution and improved capacity of the pastoralists' communities. In addition, the business model can help to develop different forward linkages such as feed processing, dairy processing, establishment of tanneries, slaughterhouses, etc.

The government, including the federal, regional, zone and district level offices, who are handling the activities of related projects, benefit from the capacity building and increased experience of implementing drought risk adaptation measures. They can benefit from the different survey reports that provide further information on drought risks, associated scientific explanations and recommendations, and the experience of managing such risks. Such direct support and more importantly the collaboration that has been built with different parties involved in the design and financing related projects is of fundamental value for sustainable development cooperation.

6. Stakeholder analysis

Analysis of stakeholders and actors' partnership is necessary for different purposes in the project. Among others: (1) to improve the design and content of the project to ensure vital local elements are considered at the outset of the project design and ensure feasibility in terms of getting buy-in and acceptance by vital actors; (2) to strengthen the implementation capacity by pooling resources and capacities from the vital partners/ actor; (3) to ensure the continuation of the project after completion of the projects through transfer of responsibility of main project based activities and finances. Among others, challenges such as the lack of a strong system to manage and handle project operation after project completion, lack of required capacity of staff particularly at Woredas and Kebele level, lack of finance and other services and supplies at local level need to be addressed during project implementation.

Accordingly, the main stakeholders include:

- The local communities (rural households, farmers cooperatives, women and youth) and clan leaders: for overall ownership and protection of the project operations
- The regional political leaders and implementing sector (Bureau of livestock and pastoralists development, including zone level, Woredas level and Kebele level agents) management and staff: for technical aspects of the measures
- Region level research institutes (SORPARI, bureau of water and irrigation development)
- The federal government Ministry of agriculture
- KfW, GIZ, including the Consulting companies involved such as GOPA, GITEC, who have been financing/ implementing and running similar projects with long years of development experience
- The private sector, including commercial business firms and investors who are engaged directly or indirectly on forage development, livestock or supply of related inputs of equipments, etc.
- Other interest groups, such as the World Bank, IGAD, (local) NGOs etc. who have global perspective of managing climate risk adaptation, and their financial and development cooperation in the national economy.

Roles of each stakeholder/actor

Government (federal and regional level public actors): deploying and capacitating their staff engaged in the respective project, provide import permit of vital importable items free of tariff. Moreover, it takes a major share of continuing and sustaining the project operations after the end of projects. The government is expected to ensure presence of enabling legal and policy level frameworks, and institutions providing vital services for successful operation of the projects, such as maintenance and repair of machineries, suppliers of vital inputs, providing safety and protections, etc. Moreover, the federal government is responsible for such activities, as allocating budgets for maintenance of different machineries, salary and operating costs, educating and organizing the communities to own the projects and be responsible for continuous development of the initiatives, organizing

and sharing of data on climate risks and preparedness, etc. The major stakeholders and their potential roles are presented in Table 4 and Table 5 overleaf.

Table 4: Major actors and their potential roles

Major actors	Potential roles
The local communities (rural households, farmers cooperatives, women and youth) and clan leaders	• Overall ownership and protection of the project operations • Ensure vital local project components are considered during the outset of the project design • Ensure feasibility in terms of getting buy-in and acceptance by vital actors • Active participation to ensure project sustainability
Regional political leaders, Bureau of livestock and pastoralists development/ bureau of water and irrigation development- including zone level, Woredas level and Kebele level agents	• Provide necessary support for the effective management of project operations • Improve the design and content of the project • Ensure vital local elements are considered at the outset of the project design • Effective implementation of the project operations • Ensure feasibility in terms of getting buy-in and acceptance by vital actors • Active participation to ensure project sustainability
Region level research institutes (APARI/SORPARI)	• Provide research output to support project implementation • Improve the design and content of the project
The federal government Ministry of agriculture	• Follow-up project implementation • Support the improve the design and content of the project • Strengthen the implementation capacity by pooling resources from vital partners • Provide import permit of vital items free of tariff • Provide enabling legal and policy level frameworks, providing complementary services • Ensure the continuation of the project after completion of the projects
Implementing agency, incl. consulting companies	• Effective implementation of the project • Sharing experience of project management
The private sector	• Project sustainability after projects completion • Commercialization of adaptation measures • Engage in scaling up the measures through developing novel business model
Development banks / Donors (e.g. KfW , World Bank, etc.)	• Sharing global perspective of managing climate risk adaptation • Financial support and development cooperation • Strengthen the implementation capacity by pooling resources • Capacitating the vital partners/ and implementers

Table 5: Classification of Stakeholders by their Level of Interest and Influence

Influence/ Interest		Interest	
		Low	High
Influence	Low	Neighboring regions	Private sector, investors, GIZ
	High	IGAD World Bank, GOPA, GITEC	• Local communities and clan leaders • Regional political leaders and implementing sector • Regional Research Institutes • Bureau of Water and Irrigation Development • Federal government, e.g. the Ministry of Agriculture • KfW

The description of the above table is presented based on the experts' view of the situation. The local communities are very much responsible for ownership and protecting the project, and participate in most of key social and environmental aspects of the adaptation measures. They are also expected to take part in contributing their labor, as required.

7. Implementation

7.1 Organization of Activities of the adaption measures

Implementation of each measure requires ensuring its potential impact onto the communities and the environment, which may demand integration with complementary components, unless and otherwise each measure can independently bring certain output and impact. In this regard, it is fundamental that the feasibility assessment needs to consider the livestock resource as the dominant means of livelihood to Afar and Somali communities. The importance of identifying complementary components while organizing the activities of the adaptation measures assessed with respect to the process of impacting the livestock sector and the communities. As supply of forage and drinking water are the most basic inputs that are compromised by the drought risk, the identified adaptation measures are supposed to have direct contribution to sustainability of forage supply.

All the initiatives can only be implemented, by integrating capacity building of implementers and consideration of the community leaders, as the central point of implementation process. It is necessary to clearly indicate how each measure is linked with the livelihood of the people.

There is a need to consider integration of related supplementary or complementary adaptation measures that are running in the regions, while specifying implementation sites for each. These projects include: IGAD-DRCSL, WB–RPLRP, KfW- SDR (see Annex 1) Moreover, vital information of preparedness for drought risks, and use of the adaptation services and products made available by the government system periodically, need to be communicated down to the Kebele level.

The following describes key components of the respective measures/ activities.

A. **Improved forage storage and treatment**
   - This measure considers the presence of forage banks developed by different projects, and practice of cut-and-carry technique of feeding despite the cut-and-carry scheme is not well developed by the majority of pastoralists. Feasibility assessment of just the forage storage measure cannot be ideal or complete, as it cannot independently generate impact. There are necessary activities that need to be considered as complementary activities. These include the forage development, marketing aspect of forage, development of private sector engagement in forage development, transportation of the forage to communities, among others.
   - Otherwise, the improved forage storage and treatment measure can be integrated with other set of complementary activities that can be assumed existing in the project area, where livestock development programs are the main economic sector considered. Forage storage development can also enhance animal production as a forward linkage in the state of drought risk environment. However, one has to consider initiatives of awareness creation about the benefits of the storage by the potential beneficiaries nearby the storage site. It

can be considered as one component of the KfW's SDR project, the IGAD's DRSL project or even the World Bank's LLRP/RPLRP.

- Private sector vendors with business model may be a way-out for sustainability

B. **Management of protected environmental areas**

- The drought risk decreases the potential of forage/ grass in the regions; and these results in concentration of grazing/ browsing animals on potential spot grasslands that causes degradation of such areas. Therefore, protection and management of such environmental areas is a vital measure to reduce the cost of drought risk.
- This measure may need to be integrated with complementary activities, such as clearance of invasive species such as Prosopis, presence of fodder or forage seeds to allow for over sawing, or soil and water conservation practices as required.
- This measure can be a standalone project to be implemented in the identified site which can be accessible enough to be used as demonstration. However, it requires clear property right regime of the land and agreement with the local communities.
- Sustainability of such measures may call for organizing groups of individuals, permitted to make such a closure, develop the areas, after which the group allowed to be compensated through payment for allowing limited number of animals to graze during drought seasons, or to sell grass through a cut-and-carry system.

C. **Establishment of Community seed bank**

- It is needed by the regions, and is easily scalable onto larger areas, with intensive awareness creation.
- This assumes the presence of livestock development strategy with vital components.
- It is more feasible in moist areas along rivers in Somali (along Shebelle, Afder, Genale, Dawa rivers where selected districts of the first to fifth zones, including Fafen zone of Somali would be ideal to demonstrate), and moist areas of Afar (along Mille, Awash and Hida rivers), such as zone 1, zone 3.
- Sustainable benefits of the measure calls for development of a minimum incentive being paid to those individuals or groups involved in community seed banks, or development of market for the product at community level.
- This measure can be independently implemented, although it has to, at least, consider ensuring a market for the seeds.

D. **Wetland restoration and rehabilitation**

- It is ideal around agro-pastoral, and pastoral areas, around river basin, which pastoralists use as dry season grazing.
- Community participation is fundamental
- The measure can be implemented as an independent stand alone project.

E. **Establishment of fodder trees and grass nursery sites**

- This measure is needed in all parts of the region as there are no such specific nursery sites for fodder or grass. Relative importance of location may be given where an irrigation/ water source is available for the nursery site, and places accessible to demonstrate and distribute the seedlings to as many households as possible.
- Technical advice and follow up and an adequate financial resource is critical
- The measure is better organized as a project; but it has to consider market development for seedlings, accessing water/ irrigation and plantation sites at individual levels, as a pilot, capacitating private sector who are distributing seedlings.

Most of the adaptation measures are characterized by different risks that may compromise effective implementation of the measures. For example, risk of discontinuity of the initiatives, missing to get full buy-in by the community, potential conflicts of interest, shortage of rain, loosely defined by-law of individual's participation etc. can be mentioned.

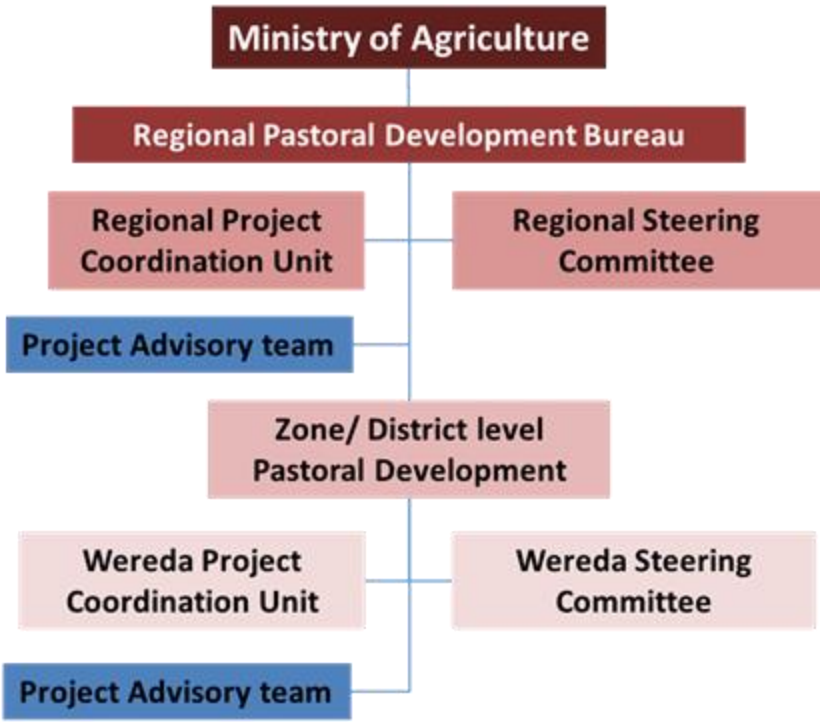


Figure 4: Implementation organizational structure

7.2 Project Implementation structure

The implementation process may follow the existing government structure, i.e. the federal and regional administrative structure (Figure 4). It respects the existing land use culture and system that is dominantly held and administered by the knowledge and direction of the social clan leaders. Moreover, project implementation cannot be operated without a strong

ownership and participation of the communities. The capacity of the government structure is rather weak particularly at the lower level of the administrative structure. Ownership of projects is not automatic, except where the local people are convinced to own and handle it. In this case, a strong advisory team can be established with independent decision making power on vital steps in the project implementation, such as procurement and purchase of vital assets, monitoring and evaluation, etc. The financing body (e.g. KfW) may use the advisory team as influential part for implementing the project. In this case, the linkage with the public body would better be established with key mid-level experts rather than higher level executives, as it may contribute to delays in critical decision making stages. Considering the existing government structure, with just financial support from a third party is known to have challenging bureaucracy processes that contribute to delays in project implementation, and compromise in time, cost and communication management aspects.

Project based implementation is ideal, while it is equally important to ensure participation of the beneficiary communities in operations and maintenance of the activities. Such an alternative modality is to organize the activities, and outsource its implementation to a third party body; given the body has organized staff and institutional capacity to be able to implement the project as planned, with its independent room for flexibility. The later, however, needs to have strong scaling–up and exit strategies to ensure sustainability of the project.

Considering the first option, i.e., where financial support is given by the financing body, and leaving implementation to the government system, it requires substantial capacity development of the implementing offices' staff knowledge and skill, financial administration, etc. More importantly, it requires capacitating the staff operating at Woredas and Kebele level, i.e., the development agents who conduct the day to day activities and capacitating the community at large. It would also be ideal if it assumes having project based staff at different critical levels. At the last, it should have a feasible exit strategy that can transfer responsibilities of all vital activities to be distributed to the government offices to cover running costs and the community to handle other activities, with enforcing accountability instruments. The capacity is key after the closure of the project; thus an exit strategy needs to be prepared carefully (See Annex 6 for specific advantage and disadvantages of the two options).

Capacity development:

- It shall consider the attitudinal and commitment of the implementing officials and staff at all levels, including the Kebele level
- The roles of each needs to be defined, and enforceable governance be institutionalized
- Exit strategy
- Private sector service providers need to be developed. Alternatively an existing private sector service provider (if available) could be capacitated.
- Business model and engagement of private sector may better handle and continue after project closure, where such private sector may require capacity development

- Ensure the activities linked with short term benefits or impact onto the livelihood of the community
- Project staff be employed at all level to enforce proper implementation of the project
- The investment and operating costs be disaggregated by components, and annually
- Project shall consider 30 years, but phase based projecting be done every five years.
- The components to be organized could optionally be the following each measure.
    1. Improved forage storage and treatment
    2. Management of protected environmental areas and pasture improvement initiatives
    3. Establishment of communal seed banks
    4. Wet-land restoration
    5. Fodder tree and grass nursery sites

Following the same approach of financial support system of project implementation, the operating budget can be managed by the consulting or advisory team in collaboration with Woreda level respective public office. The advisory team/ consultant team is supposed to be institutionalized at all levels, which can help facilitate implementation, procurement, advise technically and fund management. Project coordinator at federal level is a decision maker, instead of leaving it to the hands of busy officials. A working group/ steering committee is required at region level involving the clan leaders at the main communities, regional presidents, and respective bureau heads.

Analysis of the executing entity, their experience and capacities:
It is necessary to include the existing Ministry of Agriculture, Bureau of Pastoralists development of the regions, and the departments and offices at federal, region, zone, Woredas and Kebele level structures. More importantly, the Kebele level community clan leaders need to be consulted since the very beginning and the major share of ownership needs to be communicated to ensure their buy-in. Moreover, any such new project planned to be introduced in the regions would be communicated to the regional president, officially, as the political system can also be used to enforce implementing individuals be responsible and accountable for any gaps in the implementation process.

For an effective implementation of project activities, the initiative shall consider:

- Ensure synergy with other projects
- Prepare a monitoring and evaluation plan with strict and enforceable monitoring and evaluation system
- Ensure the presence of capacity of experts or development agents, particularly at Kebele level and Woredas level who handle the day-to-day operations, which is known to have big gap at these levels
- Ensure presence of minimum incentive to involving experts at all levels.

Moreover, the initiative needs to ensure the continuation of the implementation of the initiatives, and the mechanism of scaling-up of the lessons onto the larger regions, with specific roles of partnering parties, particularly the government and the local community.

7.3 Budget Summary

Table 6: An indicative budget to implement the project (Please see the detailed description in Annex 2 below)

	List of Adaptation measure	Life time, years	Unit	Planned Quantity	Estimate budget based on local experience					
					Unit Cost in '000 ETB[65]	160% of the unit cost in '000 ETB[66]	Total establishment cost for planned quantity, '000 ETB	Implementation phase (1st 5 years') budget[67] for planned quantity	Project life Budget[68] for planned quantity	Reference budget of the Vulnerability study[69] for planned quantity
1	Improved forage storage and treatment (planned for Afar)	20	No/ trench	2	6,000	9,600	19,200	USD 669,766	USD 1,339,534	USD 874,880
2	Management of protected areas; (planned in Afar)	10	ha	1000	3.41	5,456	5,456	USD 190,325	USD 253,767	USD 907,986
3	Establishment of Community Seed Banks (planned in Afar and Somali regions)[70]	30	ha	50*12 =600[71]	75	120	72,000	USD 8,372,093 for seed production in each region; (Plus additional USD 969,000 [72]for seed-construction)	USD 50,232,558 for each region; (Plus USD 969,000 for each region)	USD 969,000 for 50 community seed-banks for each Afar and Somali, without considering the cost of producing the seeds.
4	Wetland restoration and rehabilitation (planned in Somali)	30	ha	150	80	128	19,200	USD 513,488	USD 848,372	USD 834,750
5	Establishment of fodder	30	No/	25[73]	1,500	2,400	60,000	USD 2,093,023	USD5,831,375	USD 3,007,000 for 31 years for

[65] The estimates are obtained from Mr Abdraham, Regional Pastoral Livelihoods Resilience Project (RPLRP) in Afar Regional State and M&E officer of Drought Resilience and Sustainable Livelihood Program (DRSLP) in Somali Regional State, where the estimates are based on their project implementation budgets for the corresponding measures.

[66] About inflation of 60% is considered associated to devaluation of Birr from 27.4 to 43.3/1 USD in the last 3 years; then the unit cost estimated to be 160% of the initial establishment cost.

[67] This includes the budget for capacity building and/or management cost for each year, taking 10% of the initial establishment cost. However, this is not considered for Establishment of community seed as seed production is an annual activity, and only 3% is considered for Wetland restoration as majority of the maintenance is done through community participation.

[68]This includes the budget for capacity building and/or management cost for each year, taking 10% of the initial establishment cost. However, this is not considered for Establishment of community seed as seed production is an annual activity, and only 3% is considered for Wetland restoration as majority of the maintenance is done through community participation..

[69] Waldschmidt, F, Behre, E, Daou, D, Rojas, A, Arce Mojica, T, Koirala, P, Sebesvari, Z, Kreft, S, Souvignet, M. (2021). *Vulnerability Report – Ethiopia – Drought Risk*. Report 03. Bonn/Frankfurt. United Nations University Institute for Environment and Human Security /Frankfurt School of Finance and Management

[70] Management cost not considered as the operations are to be managed by the communities

[71] A seed bank requires 12 ha of grass/fodder land, and 50 seed banks are planned to be developed in each Afar and Somali region.

[72] The costs of the seed bank considered the estimate of the Vulnerability study.

	trees and grass nursery (Planned in Somali)		site						for 30 years	100 ha

With 10% management and capacity development budget and consideration of 60% rise in prices since the past three years, expected costs for the coming years is assumed to rise by 60%, in general.

Accordingly, the local estimates for the first five years budget for Afar, considering the three most important measures, respectively for improved forage storage and treatment, Management of protected environmental areas, Establishment of communal seed banks are respectively USD 334,883, USD 190,325, USD 8,372,093, adding USD 969,000 for construction of the facility. And, the local level estimate for the long period budget, respectively are, USD 669,767/trench, USD 253,767, and USD 50,232,558, adding also USD 969,000 for construction.

For Somali, the local level estimate for the first five years period, respectively for Establishment of communal seed banks, Wetland restoration and rehabilitation and Establishment of fodder trees and grass nursery are USD 8,372,093, adding USD 969,000 for construction of the facility; USD 669,767, and USD 83,721. And, the local level estimate for long period budget, respectively are USD 50,232,558; adding also USD 969,000 for construction; USD 1,786,046 and USD 223,255.

However, these estimates are compared with the exhaustive global level estimates that are done in the Vulnerability study in the regions by using global level standard estimates as reference, and a suggestion can be made to take the larger budget estimate for better confidence. (See the comparison and justifications in Annex 2)

[73] A local nursery site assumed to have about 4ha area

8. Conclusion and recomendations

Among the many options of adaptation measures the more important ones are identified and evaluated with a long list of criteria. The feasibility of these measures are assessed with respect to the general regional contexts, their technical aspects, the social, environmental and economic aspects. Moreover, institutional and policy level aspects, local level capacities of government offices, and implementation modality are described. Moreover, an indicative budget is estimated for each project based specification of the measures for the first phase five years project period and for their possible long term period estimates.

The most important intervention for improving livestock sector development is ensuring the sustainable supply of livestock feed, i.e., forage development and water service, among others. Climate change, particularly the frequent drought risk has been affecting the sustainable supply of livestock feed resource due to degradation of the forage land. Hence drought risk adaptation measures are found to be important measures of intervention to secure the livelihood of the people in Afar and Somali regions reducing the risks.
This pre-feasibility study therefore examines forage development and storage, forage seed production and its community based see banks, nursery establishment for the fodder and forage seeds, management of protected areas and wetland management and restoration as identified during an iterative process and a quantitative analysis as outlined in the preceding Vulnerability Report[74], which are all related to the sustainable development of livestock feed resource development.

The assessment found that each of the considered adaptation measures needs to consider vital complementary components to address the risks and bring expected impacts on the livelihood of the people. Moreover, the assessment found that the government offices have limitations of handling the implementation of the activities, and external third party technical and advisory support service is required in addition to financial support.

[74] Waldschmidt, F, Behre, E, Daou, D, Rojas, A, Arce Mojica, T, Koirala, P, Sebesvari, Z, Kreft, S, Souvignet, M. (2021). *Vulnerability Report – Ethiopia – Drought Risk*. Report 03. Bonn/ Frankfurt. United Nations University Institute for Environment and Human Security/ Frankfurt School of Finance and Management

Annexes

Annex 1: Previous and current ongoing projects related to climate change impacts adaption in the Afar and Somali regions

Project name	Financed by	Project start date	Project end date	Project cost '00 US$	Thematic scope	Target areas
Drought Resilience and Sustainable Livelihood Programme (DRSLP I)	AfDB soft loan	Oct, 2013	Sept 2018	46.5m US$		15 Woredas (6 in Afar region and 9 in Somali region)
Strengthening the drought resilience of the pastoral and agro-pastoral population in the Afar Region (SDR)	KfW	Jan, 2015	Dec, 2018	13.5m EUR	Conservation and more productive use of existing soil resources or grazing land to enable the population to sustainably manage their natural resources even under changing climate conditions	4 Woredas (3 Afar region and 1 in Somali Region)
Regional Pastoral Livelihoods Resilience Project (RPLRP)	World Bank Soft loan	Jan, 2015	Dec, 2019 (Extended)	75 m US$		21 Woredas (6 Woredas in Oromia region, 6 Woredas in Somali region, 4 Woredas in SNNP region and 5 Woredas in Afar region)
Drought Resilience and Sustainable Livelihoods Programme (*DRSLP*) -. Italian Agency for Development Cooperation (AICS)	AICS Soft loan	Jan, 2015	Mid of 2016 (Extended)	12 m EUR		4 Woredas (in Afar region)
Preservation of soil and water resources to improve drought resilience and food security in the arid and semi-arid regions of Eastern Ethiopia	KfW			10 m EUR	Promote conservation and more productive use of existing water and soil resources and the development of new ones in order to enable the population to manage their natural resources sustainably even under changing climatic conditions and thus to improve their food situation in the long term	

Strengthening the drought resilience of the pastoral and agro-pastoral population (SDR II)	KfW			15.0m EUR	Strengthening Drought Resilience	
IGAD Ethiopia	KfW			13.0m EUR	Regional Fund to strengthen drought resilience in the Horn of Africa (Ethiopia)	
Capacity development for strengthening the drought resilience of the pastoral and agro-pastoral population in the lowlands of Ethiopia	GIZ	2013 - 2018		N/A	Pastoralists and agro-pastoralists – nomadic and semi-nomadic groups that live from livestock with some arable farming – have more reliable access to natural resources, including water, land and pastures, and can make more intensive use of them.	
Capacity development for strengthening the drought resilience of the pastoral and agro-pastoral population in the lowlands of Ethiopia	GIZ	2015 - 2018		N/A	Institutional actors are able to use new and improved management, cooperation and networking instruments to enhance drought resilience in Afar and Somali Regional States	
Capacity development for strengthening the drought resilience of the pastoral and agro-pastoral population in the lowlands of Ethiopia	GIZ	2019 - 2022		N/A	State and non-state actors together with pastoral and agropastoral communities, have created the conceptual foundations for the rehabilitation and use of dry valleys.	
Pastoralist Areas Resilience Improvement through Market Expansion (PRIME)	USAID	October 2012- September 2017		62m US$	PRIME (Pastoralist Areas Resilience Improvement through Market Expansion) is a five-year project led by Mercy Corps Ethiopia in partnership with international and local organizations. Funded by the United States Agency for International Development (USAID), PRIME focuses on selected districts of Ethiopia's Afar, Oromia and Somali regions.	
Participatory Small-scale Irrigation Development Programme II	IFAD	2016 - 2024		114.5m US$ (IFAD) + 18.72m US$ (national	reduce the impact of climate change, enhance economic growth and reduce rural poverty	

				Governm ent) + 12.07m US$ (beneficia ries)		
Lowlands Livelihood Resilience Project (LLRP)	World Bank	05.2019 – 10.2025		451m US$	The development objective of Lowlands Livelihood Resilience Project is to Improve Livelihood Resilience of Pastoral and AgroPastoral Communities in Ethiopia. Four components. 1) Integrated Rangeland Development and Management; 2) Livelihood Improvement and Diversification; 3) Improving Basic Services and Capacity Building; 4) Project Management, Monitoring, and Evaluation	
RI-Regional Pastoral Livelihoods Resilience Project	World Bank	03.2014 – 03.2012		122m US$	Enhance livelihood resilience of pastoral and agro-pastoral communities in cross-border drought prone areas of selected countries and improve the capacity of the selected countries' governments to respond promptly and effectively to an eligible crisis or emergency. Five components: 1) natural resource management; 2) market access & trade; 3) livelihood support; 4) pastoral risk management; 5) project management & institutional support	
Ethiopia Resilient Landscapes and Livelihoods Project	World Bank	08.2018 – 07.2024		129m US$	To improve climate resilience, land productivity and carbon storage, and increase access to diversified livelihood activities in selected rural watersheds. Four components: (1) Green infrastructure and resilient livelihoods; (2) Investing in institutions and information for resilience; (3) Rural land administration and use; (4) Project management and reporting	
The R4 Rural Resilience Initiative	WFP and Oxfam America (+ for	2009 – N/A		2.4m US$	Covering Tigray and Amhara regions in Ethiopia The goal is to enable vulnerable rural households to increase their food and income security in the face of increasing climate risks through improved natural	

	Ethiopia: KfW, Swiss Re, Margaret A. Cargill Foundation, Norway)				resource management through asset creation or improved agricultural practices (risk reduction), micro insurance(risk transfer),increased investment, livelihoods diversification and microcredit(prudent risk taking) and savings (risk reserves.	
Strengthening Drought Resilience in the Somali Region	SDC	02.2014 – 03.2020		6m CHF	Target communities and responsible institutions in target districts (Woredas) of the Somali Region implement drought resilience measures addressing the concerns of pastoralists and agro-pastoralists.	
Strengthening Drought Resilience of the Pastoral and Agro-pastoral Populations in the Lowlands of Ethiopia (Somali Region)	SDC	05.2022 – 12.2026		7m CHF	N/A	

Annex 2: Description of the indicative budget to implement the project

№	Adaptation measure	Life time, years	Unit	Planned Quantity	Estimate budget based on local experience					Reference budget of the Vulnerability study[75]	Remark
					Establishment cost per Unit '000 ETB	160%[76] of unit Establishment cost '000 ETB	establishment cost for planned quantity, '000 ETB	Short phase (1st 5 years') budget[77] for planned quantity	Project life Budget[78] for planned quantity	Project life Budget for planned quantity	
1	Improved forage storage and treatment (two trenches Planned in Afar)	20	No/ trench	2	6,000.00	9,600	19200	19,200,000+19,200,000*0.1*5 years =Birr 28,800,000 or =USD 669,766	19,200,000+19,200,000*0.1*20 years =Birr 57, 600,000 or =USD[79] 1,339,534	USD 874,880	-464,654 (for two trenches); The difference is associated to a larger size of the local trench silos.
2	Management of protected areas; (1,000ha planned in Afar)	10	ha	1,000	3.41	5.456	5456	5,456,000+5,456,000*0.1*5 =Birr 8,184,000 or =USD 190,325	5,456,000+5,456,000*0.1*10 years =Birr 10,912,000 =USD 253,767	USD 907,986	654,218; The reason may be due to the local estimates that are underestimated.
3	Establishment of Community Seed Banks (50 seed banks plan for each Afar and Somali regions)[80]	30	ha	50*12= 600[81]	75.[82]	120	120*12*50 =72,000	72 million*5 =Birr360 million or =USD 8,372,093 for seed production in each region; (Plus additional USD 969,000 [83]for seed-bank construction for	72 million*30 =Birr 2,160 million or =USD 50,232,558 for seed production in each region; (Plus additional USD 969,000 for	USD 969,000 for 50 community seed-banks for each Afar and Somali, without considering the cost of producing the seeds.	The local estimate of about USD 50,232,558 is to produce the seeds that can be stored in the 50 seed-banks in each region.[84]

[75] Waldschmidt, F, Behre, E, Daou, D, Rojas, A, Arce Mojica, T, Koirala, P, Sebesvari, Z, Kreft, S, Souvignet, M. (2021). *Vulnerability Report – Ethiopia – Drought Risk*. Report 03. Bonn/Frankfurt. United Nations University Institute for Environment and Human Security /Frankfurt School of Finance and Management

[76] About inflation of 60% is considered associated to devaluation of Birr from 27.4 to 43.3/1 USD in the last 3 years; then the unit cost estimated to be 160% of the initial establishment cost.

[77] This includes the budget for capacity building and/or management cost for each year, taking 10% of the initial establishment cost. However, this is not considered for Establishment of community seed as seed production is an annual activity, and it is only 3% is considered for Wetland restoration as majority of the maintenance is done through community participation

[78] ibid

[79] The USD- Birr exchange rate is considered to be 1:43 that has been around June 2021.

[80] Management cost not considered as the operations are to be managed by the communities

[81] A seed bank requires 12 ha of grass/fodder land, and 50 seed banks are planned to be developed in each Afar and Somali region.

[82] This is annual per ha farming cost of producing forage seed

[83] The costs of the seed bank considered the estimate of the Vulnerability study.

[84] This cost of seed production is indeed very much less than the market value of the seeds, i.e., at local market that is priced about USD 9-23/kg.

								each region)	seed-bank construction in each region)		
4	Wetland restoration and rehabilitation[85] (150ha plan in Somali region)	30	Ha	150	80	128	19,200	19,200,000+19,200,000*0.03*5 years =Birr 22,080,000 =USD 513,488	19,200,000+0.03*19,200,000*30 years =Birr 36,480,000 =USD 848,372	USD 834,750	- 13,622 This slight difference may be for the local estimate considered much for maintenance /management
5	Establishment of fodder trees and grass nursery[86] (100 sites)	30	Number/ site	25[87]	1,500	2,400	60,000	60,000,000+ 0.1*60,000,000*5 =Birr 90 million or =USD 2,093,023	60,000,000+60,000,000*0.1*30 =Birr 240 million or =USD 5,581,375	USD 3,007,000 for 31 years for 100ha	The local nursery site holds about 4 ha where per ha cost for 30 years is about USD 55,814, while the estimate per ha with the Vulnerability study is about USD 29,100 per ha for 30 years.

[85] The annual maintenance/management cost is assumed to be 3% of establishment cost, as much of it is assumed to be done by the community

[86] A local nursery site assumed to have about 4ha area

[87] A local nursery site assumed to have about 4ha area

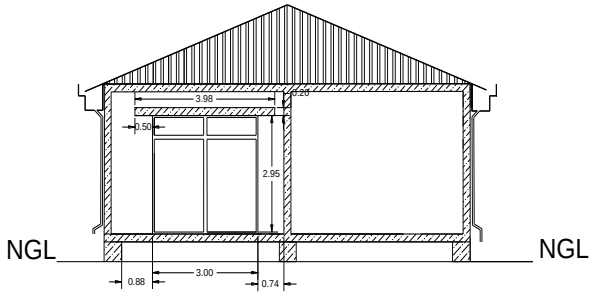
Annex 3: Key individuals and their respective organization consulted during the ECA prefeasibility study

Name	Respective organization	Specific areas of discussion
Ato Yosef Assefa	MoA, National Program Coordinator for SDR project	General discussion on the project's successes, challenges encountered during implementation
Ato Jemal Aliye Gendo	MoA Livestock Resource Directorate. National Program Coordinator for DRSLP	General discussion on the project's successes, challenges encountered during implementation
Ato Tesfaye Chekol	KfW Programme Officer	General discussion on the project's successes, challenges encountered during implementation
Dr Kenea Feyisa, Ato Samuel and Ato Dagne	RPLRP/LLRP, Ministry of Peace	General discussion on the LLRP project development and scope of the project and defined intervention Woredas
Mohammed Andoshe	EFCCC CRGE Director	General discussion on the development and implementation of CRGE strategy
Chris Annen	GITEC Chief Technical Advisor for SDR project	The overall project implementation progress of the SDR.
Mohammed Mussa	Afar National Regional State Bureau of Pastoral Agriculture and Rural Development NRM Director	The overall environmental conservation endeavors and challenges in the Afar region
Gizaw Demisse	Afar National Regional State Bureau of Pastoral Agriculture and Rural Development Livestock development department head	The overall livestock development and rangeland management endeavors in the region and critical areas of intervention
Abudrahman	Afar Pastoral and Agro pastoral Research Institute (APARI)	The overall crop and forage seedling development and past experiences.
Mohammed	Somali Pastoral Agriculture and Rural Development Bureau Livestock Development Director	The overall livestock development and rangeland management endeavors in the region and critical areas of intervention
Hussen Farah	Somali Environment, Forest and Climate Change Bureau	The overall environmental conservation endeavors, protected areas and wetland management and challenges in the Somali region
Abdinasir Abdikadir, Abdihakim and Yesut	Somali Pastoral and Agro pastoral Research Institute (SoPARI)	The overall research practices in forage seedling development, rangeland and forestry researches, management of invasive species and research on soil and water conservation endeavors
Wendessen Guliat (0911861904)	MOA/ GOPA Worldwide Consultants	Experience about their project
Amsalu (0975350190)	GITEC Consult GmbH	Experience about their project

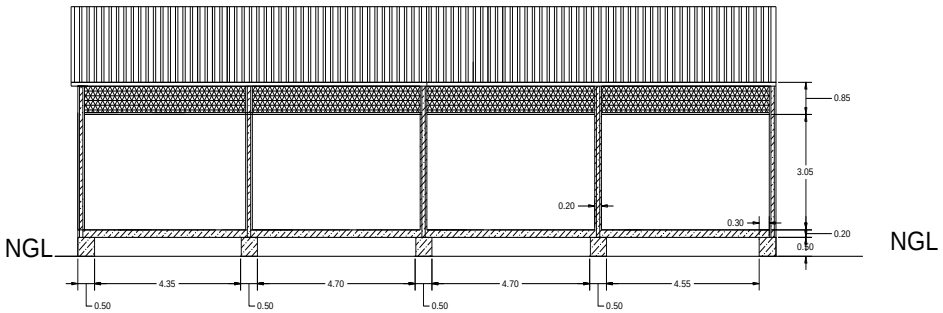
Annex 4: Site selection criteria for forage storage development

Adaptation measure	Criteria		
Improve forage storage and treatment	Forage production	Agro-ecology/moisture	Accessibility
Management of protected environmental areas	Anthropogenic threat/Degraded lands	State of biodiversity	Accessibility
Establishment of communal seed banks	Agro-ecology/moisture	Preferred/available plant species	Accessibility
Wetland restoration and rehabilitation	Hydrology	State of biodiversity	Accessibility
Establishment of fodder tree and grass nursery sites	Agro-ecology/moisture	Preferred/available plant species	Accessibility

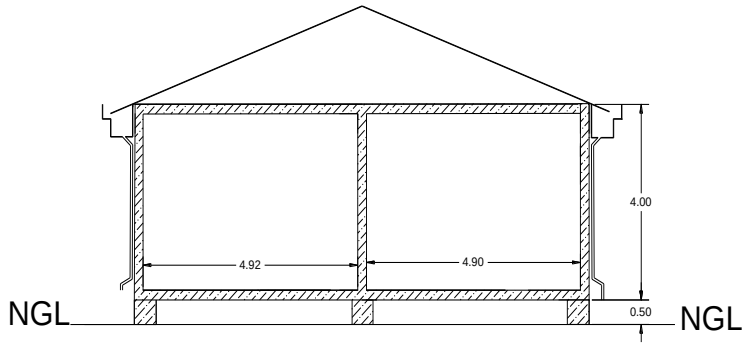
Annex 5: Hay store design and bill of quantity[88]



FRONT SIDE VIEW

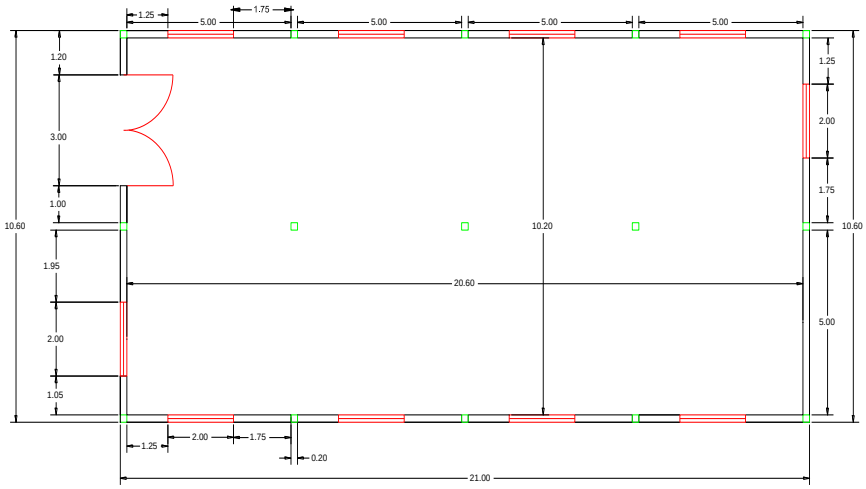


RIGHT AND LEFT SIDE VIEW

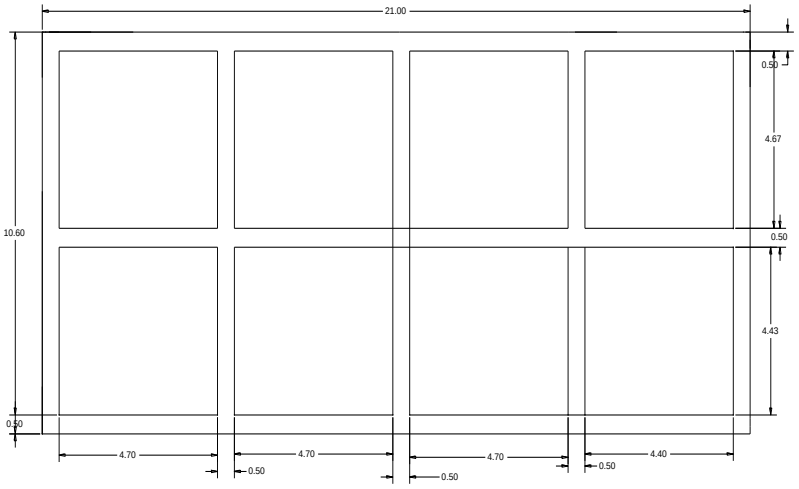


REAR SIDE VIEW

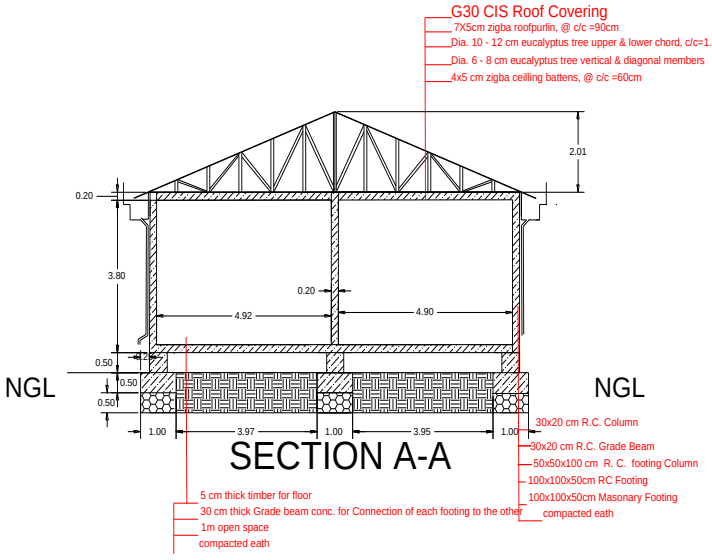
[88] The Source for the Hay store design and its description of work quantity presented below is the typical one considered by the RPLRP project in Afar and Somali



FLOUR PLAN



FOUNDATION PLAN



SECTION A-A

No.	Description of work	Unit	Qty
	A. SUBSTRUCTURE		
	1. Excavation and Earth Work		
1.1	Clear of the site to remove top soil to an average depth of 20cm	m^2	336.00
1.2	Excavation for footing natural ground level 1m	m^3	16.00
1.5	Cart away surplus excavated material and deposit at a distance of 1km from the site	m^3	147.00
1.6	25cm thick basaltic or equivalent stone hard core well rolled consolidated and blinded with crushed stone	m^2	16.00
	Total Carried to summary		
	2. MASONRY WORK		
2.2	25cm masonary footing at the bottom of the footing up to 50am below ground level	m^3	64.00
	Total Carried to summary		
	3. CONCRTE WORK		
3.1	50mm thick lean concrete in C-5 with minimum cement content of 150kg/m3 of concrete under grade beam	m^2	32.00
3.2	Reinforced concrete in class C25 with minimum cement content of 320kg/M3 filled in to form work and vibrated around reinforcement bar. From work & reinforcement bar measured separately		
	a) for footing, C-25	m3	16.00
	b) for footing column, C-25	m^3	0.68
	c) in RC grade beam, C-25	m^3	16.50
3.3	Provide and fix in position sawn zigba formwork to		
	a) for footing, C-25	m^2	60.00
	b) for footing column, C-25	m^2	5.40
	c) in RC grade beam, C-25	m^2	54.00
3.4	Reinforcement steel bars according to structural drawings, price includes cutting, bending &placing in position and tying wires		
	a) ϕ 8mm deformed bar	Kg	65.71
	b) ϕ 12mm deformed bar	Kg	432.32
	Total Carried to summary		
	b) Super structure		
	4. CONCRETE WORK		
4.2	Reinforced concrete in C20 with minimum cement content of 320kg/M3 filled in to form work and well vibrated around rod reinforcement. Form work & reinforcement bar measured separately		
	a) in elevation columns	m^3	2.56
	b) in middle beam	m^3	4.08
	c) in top tie beam	m^3	7.56
4.3	Provide, cut in size fix in position sawn zigba wood form work to:		

	a) elevation columns	m^2	51.20
	b) middle beam	m^2	92.00
	c) top tie beam	m^2	146.00
4.4	Reinforcement steel bars according to structural drawings, price includes cutting, bending &placing in position and tying wires		
	c) ϕ 6mm deformed bar	Kg	298.45
	d) ϕ 12mm deformed bar	Kg	932.72
	Carried to summary		
	5. BLOCK WORKS		
5.1	200mm thick HCB wall bedded in compo mortar 1:2:9	m^2	143.00
	Total Carried to summary		
	6. ROOFING		
6.1	G-30 galvanized CIS roofing fixed to 5x7cm zigba purloins at c/c 90cm and eucalyptus trusses members. Construction shall be according to drawing. Unit price shall include G-28 flat metal roof ridge cover and two coats of wood preservative paint to all zigba purlin and truss members.	m^2	120.00
6.2	Supply and fix G-28 galvanized sheet metal rectangular roof gutter of development length 600mm	ml	40.00
6.3	Supply and fix Ø110 pvc down pipe	ml	45.00
	Total Carried to summary		
	7. CARPENTRY AND JOINERY		
7.1	All structural members shall be well seasoned straight and free of any harmful defects. Each truss joint shall be connected with band iron and truss shall be firmly anchored to concrete top tie beam with ϕ6mm plain bars.		
	a) ϕ 10-12cm eucalyptus upper and lower chord	ml	417.60
	b) ϕ 8-10cm eucalyptus diagonal and vertical members	ml	720.00
	c) 5x7cm zigba purlin	ml	340.00
7.2	Supply and fix 25x250mm kerraro or equivalent facia board. Price include three coats of weather resistant paint.	ml	40.00
7.4	woodwork 5cm thick timber for slab of the hay sore	m^2	378.60
	Total Carried to summary		
	8. METAL WORK		
	Windows , Doors and mesh wire (NET) manufactured from 38x1.5mm LTZ profile with 4mm thick glass glazing and all as per the Engineers approval. Price includes one coat of antirust and two coats of synthetic enamel paint, door and window stopper, approved quality cylinder lock with handle, 4mm thick glass, and the necessary iron mongrey to complete the work.		
8.1	Steel door, externally cladded with 0.8mm finely CIS or 1.2mm flat iron		
	Type D9 Size 300x300cm	No	3.00
8.3	Steel Mesh wire (NET) schedule with security grill and embedded in column middle and top concrete beams		
	W2, size 5m*0.60m	No	12.00

8.4	windows size 1.50m*1.20	no	11.00
	Total Carried to summary		
	9. Plastering & pointing		
9.1	Apply two coats of compo mortar plaster of 1:2:9 to all internal wall	m^2	204.00
9.2	Apply three coats of plaster in cement sand mix 1:3 to all external concrete members		
	a. To grade beams	m^2	8.80
	b. To elevation columns	m^2	9.00
	c. To top tie beam	m^2	38.80
9.3	Apply cement mortar of 1:3 pointing to all external HCB and concrete element walls	m^2	204.00
	Total Carried to summary		
	10. PAVING & FLOORING		
10.2	3cm thick cement screed applied on floor finish, evenly spread and leveled with cement 1:3 mortars.	m^2	188.16
10.4	Roughly dressed stone pavement all around the building, bedded in and including 10cm sand bed or red ash, jointed cement in mortar 1:3 and pavement must have a minimum of 2% slope outward from building.	m^2	64.00
10.5	Half concrete ditch around the building with Quality concrete	ml	68.00
	Total Carried to summary		
	12. PAINTING		
12.1	Apply three coats of approved type plastic paint to internal plastered wall surface	m^2	408.00
12.2	Ditto as item 12.1 but to chip wood ceiling	m^2	376.32
	Total Carried to summary		
	13. Electrical Installation		
13.2	Light points fed through PVS conductor of 2x2.5 sq mm in thermoplastic conduit of ø 13.5 mm in / under surface, including caps and cover as well as flush mounted switches	Pcs	16.00
13.3	Flush mounted socket outlets of 16 Amp 1-ph fed through PVC conductor of 3x2.5 sq mm in thermoplastic conduit of ø 16 mm in/under surface including junction boxes, screw type insulating caps and cover	Pcs	16.00
13.4	Type of light fittings or equivalent		-
	a. Fluorescent Luminaries type Philips TMS 200/2.36D with 2XTL'D36W	Pcs	16.00
	b. Fluorescent Luminaries type Philips TMS 200/1.36C with 1XTL'D36W	Pcs	16.00

Annex 6: Specific advantage and disadvantages of the two options of implementing bodies

	Use the existing government structure with financial support	**Use of third party Independent Project based implementation model, i.e., contracting out the whole project implementation to a third party**
Advantages	• Better accepted approach by the public • Presence of adequate number of staff at all levels • Ownership of project automatic, after project completion	• Strong accountability system • Well capacitated staff • Smooth governance system
Disadvantages	• weak capacity of the government staff • complex bureaucracy • lengthy procurement procedure • Weak accountability system	• Weakness in linking with a responsible body to take-over for continuity of the project activities • Considered as secondary option by public body
Concerns	• A strong advisory team with independent decision making power on vital steps in the implementation, such as procurement, monitoring and evaluation • Link with the body at key expert level over a higher boss • A steering committee required at region level • Ownership and participation of the communities • Develop the capacity development of the implementing experts	• Needs to have strong scaling–up and exit strategy