THE ECONOMICS OF
LAND DEGRADATION

An assessment of grazing management practices in Puntland, Somalia

SCIENTIFIC INTERIM REPORT

Community-led grazing land management model for Dharoor valley

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Edited and coordinated by:
Mark Schauer (GIZ) and Hanna Albrecht (GIZ)

Authors:
Mohamud Hussein, Lindsay Stringer, Martin Dallimer and Kaafi Nidam Adam

Contributors:
Mohamed Issa and Liban Mohamed Farah

Visual concept:
MediaCompany, Bonn

Layout:
Additiv. Visuelle Kommunikation, Berlin

Photography:
Mohamud Hussein; Map in figure 1: bogdanserban - stock.adobe.com

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Executive summary

The overall objective of the study is to strengthen capacities of research and government institutions through training and mentoring on environmental valuation methods, so that the local decision makers are able to draw upon recommendations based on sound economic evidence. This is part of capacity building activities within the Regreening Africa project, jointly implemented by ELD initiative and the World Agroforestry Centre (ICRAF) (2017-2020). The ELD Initiative, in partnership with Agribusiness Solutions Hub, conducted training on the economic valuation of terrestrial ecosystems and their services. Training was complemented with practical exercises in the form of in-country research case studies.

This case study assesses the effects of land degradation on livelihoods of pastoral communities in the Puntland region of Somalia. It first establishes the extent of land degradation and drivers of recent land use change and then quantifies the impact of these changes on community livelihoods by comparing two different scenarios as discussed below. In consultation with local stakeholders, including relevant public institutions, researchers and communities, the research team identified Karkaar site, near Iskushaban district, as a suitable study site. Although the site currently generates significant flows of the ecosystem services, mostly in the form of grazing, fodder, firewood and building material, these provisioning services are threatened by ongoing land degradation from gradual loss of land cover and resulting soil erosion. Reoccurring drought linked to climate change amplifies the effect of the anthropogenic land degradation. To slow the rate of land degradation, the regional state Ministry of Environment, Agriculture and Climate Change (MoEACC), in partnership with the local residents, introduced in 2017 a community-led grazing reserve management (CGRM) mitigation option. The management option restricts the use of the site by non-resident pastoralists for 45 days each year to allow recovery whilst also reseeding some of the original vegetation species which were either in decline or lost in the past decade. The study assesses the impact of this management option against the hypothetical scenario of what would have happened under the 'Business-As-Usual' (BAU) scenario of continued gradual land degradation from overgrazing, tree cutting and decline local grass specie.

The study adopts the ELD methodology, which is designed to guide users through the process of conducting scientifically sound cost-benefit analyses (CBA), based on the ELD 6+1 step approach (ELD Initiative, 2015). The research team first established locations, spatial scales and a strategic focus of the study, based on an extensive review of available literature and consultations with relevant government officials and local research community stakeholders. The development of social capital arose from the capacity building aspect of the research. Follow up field visits and further discussions with local communities living in the site was carried out. Research was then undertaken to establish the geographic and ecological boundaries of the selected study site, including close examination of the site during a visit and use of available area maps to assess the quantity, spatial distribution, and ecological characteristics of land cover types. This exercise allowed the research team to categorise the study site as a savannah type agro-ecological zone, with relatively abundant grassland, shrubs and tree cover.

Given the limited availability of relevant economic and environmental data and information in

Somalia, it was necessary to undertake two focus group discussions (FGDs) with the local community leaders, pastoralists, traders and site rangers in order to obtain the necessary data. FGD participants were selected in consultation with local community leaders and public officials. In addition, the research team undertook a consultation with local government officials and experts to help establish the links between the role of ecosystem services in the livelihoods of local communities living in each land cover area and in overall economic development in the study zone. By understanding these issues, the research team was able to identify and collect relevant data to estimate the economic value of key ecosystem services.

The analysis assesses the CGRM option against BAU under three discount rates (3.5%, 5% and 10%) in line with previous ELD studies (Dallimer et al. 2018), together with two different time horizons (10 and 46 years) corresponding to the 2030 Agenda for Sustainable Development and the Africa (Developmental) Agenda 2063 respectively. A third intermediate time horizon (20 years) is also used for sensitivity analysis to assess the effect of the discount rates on the Net Present Values (NPVs) of benefits under the different scenarios and time horizons. CBA shows that the BAU scenario will result in aggregate NPV of USD 3.6 million, based on discount rate of 3.5% applied over 46 years (to 2063). This amounts to NPV of USD 76,878 per household or annual NPV USD 1,537, equivalent to USD 0.70 per person per day. Based on the latest Somalia Poverty and Vulnerability Assessment (World Bank, 2019) we assumed that rural households comprise of six members.

BCR under 3.5%. discount rate and 46 years time horizon is 11. However, aggregate NPV declined to 3.1 million and 2.2 million when applied 5% and 10% discount rates respectively, whilst the corresponding BCRs increased

slightly to 11.5 and 12.48. The latter is because the higher discount rate have a greater impact on benefits (which are larger than costs), leading to relatively higher annual decline of the former.

The CGRM intervention option yields an aggregate NPV of 9.1 million at 3.5% discount rate and a 46-year time horizon; an improvement of 5.4 million (or 153%) compared to BAU. This in turn results in NPV of 194,802 per household or annual NPV of 3,896, equivalent to USD 1.78 per day per household member. Similarly, BCR increases to 27. On that basis, the CGRM option introduced in Karkaar site has created significant societal economic benefits. An important policy implication is that the community-led grazing reserve management may serve as a model for improving rangeland management in the region, considering that the current site is a relatively small part of Dharoor valley.

Overall, the analysis suggests that the flow of the ecosystem services from Karkaar site could have declined over time in the absence of the community management option. The CGRM option has reduced overgrazing and other unsustainable land use practices such as tree cutting, especially by limiting the use of the site to just 50 households. The favourable precipitation in the region has also reduced the pressures from migrating livestock herders from surrounding areas and helping the recovery and reinvigoration of the biodiversity of the site. However, it is likely that in drought seasons the site would have been accessed and utilized by a much large number of households outside the 45 days closure to non-resident herders because of there being relatively more abundant pasture and availability of a water source in the area. On that basis, it is advisable to expand the site to a larger area covering a significant part of the Dharoor valley to ensure that there is sufficient recovered pastureland that can be made available to a larger number of households especially in dry seasons.

We note that fodder production from the site is relatively small considering the favourable consecutive seasons that have just occurred. It is therefore advisable to promote fodder production in the area through, for example, the training of Dharoor valley and wider pastoral communities using the Karkaar site as a 'demonstration site'. This will ensure creation of a reserve that can reduce pressure to migrate in the dry season, hence reducing the pressure on prominent grazing areas.

A limitation of the study is that the analysis presented relied on limited qualitative data and quantitative data because of lack of official statistics in Somalia. We acknowledge that a more comprehensive study would require a greater number of FGDs and field surveys. However, the study fulfills its main objective of providing local official and researchers with an opportunity to undertake practical work under the guidance of international and national experts to consolidate learning acquired through classroom-based training.

Finally, further research building on this case study is necessary to both improve upon the data limitations identified and to explore ways of applying the CGRM option to other areas in the region and Somalia more generally.

Acronyms and abbreviations

BAU	Business-As-Usual
BCR	Benefit Cost Ratio
CBA	Cost-Benefit Analyses
CGRM	Community-led Grazing Reserve Management
ELD	Economics of Land Degradation
FAO	Food And Agriculture Organisation
FEWSNET	The Famine Early Warning Systems Network
FGD	Focus Group Discussions
GIS	Geographic Information System
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
ICRAF	World Agroforestry Centre
KIIs	Key Informant Interviews
MoEAC	Puntland Ministry of Environment, Agriculture and Climate Change
NPV	Net Present Value
SDGs	Sustainable Development Goals
UNCCD	United Nations Convention to Combat Desertification
USD	United States Dollar

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01 Introduction

Valuing ecosystem services is a new concept for researchers and policy makers in Somalia. However, recent accelerated environmental changes call for improved evidence to strengthen environmental policymaking. Over the past four decades, significant land degradation, driven by overgrazing and deforestation, has occurred alongside frequent droughts (UNEP, 2005). These environmental changes have resulted in loss of biodiversity and quality of rangelands, leading in turn to poor livestock conditions and productivity, malnutrition, famine and increased migration of pastoralists. Reoccurring droughts linked to climate change effects exacerbate the situation as the natural rate of recovery of rangelands is disrupted. Further, when rainfall occurs on degraded land with bare soil it causes significant soil erosion. The federal government of Somalia with support from the World Bank, EU and UNDP carried out a Drought Impact Assessment (DINA) for the 2016/2017 droughts, finding the North Eastern areas of Somalia (Puntland) suffered ecosystem damages and losses[1] totaling USD163.1 and USD166 million (Federal Government of Somalia, 2018). The damages and losses considered in the DINA report are related to vegetative biomass productivity and fodder availability, biodiversity, impact on soil resources and soil quality and household energy and fuel wood losses.

Arid and semi-arid Northern and Eastern areas of Somalia in particular suffer the highest level of land degradation. These areas are locations in which the livelihoods of the communities are directly dependent on the natural (land) resources, particularly for traditional pastoralism and agropastoral livelihoods. In many parts of these regions, degradation contributed to loss of vegetation, gully erosion, loss of topsoil, silting of surface water dams and spread of undesirable invasive plant species, especially *Prosopis Juliflora* (UNDP, 2016).

Alongside recurrent drought and flash floods linked to climate change effects, there are a number of other interlinked factors that contribute to land degradation. These include unsustainable tree cutting for charcoal production, overgrazing, growing conflicts over increasingly limited resources, unplanned rural settlements and changing migration patterns linked to greater access to mobile phones and vehicles, inadequate law enforcement, weakened customary laws governing land use practices, poverty, and limited technical and financial capacity of public institutions charged with the responsibility of managing natural resources. Therefore, there is an acute need for evidence on the extent of land degradation to support better environmental policymaking. This evidence is also required to guide ongoing and future international programmes supporting recovery and resilience building efforts in Somalia.

Recognizing the need to act, the government of Puntland State of Somalia established the Ministry of Environment, Agriculture and Climate Change in 2009. The Ministry, in partnership with international donors, have since formulated laws, policies and strategies to reduce the rate of land degradation. Furthermore, affected communities in Dhahar, Dharoor, Jariiban and parts of the Iyah zone have come up with

[1] Damage is defined as total or partial destruction of physical assets (e.g. number of heads of livestock, hectares of land, etc.), whilst losses are defined as changes in economic flows arising from impact of droughts (e.g. decline livestock and agricultural productivity).

mitigating practices on their own to protect and restore degraded local rangelands. These practices include managing seasonal grazing, banning charcoal production, protecting wildlife and abolishing private enclosures. Nevertheless, getting appropriate policy attention, as well as government prioritization and financing of rangeland ecosystem protection and restoration remains a major hurdle to dealing with land degradation (Aronson & Alexander, 2013; Nkonya, Mirzabaev, von Braun, 2016). This policy failure is in large part a result of a lack of information regarding the economic and ecological value of rangeland ecosystems. Therefore, it is of little surprise that this problem is not well understood or recognized in the relevant decision-making processes. The availability of data on the value of rangelands is critical for ensuring proper planning and realization of their economic potential (Mortimore, et al., 2009), especially in Somalia where agriculture and livestock contributes over 70% of GDP (World Bank/FAO, 2018).

In the current macroeconomic environment where improving security and reducing poverty are top of the political agenda, evidence on the value of the ecosystem services threatened by land degradation is critical for raising awareness with policymakers. Seventy percent of Somalis live below the poverty line ($1.90 per person per day) and face multiple household deprivations, including lack of access to food, water, health and sanitation, and education (World Bank, 2019). To address frequent humanitarian crises, many of the public investments and international programmes are oriented toward humanitarian and state rebuilding interventions (Federal Government of Somalia, 2020). In this context, it is important to generate evidence to increase the awareness of the ongoing rates of land degradation, by highlighting the costs of inaction to all stakeholders, such as pastoralist communities, traditional elders, local authorities, line ministries, private sector and concerned agencies and donors. With a greater appreciation of the problem all stakeholders can then understand their roles in sustainable management of land resources (ELD Intiative, 2015). Having ecosystem protection and rehabilitation at the top of the regional government's agenda, and supporting community-based action in the context of weak legal frameworks and enforcement capacity, will potentially ensure more sustainable food security (crop production), economic development, enhanced environmental quality, sustainable ecosystem services, reduced land degradation and climate change resilience. Importantly, conducting studies on costs and benefits of rangeland management practices is timely because it will inform the planning process of the new Five-Year Puntland Development Plan (2020 – 2025).

In this case study, we assess the cost and benefits of the land use management practices adopted in Dharoor valley Puntland to manage a 2,100ha site under a Community-led Grazing Reserve Management (CGRM) in partnership with the regional government. This approach was introduced in 2017 and it has since yielded encouraging improvements thanks to a sparse population as well as fewer migratory nomads due to exceptionally good rainfall in the area over the past two years. To understand the impact of the CGRM on land use and associated ecosystem service values we compare the CGRM against a hypothetical business as usual (BAU) scenario. The BAU considers the situation if the CGRM had not been implemented. Importantly, the BAU captures the typical situation regarding land use in the vast majority of rangelands in Somalia.

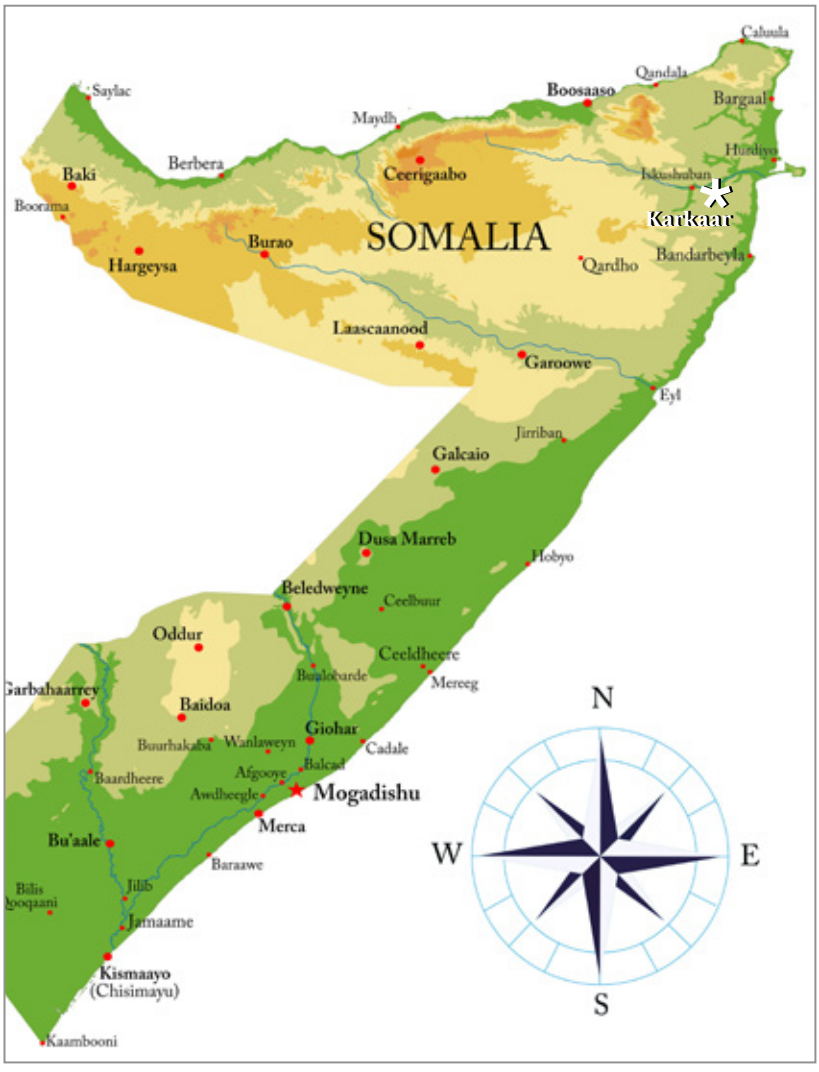
The primary objective of the case study was conducting training on the economic valuation of terrestrial ecosystems and their services. Training, participated in by local and regional state officials and researchers, was complemented by practical fieldwork-based exercises, intended to give trainees the opportunity to apply and consolidate the classroom-based capacity building provided by ELD experts and a national consultant. The work is part of the Regreening Africa project, jointly implemented by the World Agroforestry Centre (ICRAF), and ELD Initiative in eight African countries.

02 Study site identification

Dharoor valley, which extends 24,384 km2 and covers parts of Bari and Sanaag regions, has relatively abundant grazing terrains with significant provisioning ecosystem services, including forage and fodder, firewood and building material, that support the livelihoods of local pastoral and agropastoral communities. The climatic condition of Puntland is Arid and Semi-Arid with average annual rainfall ranging 100 – 200mm and having four distinct seasons (*Gu*', the main rainy season, April – June; *Xagaa*, windy and dry season, July – September; *Deyr*', short rainy season, October – December; and *Jilaal*, cold and dry season, January – March). *Jilaal* and *Xagaa* are the normal migration seasons in which nomadic pastoralists move their livestock around in search of water and pasture, usually in the coastal areas around villages and semi-urban settlements with permanent water points. Iskushuban, Ufeyn and Meeladeen are three main settlements in the Dharoor valley. The study site that was selected, Karkaar, is close to Iskushuban town, where local communities, in partnership with the Puntland State Ministry of Environment, have already successfully tested a seasonal grazing reserve management option; see Figure 1. Under this approach the reserve is only opened in the dry season to allow vegetation recovery and reduce further land degradation.

FIGURE 1

Iskushuban location



the Somali customary law, some of which still persist. These covenants stipulate that land and any other natural resources on it are common assets of the resident clan or the primary familial lineage that permanently lives on it (PDRC, 2003). However, pasture is free for all pastoralists to access in time of need, irrespective of their clan affiliation. The rest of the covenants govern behaviour of land users, in terms of rights of seasonal migrant pastoralists and hosts. Clan elders are responsible for enforcement of the customary rules and can impose fines or other forms of sanctions for breaches. Elders have authority because they are delegates and representatives of their clans and are accountable to them (Bradbury and Healy, 2010). They are selected for attributes such as age, wisdom, knowledge of customary law, powers of oratory and wealth.

The primary source of income and nutrition for the local community is livestock, including camel, goat, sheep and cattle. In addition to production of milk, butter, ghee and meat for household food consumption, pastoralists market the livestock, skin and hide to generate cash. They may also sell excess milk and milk derivatives in favourable grazing seasons. Other than grazing, the land is used for settlement (urban and semi-urban), frankincense and small-scale seasonal farming. Some of the excess local output is exported through Bosaso port (FEWS-NET - Somalia, 2009).

The main ecosystem services from the Karkaar site are pasture and fodder for livestock and wildlife, fuelwood in form of firewood and charcoal, frankincense, wild fruits and honey, cultural identity of pastoralist communities and their attachment to place, natural reservoirs storing rainwater for communities, traditional herbal medicines, material for craft and building and wildlife. We limit analysis to four main ecosystem services for which data have been obtained: grazing, charcoal, building and fencing materials because of the training and capacity focus of the study and also a lack of suitable statistical data on other ecosystem service values in Somalia. The main direct beneficiaries of flows of these ecosystem services are 50 pastoral households who live within the site in most parts of the year. Other unquantified numbers of households however can use the site for pasture during livestock migration seasons.

03 Methodology

The study values ecosystem services from Karkaar rangeland focusing on the direct benefits from rangeland ecosystems in a single site and using the ELD 6+1 steps methodology– an approach used to assess the economic value of land management practices as discussed above (ELD Initiative, 2015). The research team first established the scope, locations, spatial scale, and strategic focus of the study, based on a literature review, stakeholder consultations and a field visit. A follow up field visit and Focus Group Discussions (FGDs) with local communities, traders and experts were then carried out to establish the geographic and ecological boundaries of the study sites between 31st May and 12th June, 2020. In each location, two FGDs with an average of seven participants were held. FGD participants were selected in consultion with local community leaders and administrative authorities. They included pastoralists, elders, officials and rangers. The discussions were guided by a number of questions designed to elicit relevant inforrmation on benefits derived from the ecosystems and associated private costs (see Appendix 1: Focus group and KII questionnaires).

Furthermore, eight additional Key Informant Interviews (KIIs) were held with experts such as local environmentalists, and traders in order to get estimates of costings of economic activities and benefits derived from ecosystems services. It is worth noting that the scope of the study provided trainees with practical experience of valuation methods, considering limited time and resources available to the project.

FGDs also helped to establish the ecological characteristics of land cover types that allowed us to categorise the area as savannah-type rangeland with mix of grass, shrub and trees, as is common in the region. FGDs with the local community leaders, livestock and crop producers, and rangers, as well as consultation with local government officials and experts, were critical to establish the links between the role of ecosystem services in the livelihoods of local communities living in each land cover area and in overall economic development in the study zone. This allowed identification of assumptions and for scenarios of land degradation to be developed. In addition, market and administrative data on prices for crop and livestock input and output, and relevant environmental taxes and fines respectively were collected through focus group discussions with the local producers, trades, officials and environmental specialists.

The main benefits covered include grazing, charcoal, firewood and building material. With regard to grazing, the 50 households living on the site do not only use it for pasture but can also produce and sell fodder harvested in favourable seasons. They consume part of their milk and meat output, and sell the remainder to local communities in surrounding settlements of Iskushuban, Ufeyn and Meeladeen. In good seasons, they also sell some of their livestock to generate cash.

04

Data

In the analysis presented, we measure livestock products as an output and household animal husbandry inputs such as labour, veterinary bills, and fodder and feed purchase. Costs associated with the reserve establishment and maintenance are related to community mobilization and awareness raising campaigns, and protection of the reserve area during closure. Field activities were undertaken to identify and collect data on the different cost and benefits as summarized in Table 1.[2]

Qualitative data on historic and future environmental changes and their impact on livelihoods were used to develop assumptions for the scenarios, whilst the quantitative data were used for the calculation of the associated costs and benefits. The FAO data on livestock conversion factors for pastoral systems has been used to calculated the carrying capacity of the site. Value of livestock production and consumption was estimated based on average household consumption and offtakes, as informed by the

TABLE 1

Expected Benefits and Costs of Ecosystem services - provisioning services

Evaluation		BAU	Reserves
Benefits	1. Charcoal production	✓	
	2. Firewood production	✓	✓
	3. Building materials (poles)	✓	
	4. Building materials (weaving grasses)	✓	
	5. Livestock fencing (camels, sheep and goats)	✓	✓
Costs	1. Labor for delivery of products from sites	✓	✓
	2. Labor (guards)		✓
	3. Labor (mobilisers)		✓
	4. Transport (purchase and maintenance of vehicle)		✓
	5. Transport (purchase and maintenance of horses)		✓
	6. Transport cost for delivery of goods from sites	✓	✓
	7. Taxes		✓

[2] *The data obtained from the fieldwork and secondary sources were transferred into Excel and used for the cost benefit analysis of the two scenarios (see excel file attached)*

FIGURE 2

Annual benefits and costs, 2017 (USD)

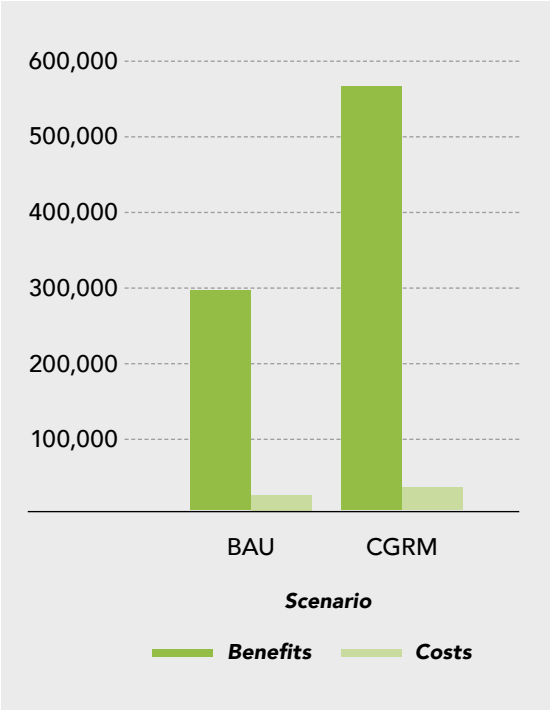
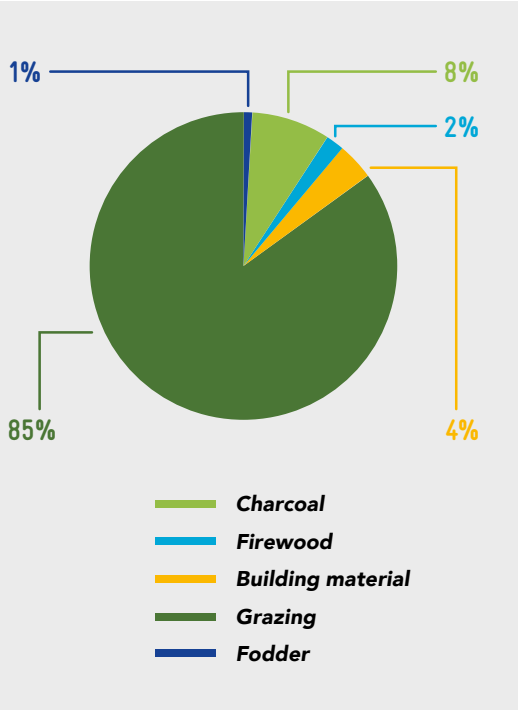


FIGURE 3

Benefits breakdown, 2017 (%)



FGDs, and market prices. Charcoal and firewood values were estimated using market prices.

Figures 2 and 3 provide an overview of the benefits and costs, and breakdown of the benefits in 2017. Grazing accounts for 85% of the total benefits, following charcoal (8%) and building material (4%).

05

Cost Benefit Analysis

Cost benefit analysis (CBA) is a widely accepted economic technique that provides a framework for assessing effects of practices aimed at protecting rangelands, slowing degradation processes or restoring the land to a former state of productivity (Macleod & Johnstone, 1990). For this study, the costs and benefits for the two scenarios considered were compared in order to identify the most economically viable land use option, in terms of aggreggate net present value (NPV), Benefit Cost Ratio (BCRs) and annual NPV acruing to households per annum and to each household member per day. Based on the latest Somalia High Frequency Survey, we assumed that each rural household comprises of 6 members (World Bank, 2019). For consistency, the study used 2,100 ha in each scenario, 50 nomadic households within each scenario, with each nomadic household each owning 10 camels and 100 shoats over the entire time horizon considered. More details on the methology are provided in the Appendices.

The study compares two scenarios: a business as usual (BAU) open access grazing scenario and the CGRM. The BAU is hypothetical scenario representing of what would have happened in the absence of the intervention implemented by the community-led seasonal grazing reserve adopted in the site. However, the BAU scenario is common throughout Somalia with no action taken by many local authorities and communities in several degrading rangelands, resulting in gradual losses of associated ecosystems services and worsening of livelihoods that depend on them over time. The BAU serves as a baseline against which the efforts of the community-led grazing management option on the ecosystem services can be assessed, thus indicating the costs and benefits associated with inaction. The aim of the analysis is therefore to assess the impact of management practices encompassed by the seasonal reserve option on the flow of benefits from the rangeland, over and above the BAU scenario.

5.1 Open access scenario - BAU

Open access or free pasture under BAU has been practiced over centuries in the study site area and wider country. In the past, the system was governed by strict and strong customary norms (Xeer) which were adhered to by all pastoralists. With regard to customary rules, fines and other forms of social sanctions were imposed on those who did not conform to the norms under both colonial rules and central government. The central government had a designated rangeland agency for management of rangeland and land use was, in general, governed by strictly enforced rules that underpinned a clear designation under three main uses: agricultural, livestock and forest production. However, since the fall of the central government in 1991, the land use governance system has weakened considerably, leading to overgrazing, recurrent conflicts over resources, unsustainable charcoal production, illegal rangeland enclosures and increasingly, displacement in context of frequent droughts.

Competition for resources among a large number of pastoralists often rushing to a small area as rains fall leads to rapid depletion of the pasture and soil compaction and soil erosion, which together exert relentless pressures and therefore limit the natural ability of land to recover. As there is little or no reserve rangeland to fall back on, animal condition and productivity declines, leading to greater household vulnerability to droughts and market shocks.

For example, if rain fails or performs poorly in one season, the livestock prices can drop from USD60 to USD25 due to poor animal weight (Inter-Agency Monitoring, 2016). On that basis, it is reasonable therefore to assume that the current level of flows of ecosystem services from Karkaar site would have continued to decline under the BAU scenario.

5.2 Implementing Community-led Grazing reserve Management - CGRM

In 2017, the government and communities in Karkaar area of Dharoor valley implemented a seasonal reserve policy which supported land resting measures and regeneration of grasses through a mix of reseeding and propagation of local herbaceous species, some of which have declined significantly or were lost in the area in the past decade or so. Under this option, a 2100ha (or 7km x 3km) area was reserved for 45 days during which the pastoralists were stopped from entering the area. The process was possible because of an agreement between the different pastoral communities and local authorities who found it suitable after considering that the pastoralists could graze elsewhere with good pastures. Furthermore, the reserve has good soils which enable regeneration quickly during enclosure, and also, availability of permanent water sources which can be used during the dry season when the reserve is reopened to pastoralists. Indeed, a good degree of vegetation restoration and slowdown of soil erosion has been observed within the site over the past four years compared to areas outside the reserve. Whilst the 45 days land resting at the CGRM site may create additional grazing pressures on surrounding area, extending the same mitigation measures in larger area within Dharoor and other prime rangelands during rainy seasons would likely facilitate greater recovery of land vegetation and therefore yield more abundant grazing to be used during dry season which would in turn reduce livestock migration and overgrazing in the region. The main inputs required to protect the site during closure are labor (guards) and patrol vehicles/ horses with associated overhead costs for fuel and maintenance. The impact of the CGRM option is assessed against the BAU, using a 2016 as the base year for the comparison.

5.3 Discount rates and time horizon

The study used three different discount rates of 3.5% 5%, and 10% in line with previous ELD studies (Dallimer et al. 2017). These rates are also in line with Pannell and Shilizzi in (Dutton, et al., 2015) who believe that discount rates applied in analysis supporting decision making on public goods investments should be between zero and the commercial rate, or to discount at the economic growth of the world (UK Government, 2018 and OECD). On that basis we apply rates varying between 10% which is the annual commercial rate in Puntland and 3.5% which is Somalia's growth rate in the base year, 2017 (World Bank Group, 2018). To correct values accounting for inflation, the rate used was Somalia's 2020 inflation rate at 4.2% (Federal Ministry of Planning, Investment and Economic Development, 2020).

With regard to the 10 and 46 years time horizons for the analysis, the study seeks to contribute to support Somalia's achievement of the SDGs (Agenda 2030) and the Africa 2063 Agenda – the continent's strategic framework that aims to deliver on its goal of inclusive and sustainable development, respectively.

06

Findings

Table 2 shows that the BAU scenario will result in aggregate NPV of USD 3.6 million, based on discount rate of 3.5% applied over 46 years (to 2063). This amounts to NPV of USD 76,878 per household or annual NPV USD 1,537, equivalent to USD 0.70 per person per day. BCR is 11. However, aggregate NPV declines to 3.1 million and 2.2 million when 5% and 10% discount rates are applied respectively, whilst the corresponding BCRs increase slightly to 11.5 and 12.48. The latter is due to the fact the higher discount rate has a greater impact on benefits (which are larger than costs), leading to a relatively higher annual decline of the former.

The CGRM intervention option yields an aggregate NPV of 9.1 million at 3.5% discount rate using a 46 year time horizon; an improvement of 5.4 million (or 153%) compared to BAU. This in turn results in NPV of 194,802 per household or annual NPV of 3,896, equivalent to USD 1.78 per day per household member. Similarly, BCR increases to 27.

Similar outcomes emerged when the same discount rates were applied over 10 and 20 year horizons. In both cases, aggregate NPVs are significantly higher than the BAU, although the difference gets smaller when 10% discount is applied; see last six rows of Table 2.

Based on this analysis we can conclude that the community-led reserve management (CGRM) option introduced in Karkaar site has created significant societal economic benefits. An important policy implication is that the community-led grazing reserve management may serve as a model for improving rangeland management in the region, considering that the current site is a relatively small part of Dharoor valley. Similar community and incentive structures within Dharoor and beyond may permit a replication of the CGRM model to reduce the progression of land degradation and improve livelihoods. Indeed, all the levels of per household per day across all scenarios considered are below the international poverty line ($1.9), CGRM options bring about significant improvement over and above the BAU.

TABLE 2

Benefits and cost of Karkaar site

Scenario	Aggregate NPV	BCR	Aggregate NPV per HH	Annual NPV per HH	NPV per person per day
BAU @ 46yrs and 3.5%	3,613,282.50	11.09	76,878.35	1,537.57	0.70
BAU @ 46yrs and 5%	3,153,959.64	11.51	67,105.52	1,342.11	0.61
BAU @ 46yrs and 10%	2,235,938.56	12.48	47,573.16	951.46	0.43
CGRM @ 46yrs and 3.5%	9,155,692.02	27.33	194,801.96	3,896.04	1.78
CGRM @ 46yrs and 5%	8,273,586.44	26.19	176,033.75	3,520.68	1.61
CGRM @ 46yrs and 10%	4,951,780.42	23.82	105,357.03	2,107.14	0.96
CGRM @ 20yrs and 3.5%	6,964,482.53	24.22	148,180.48	2,963.61	1.35
CGRM @ 20yrs and 5%	6,239,959.09	22.00	132,765.09	2,655.30	1.21
CGRM @ 20yrs and 10%	4,573,993.55	22.98	97,319.01	1,946.38	0.89
CGRM @ 10yrs and 3.5%	4,688,345.96	22.09	99,752.04	1,995.04	0.91
CGRM @ 10yrs and 5%	4,404,436.61	22.00	93,711.42	1,874.23	0.86
CGRM @ 10yrs and 10%	3,648,107.14	21.72	77,619.30	1,552.39	0.71

07

Conclusions

Analysis concluded that the CGRM option introduced in Karkaar site has created significant benefits over and above the BAU. Whilst the land pressures from the 50 households living on the site are relatively smaller than those faced in other rangelands in the region that have a much higher livestock density, the introduction of the CGRM option has allowed a more sustainable utilization of flow ecosystem services. Despite the increasing unpredictability and variability of the climate conditions in the region, the combination of a 45 day closure of the site for land recovery during main rainy season (April-May) and local community stewardship preventing tree cutting for charcoal and encouraging fodder production appear to have resulted in a more sustainable land use that generates diversified incomes. The favourable precipitations in 2018 and 2019 has helped the situation.

The sustainability of the new land use practices will depend in part on future climate conditions in the region which underpins availability of pasture and fodder both within the site and elsewhere. Also, the sustainability of the CGRM depends on the ability to maintain the local stewardship at an appropriate level. If pressures during the migratory seasons exceed the carrying capacity and droughts occur more frequently as predicted by climate models, it is reasonable to expect the existing stewardship approach (i.e. 45 day closure) will not be sufficient on its own, and further measures may be necessary to enhance ensure ongoing land use sustainability. Indeed, the site has received precipitation above the regional averages in 2018 and 2019, compared to the five years preceding the introduction of the CGRM where the region experienced reoccurring droughts in 2013, 2015 and 2017. Thus, the long-term benefits of the CGRM remain to be tested if the region experiences lower level of rainfall in the forthcoming seasons.

A limitation of the study is that the analysis presented relied on limited qualitative data and quantitative data because of lack of official statistics in Somalia. We acknowledge that a more comprehensive involved a greater number of FGDs and surveys would have been more appropriate. However, the study fulfills its main objective of providing local officials and researchers with an opportunity to undertake a practical work under the guidance of international and national experts to consolidate learning acquired through classroom-based training.

08 Recommendations

Key recommendations are:

- Overall, the analysis suggests that the flows of the ecosystem services from Karkaar site would have declined over time in the absence of the community management option. The CGRM option has reduced overgrazing and other unsustainable land use practices such as tree cutting, as well as limiting access to just 50 households. The favourable precipitation in the region which has reduced the pressures from migrating livestock herders from surrounding areas has helped the recovery and reinvigoration of the site. Indeed, it is likely that during drought seasons the site would have been accessed and utilized by a much large number of households outside the 45 days closure to non-resident herders because of the relatively more abundant pasture and availability of a water source in the area. On that basis, it is advisable to expand the site to a larger area covering a significant part of the Dharoor valley to ensure that there is a sufficient recovered pastureland that can be made available to a larger number of households, especially in dry seasons.
- The fodder production from the site is limited considering the past two favourable growing seasons. It is advisable to promote fodder production in the area through, for example, training of Dharoor valley and wider pastoral communities using the Karkaar site as a 'demonstration site'. This will ensure creating a reserve feed that can reduce pressure to migrate in the dry season, hence reducing the pressures on prominent grazing areas.
- A further research building this case study is necessary to both improve upon the data limitations identified and to explore ways of applying the CGRM option to other areas in the region and wider Somalia. Given the increasing unpredictability and variability of the rains, it is worth conducting experimental research establishing alternative strategies for optimal timing of the reserve closures so that the effectiveness of the mitigation measure can be improved across the rangelands in the region. Furthermore, a systematic ecological surveys and sampling, alongside relevant data on household livelihoods, including livestock ownership, annual offtake and different livelihoods strategies are necessary to generate sufficient data for more comprehensive assessments of the ecosystem services and therefore stronger evidence for future environmental policymaking.

09

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Annex 1: Timeline for the activities

TABLE 3

Activity no.	Activity description	Timeline
1	Two days training workshop for 10 enumerators and pilot testing of data collection tool	27th –30th May 2020
2	12 focus group discussions (1 male and 1 female FDGs) per site for the selected sites (including meeting days with authorities	31st May to 12th June 2020
3	Data analysis	15th –30th June 2020
4	Expert review meeting	5th July 2020
5	Data collected shared with ELD team	15th July 2020
6	Email update on progress on analysis	22nd July 2020
7	Analysis completed and uploaded to shared drive	30th July 2020
8	Final report and policy briefs written up and shared	25th August 2020

Annex 2: Focus group and KII questionnaires

Preparation works:

Prior to community meetings, special meetings were arranged with the Regional Authorities of Bari Region and District authorities of Dangoroyo, Iskushuban and Ufeyn to inform them about the study, planned activities and site identified. General information on the area and identification of key local informants and elders was also gathered.

TABLE 4

A: General Questions

Focus Group Discussions at Community Level
How many households (HHs) are there in the community, Karkaar area – FGD?
How many of those HHs are living with the selected site?
On average, how many camels and shoats are reared household within your community (wet and dry) – FGD?
Fuel wood stocks (Firewood) – KII with charcoal/firewood traders
o What types of trees used for firewood in your area? (age, species)
o What are the costs of delivering 1 bundle firewood or 50kg charcoal to your households?
o Is firewood collected from the BAU area?
o If yes, how truckloads are collected per month?
o How many bundles on each truck?
o How many days does it take to collect a truckload? (includes travel to site, cutting trees, travel back from the site, selling)
o What is the cost of the transport (truck, fuel, depreciation) for firewood collection?
o Is charcoal collected from the open grazing area?
o What fines or taxes did you pay in the last 12 months?
o How much firewood or charcoal (sacs) is used per household per month? – FGD
o Average household size?

TABLE 4 (CONTINUED)

Building materials – KII with construction traders
o In the last 12 months have building materials been collected from the BAU site? Ask about wood and grasses for *caws* separately
o How many truckloads of wood were collected?
o How many days were spent collecting wood? (includes travel to site, cutting trees, travel back from the site, selling)
o What is the cost of the transport (truck, fuel, depreciation) for collection of poles?
o How many truckloads of grass were collected from the BAU site?
o How many days were spent collecting? (includes travel to site, cutting trees, travel back from the site, selling) grass for construction purposes
o What is the cost of the transport (truck, fuel, depreciation) for grass collection?
Fencing materials – FGD with local communities
o In the last 12 months have fencing materials been collected from the BAU site?
o How many newly established fenced areas were there?
o What is the perimeter?
o How many hours were spent fencing this area?
o How many people were involved?
Awareness and notifications on environmental resources management – FGD (MoEACC)
o How can we reach the different target communities for notification and announcements?
o What is the cost of each of the different ways of reaching to the target communities? (e.g. SMS, local papers, small vehicle with microphone, community meeting).
Key Informant Interviews with environmentalists and MoEACC staff
o On average, how much grass does a hectare of land in the open grazing area can produce in a year?
o On average, how much grazing browsing biomass does a hectare of land can produce in each year?
o On average, how many sacks of maize/sorghum are needed to feed 10 camels for a month, as a replacement of pasture?
o What are costs of training for 200 community members on environmental conservation, tree planting and management for 1 day? – check how many days of training were received and multiply up.

TABLE 5

B: Grazing Reserve

All questions in this section are to be asked in reference to the CMGR site identified by the authorities

1. Fuel wood stocks (firewood) – KII with charcoal/firewood traders
1.1 How many households (HHs) are there in the community, Karkaar area – FGD?
1.2 How many of those HHs are living with the selected site?
1.3 On average, how many camels and shoats are reared household within your community (wet and dry) – FGD?
1.4. If yes, how truckloads are collected per month?
1.5. How many bundles on each truck?
1.6. How many days does it take to collect a truckload (includes travel to site, cutting trees, travel back from the site, selling)
1.7. What is the cost of the transport (truck, fuel, depreciation) for firewood collection
1.8. Is charcoal collected from the CMGR site?
1.9. If yes, how truckloads are collected per month?
1.10. How many bundles on each truck?
1.11. How many days does it take to collect a truckload (includes travel to site, cutting trees, travel back from the site, selling)
1.12. What is the cost of the transport (truck, fuel, depreciation) for firewood collection
1.13. What fines or taxes did you pay in the last 12 months
2. Building materials – KII with construction traders
2.1. In the last 12 months have building materials been collected from the CMGR site? Ask about wood and grasses for *caws* separately!
2.2. How many truckloads of wood were collected?
2.3. How many days were spent collecting wood? (includes travel to site, cutting trees, travel back from the site, selling)
2.4. What is the cost of the transport (truck, fuel, depreciation) for collection of poles?
2.5. How many truckloads of grass were collected from the CMGR site?
2.6. How many days were spent collecting? (includes travel to site, cutting trees, travel back from the site, selling) grass for construction purposes
2.7. What is the cost of the transport (truck, fuel, depreciation) for grass collection?

TABLE 5 (CONTINUED)

3. Fencing materials - FGD with local communities	
3.1. In the last 12 months have fencing materials been collected from the CMGR area?	
3.2. How many newly established fenced areas were there?	
3.3. What is the perimeter?	
3.4. How many hours were spent fencing this area?	
3.5. How many people were involved?	
4. Labor costs – KII with MoEACC engineers, Ministry of Planning, Ministry of Public Works & Markets	
4.1. How many gardeners are required for 2 ha of the CMGR site for 1 year? (note convert to 2,000 ha later)	
4.2. How many watchmen are required for the for 2 ha CMGR site for 1 year?	
4.3. How much is the local monthly wages of:	4.3.1. CMGR watchmen 84 hours per week (1 shift of 12 hours per person per day) – *annual cost (every year)*
	4.3.2. CMGR gardeners 36 hours per week (1 shift of 6 hours per person per day) – *annual cost (every year)*
5. Farm inputs (fencing, tools, seeds and seedlings) (establishment costs) – KII with MoEACC & Traders	
5.1. What is the price of installing 100 meter of wire fencing that is 1.8 m high (including labor, wire, metallic poles, cement, etc) – *add maintenance costs for one year (e.g. watering cans, sheds)*	
5.2. How many hand tools (variety and pieces) will be required for 2,000 ha of land for the CMGR site? What are the prices of these tools?	
5.3. How many seeds (kg) and seedlings (pieces) will be required to plant in the site? What are the prices of the seeds and seedlings?	
5.4. What should be the variety of species to be planted in the CMGR sites?	
5.5. What are the prices of products of the tree species planted in the site in the local markets?	5.5.1. Fruits (e.g. lemons, papaya, guava, oranges, etc)
	5.5.2. Vegetables (e.g. cabbage, spinach, greens, etc)
	5.5.3. Fodder and grass
	5.5.4. Poles
	5.5.5. Firewood
	5.5.6. Trees seedlings
5.6. How many seedlings can be produced by the CMGR tree nursery for one year? (Scale up to 5 years). – break these down	

TABLE 5 *(CONTINUED)*

5.7. What are the prices of seedlings below to be produced in the CMGR tree nursery in the local markets?	5.7.1. Fodder trees
	5.7.2. Shade trees
	5.7.3. Grasses
	5.7.4. Fruits trees
	5.7.5. Vegetables
6. Water reservoir (reserve)– check secondary data sources – KII with MoEACC & Traders	
6.1. What are the prices of metric cube or barrel of water in the area in the different seasons?	
6.2. What is the cost of construction of four water reservoirs each 100*50 m*3m (including excavation works, labor costs, material costs such as concrete, timber, solar systems, etc)?	
6.3. What is the cost of maintaining four water reservoirs 100m*100m*3m for one year?	
7. Soil & water conservation structures within the reserve site – KII with MoEACC & Markets	
7.1. What will be the cost of establishing soil and water conservation structures mentioned below? – (material, transport and labor) – for each of the list	7.1.1. Rock dams
	7.1.2. Strips
	7.1.3. Water diversions
	7.1.4. Soil bunds
	7.1.5. Infiltration pits Material costs
8. Trainings – KII with MoEACC	
8.1. What are costs of training of one reserve site manager for 1 day? (gardeners and support staff) – check how many days of training were received and multiply up	

TABLE 6

C: Grazing Reserves

All questions in this section are to be asked in reference to the reserve area identified by authorities

1. Fuel wood stocks (firewood) – KII with charcoal/firewood traders
1.1. What types of trees used for firewood from the reserve area? (age, species)
1.2. What are the costs of delivering 1 bundle firewood or 50kg charcoal to your households?
1.3. Is firewood collected from the reserve area?
1.4. If yes, how truckloads are collected per month?
1.5. How many bundles on each truck?
1.6. How many days does it take to collect a truckload (includes travel to site, cutting trees, travel back from the site, selling)
1.7. What is the cost of the transport (truck, fuel, depreciation) for firewood collection
1.8. Is charcoal collected from the reserve area?
1.9. If yes, how truckloads are collected per month?
1.10. How many bundles on each truck?
1.11. How many days does it take to collect a truckload (includes travel to site, cutting trees, travel back from the site, selling)
1.12. What is the cost of the transport (truck, fuel, depreciation) for firewood collection
1.13. What fines or taxes did you pay in the last 12 months
2. Building materials - KII
2.1. In the last 12 months have building materials been collected from the reserve area? Ask about wood and grasses for caws separately!
2.2. How many truckloads of wood were collected?
2.3. How many days were spent collecting wood? (includes travel to site, cutting trees, travel back from the site, selling)
2.4. What is the cost of the transport (truck, fuel, depreciation) for collection of poles
2.5. How many truckloads of grass were collected from the reserve area?
2.6. How many days were spent collecting? (includes travel to site, cutting trees, travel back from the site, selling) grass for construction purposes
2.7. What is the cost of the transport (truck, fuel, depreciation) for grass collection

TABLE 6 (CONTINUED)

3. Fencing materials - FGD	
3.1. In the last 12 months have fencing materials been collected from the reserve area?	
3.2. How many newly established fenced areas were there?	
3.3. What is the perimeter?	
3.4. How many hours were spent fencing this area?	
3.5. How many people were involved?	
4. Labor costs – KII (MoEACC engineers, Ministry of Planning, Ministry of Public Works)	
4.1. How many guards are required for reserves? for 2000 ha reserve area for 1 year	
4.2. How much is the local monthly wages of:	4.2.1. Seasonal reserve guards 84 hours per week (1 shift of 12 hours per person per day) –annual cost (every year)
5. Vehicle, horses, donkeys, fuel and their maintenance in the seasonal reserve - KII	
5.1. How many vehicles, horses, donkeys will be required for surveillance of the reserve sites for one year?	
5.2. What is the prices of:	5.2.1. two Vehicles suitable for surveillance and other services in the reserve site
	5.2.2. four Horses and eight donkeys to support the surveillance and other services for the reserve site
5.3. What are the prices of hiring one horse and one donkey per month for during closures (3 months)?	
6. Soil & water conservation structures within the Reserve area – from the ministry - KII	
6.1. What will be the cost of establishing soil and water conservation structures mentioned below? - *(material, transport and labor)*	6.1.1. Rock dams
	6.1.2. Strips
	6.1.3. Water diversions
	6.1.4. Soil bunds
	6.1.5. Infiltration pits Material costs
7. Awareness and notifications on closure of seasonal reserves – check data at ministry - KII	
7.1. How can we reach the different target communities for notification and announcements?	
7.2. What is the cost of each of the different ways of reaching to the target communities? (e.g. SMS, local papers, small vehicle with microphone, community meeting).	

TABLE 7

Quantitative data, Karkaar site

Category	Item description	Dharoor Locations		
		Iskus-huban	Ufeyn	Meela-deen
General	No. of Nomadic HHs in the general settlement	550	3000	2000
General	No. of Village HHs	1200	1800	550
General	No. of Charcoal bags per HH per month for charcoal users in villages	2	2	2
General	No. of Firewood bundles per HH per month for firewood users only	30	30	30
General	Av. Agricultural labour wage per month	USD 150	USD 150	USD 150
General	Animal husbandry wage (herders' opporunity cost of time)	USD 15	USD 15	USD 15
General	Av. HH camel size	20	10	10
General		100	90	200
General	Av. HH size	6	6	6
General	10 camels feed per month in maize	525	242	250
General	100 shoats feed per month in maize	350	220	250
General	Firewood costs for cooking maize for Camels per month	42	42	48
General	Firewood costs for cooking maize for Shoats per month	21	21	24
General	Cost for training 400 community members of NRM for 1 day (200 in dharoor)	USD 2,667	USD 2,667	USD 2,667
General	No. of months of staying at the GR site in 12 months for 50 HH with 100 shoats and 10 camels	6.0	6.0	6.0
General	No. of months of staying at the BAU site in 12 months for 50 HH with 100 shoats and 10 camels	3.0	3.0	3.0
BAU	No. of HHs utilizing resources from BAU site	50	50	50
BAU	Do you collect Charcoal from BAU site	Yes	Yes	Yes
BAU	Av. No. of truckloads of charcoal per month	1	1	1
BAU	Cost of delivering 50 kg of charcoal from BAU site to HHs in the village	USD 17	USD 20	USD 20
BAU	Av. No. of days to collect charcoal (truck)	21	0	0
BAU	Av. cost of transport per truck load of charcoal from BAU site (vehicle rent + fuel + depreciation)	USD 50	USD 50	USD 50

TABLE 7 (CONTINUED)

BAU	No. of people collecting charcoal	6	8	8
BAU	No. of charcoal bags per truck	53	53	53
BAU	Taxes/fines for the last 12 months on charcoal from BAU site	USD 280	USD 280	USD 280
BAU	Do you collect Firewood from BAU site	Yes	Yes	Yes
BAU	Price of 1 bundle of firewood in the market	USD 0.7	USD 0.7	USD 0.8
BAU	Av. No. of days to collect firewood (truck)	3	3	3
BAU	No. of firewood bundles by trucks (Dhayne)	300	300	300
BAU	Price of 1 truck load of firewood bundles in the village	USD 120	USD 120	USD 120
BAU	No. of firewood bundles per truck from BAU site	100	100	100
BAU	No. of people collecting charcoal	6	8	8
BAU	No. of charcoal bags per truck	53	53	53
BAU	Taxes/fines for the last 12 months on charcoal from BAU site	USD 280	USD 280	USD 280
BAU	Do you collect Firewood from BAU site	Yes	Yes	Yes
BAU	Price of 1 bundle of firewood in the market	USD 0.7	USD 0.7	USD 0.8
BAU	Av. No. of days to collect firewood (truck)	3	3	3
BAU	No. of firewood bundles by trucks (Dhayne)	300	300	300
BAU	Price of 1 truck load of firewood bundles in the village	USD 120	USD 120	USD 120
BAU	No. of firewood bundles per truck from BAU site	100	100	100
BAU	No. of firewood bundles by individual hand collection from BAU site per month	0	0	0
BAU	No. of truckloads of firewood from BAU site per month	1.3	1.3	1.3
BAU	Av. No. of firewood bundles by trucks from the BAU site per month	400	400	400
BAU	Total price of firewood bundles from BAU site per month for villagers	USD 280	USD 280	USD 320

TABLE 7 (CONTINUED)

BAU	No. of people collecting per truck load of firewood	3	3	3
BAU	Av. cost of transport per truck load of firewood from BAU site (vehicle rent + fuel+ depreciation)	USD 20	USD 20	USD 20
BAU	Taxes/fines for the last 12 months on firewood from BAU site	USD 80	USD 80	USD 80
BAU	Do you collect building materials (poles and grasses) from BAU site	Yes	Yes	Yes
BAU	No. of poles collected from the BAU site the lanst 12 months	50	35	25
BAU	Price of 1 pole of building material from the BAU in the village	USD 3.0	USD 4.0	USD 4.0
BAU	Price of 1 pole of building material from the BAU on site	USD 1.5	USD 1.5	USD 1.5
BAU	No. of days of collecting one unit (11) of poles fron the BAU site	2	0	0
BAU	No. of people collecting one unit (11) of poles from the BAU site	2	0	0
BAU	Transport cost for deliverting one unit (11) of poles from the BAU site	1	2	2
BAU	Do you collect weaving grasses from the BAU site	Yes	Yes	Yes
BAU	Price of one bundle (xarig) of grasses (cawsan) in the village	20	20	20
BAU	No. of people collecting cawsan per load	USD 4	USD 4	USD 4
BAU	No. of bundles per load	100	100	100
BAU	Price of 1 bundle (xarig) of cawsan on site	USD 15	USD 15	USD 15
BAU	Price of one bundle (xarig) of grasses (mayro)	USD 5	USD 5	USD 5
General	No. of people collecting mayro per load	4	4	4
	No. of days of collecting 1 truck load of Cawsan fron the BAU site	10		
	No. of days of collecting 1 truck load of Mayro fron the BAU site	10		
BAU	No. of bundles of mayro per load	100	100	100
	Av. cost of transport 1 truck load of grasses of Cawsan from BAU site (vehicle rent + fuel+depreciation)	30	30	30
	Av. cost of transport 1 truck load of grasses of Mayro from BAU site (vehicle rent + fuel+depreciation)	30	30	30
BAU	No. of truckloads of grasses (Cawsan) from the BAU site per month	0.3	0.3	0.3

TABLE 7 (CONTINUED)

BAU	No. of truckloads of grasses (Mayro) from the BAU site per month	0.3	0.3	0.3
General	Price of 1 bundle (xarig) of mayro on site	USD 2.5	USD 2.5	USD 2.5
General	Do you get fencing materials from BAU site	Yes	Yes	Yes
BAU	No. of livestock fencing established for camels in the last 12 months in BAU site	150	150	150
BAU	No. of fencing materials established in the 12 months for farms	1500	39	540
General	No. of fencing materials established in the 12 months for farms in BAU site	0	0	0
BAU	No. of livestock fencing established for shoats in the last 12 months	50	50	50
BAU	Av. Perimeter of fence for 100 shoats (m)	22	22	22
BAU	Av. Perimeter of fence for 20 camels (m)	31	31	31
BAU	No. of people established livestock fencing	3	2	2
BAU	No. of hours used to establish new livestock fence	4	3	3

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For further information and feedback please contact:
ELD Secretariat
Mark Schauer
c/o Deutsche Gesellschaft
für Internationale Zusammenarbeit (GIZ) GmbH
Godesberger Allee 119
53175 Bonn
Germany
T + 49 228 24934-400
F + 49 228 24934-215
E eld@giz.de
I www.eld-initiative.org

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