Save the Children

Community Based Watershed Restoration

R.S. Bhalla[1]

A Programme Proposal for Save the Children
Final Report (2 of 2)[2]

[1]Foundation for Ecological Research, Advocacy and Learning (FERAL)
170/3, Morattandi, Auroville Post
Tamil Nadu - 605101, India
http//:www.feralindia.org

[2]Citation: Bhalla, R.S. 2012. "Community Based Watershed Restoration". Nairobi, Kenya.: Save the Children.

Contents

Executive Summary 1

1 Introduction 4

2 Designing interim and incremental interventions 6

3 Designing a full scale watershed restoration programme 11

4 Site specific project design and examples 21

5 Watershed restoration for Dhabar-Mamac 28

Bibliography 44

Appendix 47

A Review of appropriate field methods 47

B Data - Requirements and Gaps 53

Executive Summary

This document attempts to provide a strategy for Save the Children to develop a long term programme on community based watershed restoration. The justification for this is provided through another document entitled "Integrated Watershed Approaches to Mitigate Slow Onset of Droughts" which comprises the first part of this study. By extending their portfolio to include watershed restoration, Save the Children will be among the first agencies working in this region which has moved beyond disaster relief to disaster preparedness and mitigation. This is essential in the light of probable climate change and consequent impact on the natural resource base on which the major proportion of the population depends.

This is an inception report which provides a methodological approach which can be adopted by Save the Children to initiate activities in watershed restoration. It is based on a quantitative methodology and results presented here have been validated by the stakeholders at both the community level and by staff of Save the Children at various levels.

This report discusses two possible strategies. These are complementary in nature and can be implemented in succession or simultaneously. The first is to take up watershed restoration in an incremental fashion taking advantage of existing programmes of the organisation. This strategy has a number of advantages. These include the fact that these can be linked to ongoing activities and run by existing staff. They can be initiated in a short time frame, with a low budget and low overhead. On the downside there are issues of scale which make the interventions less effective and issues of management and equity.

A more comprehensive approach would require activities at the scale of five to ten thousand hectares to cover larger and contiguous watersheds. This approach would require a larger dedicated team, more formal institutional arrangements between and within stakeholders from different communities and a larger and longer duration of funding. The advantages of this approach include the positive effect of scale by which ecological processes have a greater chance of "kicking in" over a larger contiguous area than small isolated patches. Scale effects also ensure the community as a whole benefits from the interventions and not individuals whose private assets have been restored. Impacts of larger sized projects are also more significant for processes such as ground water recharge and stabilisation of catchments.

The prevalent conditions on field, in particular raise a number of challenges for management structures. Suggested strategies follow the broad rule that the higher the intensity of intervention, the closer the activity be to the settlement. This is because high value investments often require higher management inputs and have longer gestation periods. A second, broader strategy, is to initiate dialogue between users of specific watersheds and build a platform where resource sharing can be discussed.

Studies on successful NRM projects show that the majority have adopted adaptive management strategies. These rely heavily on experiential learning and adaptations to ground conditions. The also require that the community structure is amenable to such adaptations. More importantly, mechanisms need to be in place that ensure that learning from the ground can feed back into decisions made at higher scales. For instance, a highly successful technique should be transferred to other projects of a similar nature. Institutional mechanisms are also needed to ensure that communities are facilitated financially, in terms of materials and in terms of technical inputs. This requires that technical teams are at their disposal. It also requires that the community decisions prevail and not those of the technical teams and so called experts.

There are a large number of requirements for formulating and implementing a multidisciplinary programme, such as watershed restoration. These cover data and information with which proposals can be written and put in a policy context at one scale, and be representative of requirements of the community at the other. In some cases, data is available from secondary sources but has gaps which need to be identified and filled.

Capacities need to be built in collecting this data, compiling and analysing it. Some of these can be hired, but for the larger part, they need to be built into the team. This is because natural resources restoration is highly site specific. No two sites are alike in the types of restoration activities to be conducted. Consequently there is no single solution. Implementing agencies need to have a bouquet of possible restoration activities from which the most appropriate is picked by the community. This bouquet of options grows with the experience of the team and the community.

Overview of the document

This document starts by presenting different approaches that may be adopted by Save the Children to initiate a watershed restoration programme in Somaliland. The introduction in chapter 1 provides an overview of watershed restoration as a disaster proofing strategy based on case studies and experiences from this region. Chapters 2 and 3 give an overview of two approaches which may be adopted by Save the Children. Chapter 2 covers an approach to initiating watershed restoration through small and incremental interventions. The major advantage of this approach is that it will allow Save the Children to build in-house capacities and experience with a slew of interventions. This strategy could help generate important case studies and documents that lead up to larger scale interventions.

Chapter 3 covers the major organisational aspects of setting up large scale watershed restoration projects. It draws heavily from the Indian experiences, but is presented in the local context of social organisation and roles of implementing agencies and the government. The important messages from this chapter are that restoration projects operate on substantially longer time scales than most development and certainly, most emergency interventions. Consequently they require institutional arrangements that can liaison with the government and donors at one end of the scale and with specific stakeholders on the other. Adaptive management is a fundamental ingredient in the success of these projects and systems for monitoring and disseminating information need careful attention. This chapter ends with a brief listing of agencies currently engaged in funding watershed related work in Africa.

To pursue watershed restoration as a programme in Save the Children, the organisation needs to set aside substantial financial and human resources. Suitable persons should be identified to head the regional (or project) unit and set the task of putting together sufficiently detailed datasets for region scale watershed restoration projects. Relevant government agencies and potential donors need to be contacted with these proposals to raise funds for periods of not less than six years and preferably in the region of eight to ten years.

Watershed development plans are the basic building block of watershed restoration. There are a large number of activities which can be undertaken for such projects. Chapter 4 presents an outline which may be dovetailed into ongoing WASH and livelihood programmes of Save the Children or for interns interesting in WASH or studying migration patterns of pastoralists.

Chapter 5 is a report based on findings of the field study. It has been prepared so it can be utilised, almost without modification, as the core of a watershed restoration proposal. The proposed project area is under two thousand hectares, a small area by watershed restoration standards. The report draws from a range of data sources and GIS and remote sensing datasets for the region.

The appendices to the document cover two areas. Appendix A covers the basic skill-set required by field teams for implementing natural resource management projects. The methods described are what are considered a bare minimum to build a baseline where such data is not available from secondary sources. The document, however, does not touch upon specialised skills that are expected of development professionals, engineers, veterinary and agricultural professionals. It is assumed that their training ensures they possess the necessary abilities to conduct surveys, collect and analyse data and diagnose and find solutions to common problems on field.

The final section, appendix B, analyses additional sources of data and identifies gaps in information which is considered important, if not crucial from a NRM perspective. The gaps in data for most regions of Sool and Sanaag are very wide and this includes our knowledge of how the natural system works, physical and chemical processes as well as biological systems. Building up this data will require both an extensive review and collation of literature as well as long term studies and field based experiments. Areas that need attention from the watershed restoration perspective include an understanding of processes leading to salanisation of water sources, identification of regions where salinity and flouride contamination are a major problem and isolating the causes of this contamination. Long term experimental work is required to determine appropriate species choices for biological interventions, levels of grazing pressure and their impact on regeneration which can inform decisions such as rotation of rangelands and enhancement of productivity through addition of moisture and nutrients.

Chapter 1

Introduction

There is conclusive evidence that climate change has and will, in the coming decades, test the resilience of natural systems and all the communities dependent on them. Communities, such as traditional pastoralists and agriculturists in Africa, will be particularly stressed owing to the inherent nature of their livelihoods - total dependence on low productivity range lands, many of which are well into the process of desertification.

This document attempts to provide a framework for Save the Children to identify and address gaps in internal capacities and to address requirements of action research to be able to design and implement community driven watershed restoration projects. The framework is broadly based on the sustainable livelihoods approach[1,2] with a clear bias towards quantitative and spatially explicit data. The reasons for this are as follows:

The experience of development interventions in the Horn of Africa in the past clearly shows the need for involving local communities in the planning process as traditional systems for resource partitioning remain fundamental to resource management. Top down development approaches have, at best, had mixed results.

Furthermore, some of the important stakeholders follow migratory resource use patterns. Pastoralists traditionally cover large areas of pasture lands traversing many watersheds along the way. They spend varying amounts of time in these pastures, their movements being triggered by a mix of season and forage availability. Knowing the location of these watersheds and the number of pastoral users, extent and type of resource dependence in each is therefore essential.

Watershed restoration requires treatment of complete basins and not parts of different catchments. Hence local planning needs to be integrated to a watershed scale framework. Understanding traditional and present management institutions and resource partitioning arrangements is therefore essential. These insights will help evolve strategies for managing and protecting interventions with participation and cooperation among the stakeholders.

Participatory methods provide a visual, spatially explicit and transparent means of collecting information from communities. Merging this with GIS and data management techniques allows the scaling up of information across multiple stakeholders and communities. Thus a regional picture can be generated through cumulative surveys of spatially linked communities. Once spatial extents of pastures and information about their watersheds has been obtained, it is possible to develop modelling based scenarios for the watersheds. This in turn can inform communities about likely conditions of watersheds such as moisture, vegetative cover, stream flow and sedimentation in advance of grazing or planting seasons, allowing them to make informed choices about stock sizes and grazing destinations or crop choices, as the case may be.

Action research can lead to answers regarding a number of fundamental questions about the ecology of pasture lands, local scale hydrological processes and facilitate adaptive management[3]. In that sense this programme will need to be evolved as a long term intervention and learning effort.

Chapter 2

Framework for interim and incremental interventions for watershed restoration

Introduction

Resources required to prepare and implement a full blown watershed restoration project can run into millions of dollars. Even pilot projects run on watershed scales are expensive. This poses a problem when such interventions are new to a region. This section tries to propose an interim and incremental approach which has certain distinct advantages - other than the financial issues already mentioned.

Incremental interventions in watershed restoration can be linked to ongoing projects, piggy-backing on them as it were for a number of otherwise expensive investments. While they may not address a particular issue at the watershed scale,[1] they can provide immediate relief to stakeholders for specific problems. In other cases they can act as a “a stitch in time” and save larger investments through small immediate interventions.

Another major advantage of small incremental interventions is that it will give Save the Children field staff and the community time to pick up important techniques and experiences from the field trials. These would over time, greatly improve the competence of the team and prepare it for larger watershed scale interventions. The approach would also allow small experimental studies and innovate and test out local-low cost interventions for soil and water conservation and in the process fill gaps in our knowledge of best practices.

Finally, small pilot projects in existing settlements can create important documentation and case studies to support larger scale interventions. The strategy of small and incremental interventions could therefore set the stage for a full blown watershed programme.

There are, however, certain operational challenges that these approaches bring. This section tries to cover some of these challenges and to suggest a way forward.

[1] Which often implies not addressing the “root” of the problem.

The piggyback approach WASH projects being implemented in the region can subsidise many of the activities through a simple expansion of their mandate. For instance, participatory mapping and monitoring of natural resources can be added to their existing monitoring and data collection agenda. A small watershed team may be permitted to accompany the WASH team to field sites to complete rapid surveys thereby saving on logistic costs.

WASH and watershed interventions have a lot in common. Certain watershed interventions could therefore be justified under a WASH umbrella. For instance, stabilising water resources for a berkad or undertaking ground water recharge for an aquifer being tapped for drinking water supply to a village.

The "stitch in time" approach Certain cases of erosion identified at Dhabar-Mamac require small investments in soil or masonry structures to plug gullies and re-direct water away from roads. If not done, some of these roads will turn into gullies and large ravines as seen not so far away from the village.

Implementation mechanisms

Roles and capacities

The implementation structure required for small scale interventions will require the supplementing of the existing WASH or other teams in at least three areas:

Overall coordination: The prioritisation and implementation of activities would require a coordinator who is able to report, analyse field level data and come up with implementation strategies for specific interventions. This will require sufficient knowledge of participatory GIS to generate geo-referenced maps for area calculations and visualisation of proposed activities.

Linking with ongoing programmes: An important requirement of the "piggy-back" approach will be to prepare proposals that meet the objective of the "host" programme while effecting natural resources management. This will require both innovative project ideas as well as the ability to frame them so that funding sources are willing to support them within their mandate.

Subject expertise: Veterinary and agricultural sciences are two areas which will require inputs on a regular basis to help design interventions such as improvement of pasture lands and afforestation or agro-forestry. Given that there are a number of engineers amongst the staff, it is assumed there is in house expertise in construction. However, expertise may be required in building low cost soil and water conservation structures such as gabion dams, earthen bunds for contour bunding, types of gully plugs and low cost check dams.

Other aspects of forming watershed development committees and conducting participatory assessments for prioritising interventions are within existing capacities of the team. These would require an orientation and training in important participatory techniques, many of which will be useful in other programme areas such as WASH and livelihood interventions.

Site selection

Site level planning will remain a requirement that the existing teams will need to fulfil. However, instead of operating on large basin scales, the focus would need to be on specific small low cost interventions examples of which are provided in chapter 4. Selecting a community or region to work in depends on a number of parameters. Among these are:

- Existing contacts and relations. This is not an option when referring to incremental interventions. However while comparing between two sites, those which have a better track record in terms of management should be selected.

- Looking at the potential resource. Data derived from satellite images such as MODIS can provide simple maps to measure productivities across seasons. Normal Difference Vegetation Index (NDVI) maps are a rough and ready measure of productivity records for a region.

- Looking for extents of problem areas. Other datasets such as gradients in the project site, soil types and land cover can provide additional information about productivities and propensity to erosion and volume of discharge.

- Sourcing of local labour and materials locally can reduce the implementation costs substantially. Materials here refers both to construction related materials such as cement, stones, sand and steel as well as biological materials which otherwise will need to be procured and transported from distant places. Negotiations with the community should include the aspect of contribution to the physical labour either as a cash for work[2] or as a contribution towards building a private or collectively held asset.

This information can be overlayed on participatory resource maps to further refine the information. Results obtained can be scored or discussed in the team and with the communities and used to prioritise some areas and avoid others which require very large investments or have a poor ratio of investment to returns.

Management issues and conflicts

Management structures for the implementation mechanisms described above need to ensure that primary stakeholders are consulted and involved at all stages of the project. This is particularly important as some activities may be taking place in areas exclusive to specific households or families. The basic strategy suggested for a management structure are as follows:

[2] Which would allow this become a livelhood intervention.

1. Identify and formally involve - through a consent note, the primary stakeholders in the planning and design decision, discussing the budgetary implications and extent of labour and material requirements.

2. Ensure there is a fair[3] share of expenses made by the primary stakeholders. Even if this doesn't reduce the budgetary load on the project, it is likely to reduce administrative costs and more importantly, will create a sense of ownership which has long term advantages for management of newly created assets.

3. Try and maximise the benefits of activities by selecting common property and common access resources in preference to privately controlled assets. In this case the primary stakeholders involved will be a "user" group which needs to be involved in decisions and planning as mentioned earlier.

Conflicts between competing claims may arise in situations where there are multiple stakeholders sharing a single resource. In large watershed projects, this situation is handled through multiple stakeholder platforms. In smaller projects with fewer resources, such platforms are usually not created. There are two ways of compensating for these eventualities:

1. Ensure that resource mapping taken up clearly identifies regions with multiple stakeholders and seasons when these stakeholder are utilising a particular habitat. Avoid or minimise restoration measures in these regions to minimise chances of conflict.

2. Initiate dialogue between the stakeholders with the help of the resident community and arrive at a consensus on resource management prior to initiating activities.

The first option is usually the simplest to accomplish, however the second may become necessary for critical resources. The decision to make contact or not to has to lie with the resident community who may chose not to do so until the conflict actually arises, or to do so through informal discussions without the involvement of a third party. Both are preferable to forcing a dialogue which results in a conflict over a hypothetical resource.

Challenges

Effectiveness

Small interventions in watershed restoration have a limited and localised value unless they follow a sequence which gradually covers the entire drainage basin. This throws up a major challenge for the coordinator who has to juggle between urgent requirements in terms of restoration, the priority of the community and the overall basin level restoration objective.

Furthermore, it is important that the interventions span a range of resources so that the project moves towards a holistic restoration of the watershed and not just one component. This

[3] Fairness is relative, and probably based on precedent of earlier projects and initiatives.

would require both the identification of probable interventions and expertise to set up these pilots. Raising funds for each of these interventions may also pose a problem as some, such as agro-forestry, cannot be justified under ongoing WASH activities.

Costs and sustainability

Sustainability of interventions is an issue which will strain both human and financial resources over a period of time. While the community can be asked to step in for minor maintenance works, it is unlikely they will be able to afford large scale repair of infrastructure. This is supported by the findings of the field survey5.

A series of similar structures built across a basin is likely to cost substantially less than individual structures due to economy of scale. This also applies to community mobilisation efforts which will be similar regardless of the scale of the project and have implications for the human resource costs of the project.

Finally, justifying natural resource interventions on the backs of other related projects also means that certain activities will not be considered. For instance, a WASH initiative can justify stabilising the catchment of a berkad but cannot justify tree planting or check dams at other locations.

Summary

- Small scale watershed restoration activities can be taken up under ongoing WASH and livelihoods programmes in Somaliland.
- These will be relatively inexpensive and will improve WASH or livelihood objectives. For instance, the catchment of a berkad can be restored to improve the quality and quantity of water the berkad receives.
- Capacity building in participatory and survey methods will be required for existing teams, particularly engineers and community organisers.
- Additional person will be needed for formulating projects using GIS, animal husbandry and agriculture.
- Communities will need to be involved at all stages of planning, design and implementation of activities.
- This approach will provide valuable experience to the Save the Children field teams and allow the programme to be scaled up in the future.

Chapter 3

Framework for a full scale watershed restoration programme

Introduction

This section tries to outline an institutional framework for designing pilot watershed restoration projects in settlements in Somaliland. The information used here is from a mix of sources including field surveys, spatial data from various sites and publications, particularly those pertaining to this region. The framework presented here is based on experiences from designing and implementing numerous watershed restoration programmes and analysing policies and guidelines for such programmes from around the world. Many of the lesson learnt and best practices presented here originate in India which has a large government supported watershed development programme and decades of independent NGO supported and executed programmes.

Implementation mechanisms

Different funding mechanisms are available for supporting watershed restoration projects. However, owing to the necessity of detailed on-ground surveys for evolving working plans and budgets, most funding is done based on benchmark figures. The Indian government model works well in this regard and essentially allocates an overall budget based on the area of the specific watershed to be treated. This figure is then broken down into specific components and allocated to different implementation partners based on their roles. Careful consideration needs to be given to the realities of governance while setting up implementation mechanisms and assigning roles to stakeholders. These tend to formalise power structures and can be difficult to re-structure once they are in place. One way of avoiding this is to separate the technical aspects of implementation from the management. However, this is not always feasible.

The project is usually split into three phases corresponding with preparation, implementation and consolidation respectively. These are, in turn split into major components as follows.

1. Preparatory phase (15-20% of budget)

   (a) Capacity building and setting up institutional mechanisms for management
   (b) Detailed surveys of activities to be undertaken including financial, human resources and time outlay.
   (c) Setup of monitoring frameworks, including baseline surveys and monitoring equipment and loggers.

2. Implementation phase (65-70% of budget)
   (a) Restoration works including physical and biological interventions.
   (b) Record keeping and reporting on the above.

3. Consolidation phase (10-15% of budget)
   (a) Monitoring of project outcomes as per established protocols
   (b) Management and maintenance of assets by community institutions and gradual withdrawal of NGO.

Institutional and management arrangements for project implementation consist of four tiers. Teams engaged at each tier can be increased depending on the number of restoration activities being undertaken and number of sites being covered. An outline is provided in table 3.1 and described below.

Table 3.1: **Management structure of a watershed restoration project.**

Roles and jurisdiction	Institutional members and office bearers
Regional coordination unit	
• Preparation of proposals • Coordination with other agencies • Overall project evaluation and coordination including sanctions	• Government representatives • Funding agency • NGO representatives

Roles and jurisdiction	Institutional members and office bearers
Watershed Project Unit	
• Scrutiny and approval of detailed work plans prepared by the watershed restoration team • Analysis of baseline data and monitoring of socio-economic and environmental parameters to feed back into project decisions. • Design and implementation of training programmes for capacity building of staff and stakeholders. • Financial and programmatic reporting to regional coordination unit. • Identification and coordination of action research studies to feed into project management and restoration initiatives.	1. Project manager (natural sciences or development professional) 2. Accounts manager 3. Education and extension officer 4. Engineer
Watershed Restoration Team	
• Conduct baseline surveys for socio-economic parameters as well as for engineering and biological interventions. • Set up of monitoring stations for all physical parameters, regular collection of data from watershed committee and maintenance or replacement of equipment as needed. • Capacity building of stakeholders in regular management and maintenance of assets and materials created during project, including biological materials and data loggers. • Mobilisation of stakeholders, particularly vulnerable groups for active role in watershed restoration plans. • Accounts and assets reporting as per prescribed format. • Prepare detailed work plans for activities approved by the watershed committee, including financial outlay.	Coordinator (one of the below) 1. Engineer 2. Community mobiliser 3. Veterinary scientist 4. Agricultural scientist

Roles and jurisdiction	Institutional members and office bearers
Watershed Committee	
• Identification of priority areas for treatment in consultation with stakeholders for watershed restoration plans. • Vetting and approving implementation plans including allocation of human resources and other resources from the settlement. • Inspection and supervision of work undertaken attestation of completed tasks and use of materials Sanction of payments for activities. • Attending regular planning meetings with the project unit and overseeing submission of activity reports by the watershed restoration team.	1. Village president 2. Representatives of WASH and other committees

Regional coordination unit

This is an overall coordination and advisory body to which the project coordinator reports. It often controls the purse strings of the project and has the authority to appoint or dismiss staff. The regional coordination unit gains importance when there are multiple projects covering large areas, which is not presently the case.

Members of regional coordination units are drawn from the local government authority which usually heads this unit. However existing coordination arrangements in Save the Children would probably suffice to fill this role at present. Other members include concerned government or development agencies and most importantly, representatives of stakeholders in the region. The latter often requires the creation of a stakeholder platform, which will be vital in the Somaliland context as there can be multiple groups of pastoralists accessing resources of a given watershed or different farmers tapping flows of a river at various locations. The other roles of this body include:

Evaluation and coordination: The overall evaluation of the project across multiple watershed project units and watersheds is the primary responsibility of the regional coordination unit. This includes the assessment and evaluation of activities, auditing of accounts and human resources management. Sanctioning of succeeding instalments for the project is also handled by the regional coordination unit.

Formulating proposals: These identify the area of interest and, provide data about the concerned stakeholders, their needs and how watershed restoration will assist them.

Statistics about the area to be taken up for treatment and general information about the region is also provided. This includes climatic, ecological and environmental conditions, and socio-economic status of the proposed sites. Finally, the proposal provides the funder evidence of active stakeholder support for the project. This is often in the form of written agreements with the community representatives.

Liason: To ensure that there is adequate representation of government agencies, research institutions, donors and other activist organisations in project oversight and for sharing project experiences and developments.

Watershed project unit

This unit operates at a watershed scale, which approximately corresponds to five to six thousand hectares. Based on calculations made for Dhabar-Mamac, it would involve an additional four to five settlements of that size. It comprises of a coordinator who is from a natural sciences or development background and is assisted by an accountant, a veterinarian, an engineer and an outreach and training specialist. This is the apex team of the project and its responsibilities include the following.

Passing watershed development plans: Scrutiny and approval of detailed work plans prepared by the watershed restoration teams is the principal technical role of the watershed project unit. This scrutiny includes the technical evaluation of all proposed activities, their financial outlays and time frames of implementation.

Monitoring: Designing baseline studies and setting up monitoring frameworks including analysis of resulting data reporting based on this analysis is another core function of the project unit. This often precedes the implementation phase as it pertains not only to physical activities but also to socio-economic and environmental parameters which a project may track as part of its overall evaluation framework. Monitoring is usually separated into two parts - activity monitoring which involves measurements and validation of physical works, and impact monitoring which tracks project progress indicators mentioned earlier. Activity monitoring is linked directly to release of instalments for payments within the project teams. Impact monitoring on the other hand, is often linked to release of funds from donor agencies to the project. Project monitoring often has a feed back into capacity building and implementation components of the project.

Capacity building: Capacities of both the implementing agency as well as stakeholders usually require to be upgraded and built prior to a project. This component can have a major allocation of funding and time set aside for it. Experts and stakeholders from other regions are often called upon during the capacity building phase of a project. Exposure visits of stakeholders and staff to other projects are taken up as well. Concerned staff will need to compile documents and data on best practices for the region in terms of interventions in engineering and biological activities.

Reporting: The watershed project unit is responsible for collating all watershed development plans and presenting a consolidated analysis of programmatic and financial progress to the programme unit and watershed committee.

Research: The identification of gaps in information and assigning resources for conducing appropriate action research to inform project activities.

Watershed restoration team

This is the core implementation team of the project responsible for technical inputs and support to stakeholders for project activities. The team comprises of technical staff competent in the major resources, in this case veterinary sciences, agriculture, community organisation and engineering.

Mobilisation: The mobilisation of stakeholders, particularly vulnerable groups is one of the first responsibilities of the restoration team. This is to ensure all stakeholders are adequately represented in the selection of restoration activities for the village. The mobilisation is meant to create a democratic, equitable and transparent structure at the community level for implementing and overseeing restoration activities of the project.

Site level plans: These require detailed surveys of activities across each of the sites. The surveys are initiated through participatory mapping of specific problem areas followed by a discussion on alternative solutions. Once a decision on specific activities to be taken are made, field measurements are taken and detailed estimates are drawn up for each activity. These are vetted by the team expert and then sent for financial sanction. Formulation of site levels plans is an ongoing process and the plans cover both new activities as well as maintenance and management interventions.

Physical implementation: This phase involves the actual physical work on the sites. Implementation usually involves a mix of engineering and biological interventions. The technical inputs vary from one activity to another. For instance, a large dam would require engineering while a contour bund can be laid out without much technical inputs.

Capacity building: Capacity building of stakeholders in regular management and maintenance of assets and materials created during project, including biological materials and data loggers. This is done through a mix of training sessions and through hands on implementation of activities. The team is usually provided formats and training materials by the project unit which also deploys trainers and staff for the programmes.

Record keeping: The restoration team needs to maintain records of assets, expenses under different budget heads and use of materials during activities as per prescribed formats. These are then submitted for verification to the watershed committee and forwarded to the project unit for sanction of subsequent instalments.

Watershed committees

These are the grass-roots institutions responsible for planning, overseeing and implementing project activities with assistance from the watershed restoration teams. They are comprised of village representatives and elders who have an understanding of the resource base and its management. Members of the committee necessarily need to be able to take management decisions on behalf of the community. Their functions are:

Prioritising activities: Identification of priority areas for treatment in consultation with stakeholders for watershed restoration plans. This is usually done during participatory mapping exercises wherein all major stakeholders are involved. Once areas are identified, detailed surveys are undertaken for which members of the committees are deputed to accompany and assist the restoration teams.

Authorisation: Vetting and approving implementation plans including allocation of human resources and other resources from the settlement for specific activities. The approval and attestation of the committee is necessary for the plans to be forwarded to the project unit for sanction.

Evaluation: Inspection and supervision of work undertaken with attestation of completed tasks and confirmation that the use of materials is as per the work plan is required from the committee as a pre-requisite for the project unit to consider a task as accomplished. The committee may be required to fill in a short evaluation form for these activities which forms part of project reporting.

Coordination: Attending regular planning meetings with the project unit and overseeing submission of activity reports by the watershed restoration team so as to coordinate with the rest of the community is another important function of the committee.

Management Framework

Implementation mechanisms described in section §3 can create the impression of a top-down management structure. This section provides a framework to ensure that implementation mechanisms remain a framework for implementation of project activities, and remain answerable to a structure described below.

There are various tiers at which project management needs to operate. However the basic principals are as follows:

Village based watershed committees and users decide on the interventions - they are informed by the watershed development team, but the final decision lies with them.

Resources with multiple stakeholders, i.e. different communities, are managed by a committee comprised of their representatives. This often requires facilitation by a third party, usually the implementing agency or government representative. This committee operates at two levels. At the scale of individual basins earmarked for treatment and at the scale of the entire watershed project. For the former, representatives are part of the watershed committees. For the latter, representatives need to be elected to represent their collective interests at the regional coordination unit.

Watershed development teams and the project unit are essentially facilitators and technical support for the watershed committees. They may suggest interventions and strategies, however these need to be ratified by the stakeholders in either the local or regional fora.

Sustainability issues

Sufficient attention needs to be given to long term sustenance of activities initiated by restoration projects. Experiences from around the world show that these projects are prone to collapse after the implementation phase unless long term funding and support mechanisms are established. While there are cases showing the ability of communities to sustain such activities on a long term basis[4], these originate from different ownership arrangements and are probably not applicable to local conditions.

Approaches used elsewhere include creation of a corpus to meet some of the costs of operation and maintenance. This is usually initiated through project funding but is sustained through user fees for use of resources. The challenges of implementing such an arrangement on resources which are considered largely open access are likely to be substantial, however they are more likely to succeed for community assets such as berkads and enclosed emergency fodder banks.

Funding options

Most funding for the region is focussed on disaster relief and rehabilitation. However there is a growing understanding that a shift in focus is required to address longer term, climate related "slow" disasters. Funding agencies have gradually begun taken interest in watershed restoration as one of the basic strategies for mitigating such disasters. This section provides links to some of the agencies supporting watershed restoration and natural resources management in the region. This is an indicative list.

African Development Fund: A number of projects funded across Africa, among them being a US$ 14.61 million for Burundi in April, 2012.[1]

[1] http://www.afdb.org/

African Water Facility: "As at January 2012, the Facility had approved a total of 71 projects, at a cost of €86.7 million. These have leveraged €420 million on follow-up investment projects. The support is spread across 50 countries and range from community level to national, sub-regional and regional levels." The approved projects list provides details of a number of integrated water resources management and community centric initiatives across Africa.[2]

Global Water Initiative: This initiative is funded by the Howard G Buffet Foundation[3] and is a coalition of Action Against Hunger—USA, CARE, Catholic Relief Services (CRS), International Union for Conservation of Nature (IUCN), International Institute for Environment and Development (IIED) and Oxfam America. GWI has a specific chapter for East Africa and is currently running an initiative entitled "Running Dry – Empowering Poor People to Manage Water in Arid and Semi-Arid Lands."[4]

Waters and Development Alliance: Funded by the Coca Cola company and USAID, this initiative has invested over $28 million since 2005, in 22 countries, 16 of which are African. Its four primary objectives are:

- Establishing participatory, sustainable water and watershed resources management to benefit people and ecosystems
- Increasing access to community water supply and sanitation services
- Fostering improved behaviors in sanitation and hygiene for positive health impacts
- Promoting efficient and sustainable productive use of water to protect the environment and provide economic benefits to communities. [5]

International Water Management Institute: IWMI is a research institute with a chapter in East Africa. Its work includes research collaborations on water resources issues, particularly in the context of climate change and capacity building in the sector.

European Commission: The EU has funded existing projects such as the IWMNet in East Africa under the EU Water Facility has allocated €129 million in 2010. Although this round of funding is over the EU remains a major donor in the region.[6]

[2] http://www.africanwaterfacility.org/en/
[3] http://www.thehowardgbuffettfoundation.org/
[4] http://www.globalwaterinitiative.com/
[5] http://www.getf.org/our-projects-partnerships/wada/
[6] http://ec.europa.eu/europeaid/where/acp/regional-cooperation/water/second-water-facility_en.htm, http://ec.europa.eu/europeaid/work/procedures/financing/international_organisations/documents/guide_on_relations_with_ios+na+bc_en.doc

CARE: Apart from a slew of development programmes in the region CARE has launched the Adaptation Learning Programme for Africa which is being implemented across 40 communities across Ghana, Niger, Mozambique and Kenya. [7]

DFID: DFID “work directly in the countries of the Eastern and Southern Africa, as well as through partnerships with the European Union, UN, African Union and other regional and multilateral organisations”. The Africa Regional programme of DFID[8] and the provisional grant awards[9] are two of the promising funding and collaboration streams offered by DFID in Africa.

Summary

- A comprehensive watershed project offers many advantages over small projects on account of economies of scale and because ecosystem restoration is more effective when larger contiguous areas are treated.
- On the down side, it much more expensive, more complex to manage and requires larger dedicated teams.
- Roles, jurisdictions and responsibilities of different teams are provided. These involve primary stakeholders at both the grassroots level as well as in the apex decision making body of the project. Government agencies and other institutions active in the area are need to be involved.
- Stakeholder platforms need to be created to manage resources shared by different stakeholders and communities. This needs to be facilitated by Save the Children.
- Monitoring and adaptive learning are crucial components of the implementation strategy.
- Systems to ensure sustainability of interventions need to be put into place so communities can take up operation and maintenance of assets created by the project by the time it is completed.

[7] http://www.careclimatechange.org/adaptation-initiatives/alp

[8] http://www.dfid.gov.uk/Documents/publications1/op/afr-reg-2011.pdf

[9] http://www.dfid.gov.uk/Work-with-us/Funding-opportunities/Not-for-profit-organisations/Global-Poverty-Action-Fund/Provisional-grant-awards---impact-funding-stream/

Chapter 4

Site specific project design and examples

This section presents outlines of various small initiatives which could be tagged onto existing programmes. These originate from discussions with staff at Save the Children and with primary stakeholders and can potentially fill important gaps in our understanding of specific resources and their management. Many of the activities involved in the projects require a high input of manual labour. Food or cash for work programmes in the regions would therefore fit into most of the activities listed. However others such as WASH and DRR will require more careful justification.

Erosion control and consolidation of catchments for berkads - a generic work plan for site level projects

Introduction

This is a possible WASH related intervention.

The quality and quantity of water entering berkads is a function of the size of the catchment areas and the amount of rainfall. Other parameters that affect runoff are soil types, ground cover, gradients and natural or man made structures which act as dams and reservoirs and slow or arrest the flow of water and with it, sediment.

Various activities can be taken up in these catchments which include protection of drainage areas so that they have a buffer of vegetative cover, construction of checkdams and gully plugs to slow down and divert flows giving a chance for sediment to settle and improving ground cover.

Methods

Site selection

Site selection needs to be done based on the following procedures:

- Identify berkads that are located directly along or very close to drainages using the resource map overlayed on the generated stream flow map.

- Identify the catchment of the drainage immediately above the berkad as shown in figure figure 5.7a. This area should be under ten hectares. This may require a re-generation of the basin and stream layers with lower area thresholds.

- Derive other layers from available datasets. For instance gradients from elevation maps, soils from the SWALIM dataset and cover from MODIS series.

- Number and details of users of the berkads from the resource map.

Field surveys

Once sites have been shortlisted, field surveys need to be done with the concerned berkad users to cover the drainage lines which should (and this needs to be verified) match the derived stream layer. Specific sites to be noted include:

- Possible sites for building check dams and gully plugs.

- Areas that may be set aside for a riparian buffer.

- Areas where contour bunding may be taken up.

- Areas where tree and shrub species may be introduced or protected.

For all of these their locations with a waypoint, photographs and a list of possible activities should be made. In addition rough calculations of the size and extent of each intervention should be noted. For example, trees can be replanted at 10m spacing covering area between waypoints ## and ## enclosed in track number #.

Selection of activities and validation by stakeholders

This information should be collated and analysed and then presented to the community. The presentation should cover relative costs, materials, labour, time duration of activities and likely benefits of each activity. The community, based on available budgets and their contributions should be asked to prioritise activities.

Work plans for the selected activities should be created and submitted to the community for validation and passing. Once cleared, they should be presented to the concerned programme officer for release of funds. The work plans should include detailed drawings of the structure if construction is involved along with listing and budgeting of materials and labour. In case of contour bunds, the dimension of the bunds in terms of height and length should be drawn on the maps. In the case of planting or fencing, areas and perimeters and details of species need to be listed.

Monitoring

Quantitative and qualitative indicators for monitoring the success or failure of an intervention need to be built into each activity. This should cover both the structures themselves as well as the expected outcomes of the intervention. Information from monitoring needs to be reported back for analysis on a regular basis.

Likely outputs and possible risks

Each of these potential activities contributes to the reduction of sediment entering the berkad and reducing the rate of flow while increasing the duration of flows, especially during intense showers. However there is an important proviso - if the amount of rainfall received is low, check dams and gully plugs will obstruct the flows completely. Communities need to be made aware of this danger. Certain design elements can be added to reduce the risk, such as provision of sluices in the check dams which are only closed once the berkad has filled or reached a certain level.

Construction of water spreading bunds for a small, highly productive grazing area

Introduction

Bunding is a simple exercise of creating low continuous mounds of soil and stones, along the contour in gradually sloping areas (less than a 5% slope). This results in the arresting of natural flows and gives sufficient time for the sediment to settle down, moisture levels in the soil to increase and consequently increasing productivities.

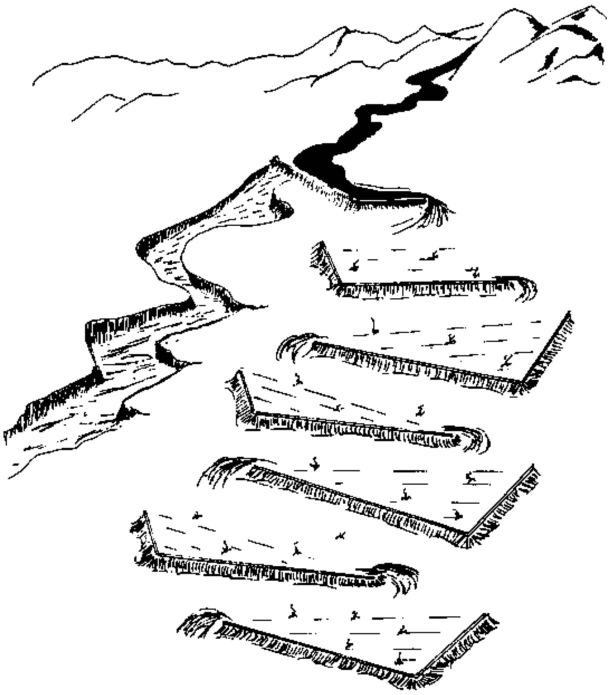
Methods

Water spreading bunds require the use of sight levels or tube levels to ensure the height, width and length of the bund is sufficiently proportioned so that likely flows don't breach the structure. This depends on the type of soils and materials used to construct the bund.

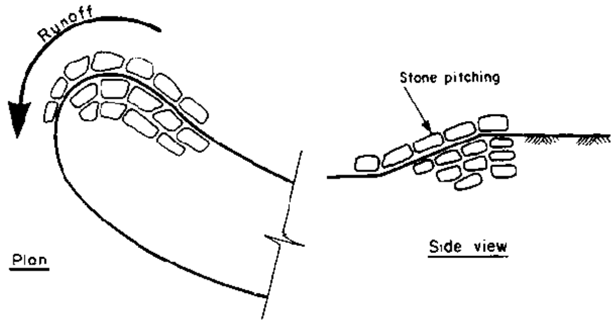
A series of bunds is usually constructed along a given area. There is a clear route planned for drainage by designing overflows at suitable areas as shown in figure figure 4.1 .

Site selection

Seasonal NDVI values for different basis taken over a period of five years can provide a reasonable indication of which basins are productive and which tend to have highly variable or consistently low productivities. Those basins which show high productivities in the rainy seasons should be selected as potential sites. Site selection should also ensure the gradients or slopes



(a) **Water spreading bund design.**



(b) **Overflow design of the bund.**

Figure 4.1: **A water spreading bund, usually used in gradual slopes. The bund ensures that soil moisture is increased and soil loss arrested while it makes provision for excess water to drain. Source `http://www.fao.org/docrep/U3160E/u3160e07.htm`.**

do not exceed 5% as these structures are unstable at higher gradients and their maintenance increases substantially.

The basin maps need to be overlayed on resource maps to determine whether they fall within reserved grazing areas which is preferred from a management perspective. Areas under forest patches or which the community would like to reforest are also preferable as they can provide long term forage and meet local fuelwood requirements.

These maps need to be made available to the community and potential sites shortlisted based on discussions about their relative productivities, management and likely costs of work.

Field surveys

Site visits with photographs and locations of drains and potential bunding sites need to be made with the community to all the shortlisted sites. Surveys with sight levels or tube levels need to be taken for the bund. In case the site is homogenous, a single survey followed by waypoints at centres of subsequent bunds may be taken. Distances between bunds[1] will need to be worked into these surveys.

The selection of activities and budgeting is the last step and is described in **??**.

[1]Calculations are shown at `http://www.fao.org/docrep/U3160E/u3160e07.htm`

Likely impacts and possible risks

Water spreading bunds, and bunds of other types essentially enhance the levels of soil moisture. Therefore, they are usually accompanied by planting of trees, shrubs or seeding of grasses. Alternative these activities are taken up in areas with substantial root stocks in the soil. Soil type is another variable which can determine the effectiveness of these measures. Some soils are easily drained and retain lower moisture than others. Soil types also determine the stability of bunds. In places where soils are loose and flaky, bunds need to be larger and if possible, reinforced with stones and grasses.

In areas of low rainfall, bunding can result in an arrest of drainage when rainfall intensity is lower than the soil permeability. This can raise problems if the bunds are on drainage lines meant for water harvesting downstream.

Building a spatially and temporally explicit database on water quality

Introduction

An important concern of water, sanitation and hygiene professionals is the provision of sufficient quantities and quality of water to communities. The requirements and availability of water changes dramatically on a seasonal basis in many regions. However little is known about the actual changes and their causes. This proposal can answer part of these questions.

Methods

Relatively inexpensive water testing kits and electronic meters are available in the open market. These, in conjunction with global positioning units can be provided to school children who can:

1. Test water from available sources in the village with the meters and log down their observations in simple data sheets.

2. Take GPS readings of the location and record the waypoint number as part of the observation.

The GPS reading can later be downloaded off the units (by Save the Children Staff) and will provide the location of the sample as well as the time and date on which it was acquired. The water tests themselves can provide readings for different physical, chemical and biological properties and contaminants. These include pH, salinity, total dissolved solids, electrical conductivity and presence/absence of e-coli among others.

Application

A dataset such as this developed over time can provide valuable insights for planning WASH interventions. This information ought to be shared with the children as part of hygiene awareness and environmental awareness.

Tracking migratory routes of pastoralist communities

Introduction

Little is known about the migratory patterns of pastoralists in the proposed project area around Cee Lafwyne. This information, however, can be crucial in designing management strategies for pasturelands. For instance, the creation of fodder banks may be a suitable disaster proofing strategy but it will only work if the pastures limits are honoured by all the pastoralists. While this study was independently conceived, a similar enquiry came to light during the literature review[5].

Methods

Inexpensive hand held GPS units can be provided to pastoralists who need to be trained in their operation. These units can be invaluable to them as navigation aids as they are for location tracking. Each participant in the research will be provided a unit and a simple pictorial data sheet to note down the waypoint number and indicate the activity or context. For instance, a waypoint might indicate availability of a good water point or a region of superior forage. The units will further be set to track mode and the participant asked to turn it on every day and off at night, to replace batteries when they get exhausted and to contact the field team or local resource person whenever they reach their settlement.

The field team or local resource person will collect the datasheets, download the data and replenish the supply of batteries and datasheets on a regular basis through a village contact or by meeting the respondent.

Application

Tracks and waypoints collected over a period of time will provide invaluable information about the migratory patterns, nature of resources used and their location. Each GPS reading has a time-stamp which will provide information on rates and distances of movements across seasons and times of day. In turn, the pastoralist will be provided a useful navigational aid and information collected in this process will help design management interventions for the community.

Summary

- Site specific projects require careful site selection as a prerequisite. This involves the integration of data collected through participatory exercises and GIS and consultation with the stakeholders.

- Site specific plans need to be drawn up for each proposed activity. These are based on visits to each and every location and measurements and surveys as dictated by the activity. Stakeholders must actively participate in these surveys.
- Plans for different sites are compared and prioritised by the stakeholders based on budgets, time frames and other available resources. An explicit contribution of the stakeholders should be included in the plans.
- Activities need to be reviewed both in terms of the benefits as well as the risks they entail. These risks can adversely affect resources and access to resources by other stakeholders.
- Prioritisation should consider aspects of control and management of the assets created. Expensive assets and those requiring high maintenance (such as trees) should be located closer to the settlement.
- Monitoring of the activities in terms of effectiveness as well as sustainability needs to be built into the projects.

Chapter 5

Proposal for Watershed Restoration of the Dhabar-Mamac Region

R.S. Bhalla[1], Ibrahim Osman Adam[2], Zakaria Muhumed Mohamed[3]

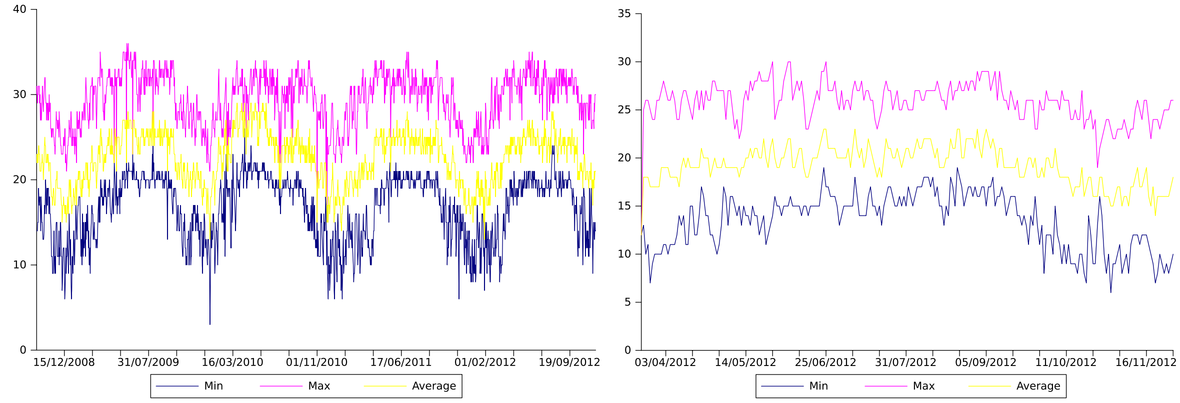
Background

Dhabar-Mamac is a small and predominantly pastoral settlement located in the Ceel-Afweyn district in the Sanaag region of Somaliland. It lies about 25 kilometres south-east of Ceel-Afweyn town and between two small rivers called togga Galiyoqac on the west and togga Murcanyo on the east, falling under the Tug Der/Nugal basin. The land cover of the region has been categorised as sparse shrubs and the precipitation ranges from 200 to 250mm per annum[4] and altitude of about 850 metres. Rainfall, relative humidity and temperature vary greatly across seasons and directly affect the productivity in the region. The soils around the settlement are categorised as Eutric Leptosols[5] which are shallow soils (leptos – thin) and characterised by stoniness, limited rooting depth, low moisture availability. These soils are unattractive soils for arable cropping; limited potential for tree crop production or extensive grazing. Leptosols are best kept under forest and are highly susceptible to erosion[6]. The region falls under the 2a class of length of growing period which corresponds to less than 30 days in both the rainy seasons[7].

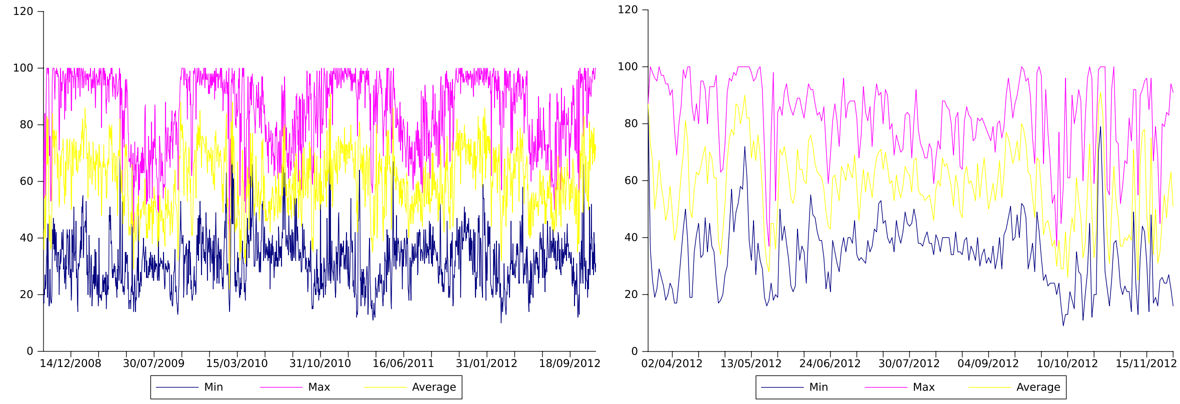
The village is a typical pastoralist settlement and was settled in 1995 due to the presence of berkads and water in the area. Earlier, in 1981 there had been attempts by the then Somali government to settle groups of families across the region, however this attempt at sedentarisation ended with the civil war in 1988. From the initial settlement of 100 families, Dhabar-Mamac has grown to 200 families comprising pastoralists, merchants/traders and others.

There are a total of 124 households with a total population of 500 in the village. Of these

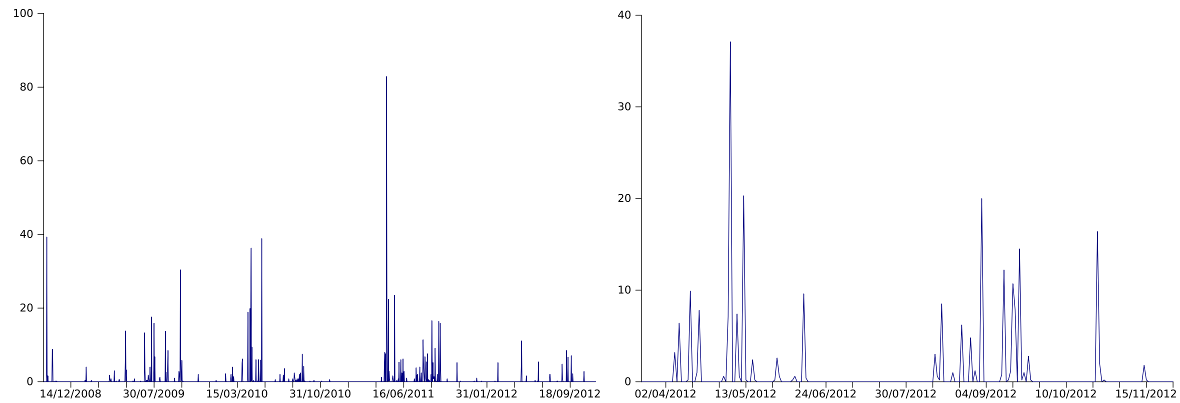
[1]Sr.Research Fellow, FERAL. Consultant Save the Children.
[2]Senior Save the Children Project Officer.
[3]Save the Children WASH Engineer.
[4]From SWALIM/FAO spatial dataset `http://www.faoswalim.org/`.
[5]FAO Africover (2002): Soi l map of Somalia at scale of 1:1000,000.



(a) **Temperatures (°C).**



(b) **Relative humidity (%).**



(c) **Rainfall (mm). The graph on the left shows that 2011 had exceptionally high rainfall on some days during Gu. Also the total rainfall received in 2011 appears to be higher than other years, particularly 2012.**

Figure 5.1: **Basic meterological readings from automatic gauges at Hargeisa (left), with observations since 2008 and Erigavo (right), with observations from 2012. From `http://www.faoswalim.org/`. The graphs show how minimum, mean and maximum temperatures, relative humidity and rainfall change through the seasons.**

120 are men, 180 women and 200 children. There are two thousand goats, a thousand sheep and two cows. The village has no camels. A unique feature about this settlement is that it has members from different clans who work together as a community.

Living conditions in the settlement have been getting worse due to the lack of development support from the government, increasing number of people and a climate which is also changing for the worse.

Economy and livelihoods

The village is comprised of a mix of families of which about 25% are displaced persons who have settled here, another 25% of the households are very poor and without assets. A third quarter of the households is pastoralists, 15% own small shops and local businesses and 10% practice rainfed farming. Roles of different gender groups are as follows:

Children keep animals, collect fuel and water.

Women take care of the bulk of domestic work including cooking, health and some care of livestock.

Men take care of about 90% of all livestock management, they are engaged in construction of berkads, farming and watering animals.

Elderly are usually involved in conflict resolution.

There is a strong influence of seasons on the lives and economy of the village. The Gu summer rains, from April to June are the most important from the perspective of resources, particularly livestock which tends to breed and grow most in the period and also show the least signs of stress and disease. The opposite end of the spectrum is the Jilaal which is the dry spring between December and March. Jilaal marks a period of low water and fodder availability, drop in livestock populations, high stress and health issues with livestock and high rates of migration among pastoralists. The dry summer of Xaaga between July and September is the second most stressful period which is in good years broken by the short winter rains of Deyr during October and November. The Deyr period also marks the maximum sales of animals as the Haj pilgrimage falls during these months. Details of seasonality in activities and resources are provided in figure 5.2.

The settlement has been through some major shocks since its founding. Among these are fire which has burnt the main settlement down three times; in 2006, 2007 and again last year - 2011. In addition there have been two major droughts which in 2003 and again in 2005 resulted in the death of women, children and elderly. The latter drought claimed 3 children and two elderly persons. In both episodes, almost all the livestock was lost and the village had to rebuild their resources through re-distribution of animals within the settlement. The community takes pride in being self reliant as far as livestock was concerned. External aid during this period was confined to water and food distribution by voluntary organisations. Agencies continue to

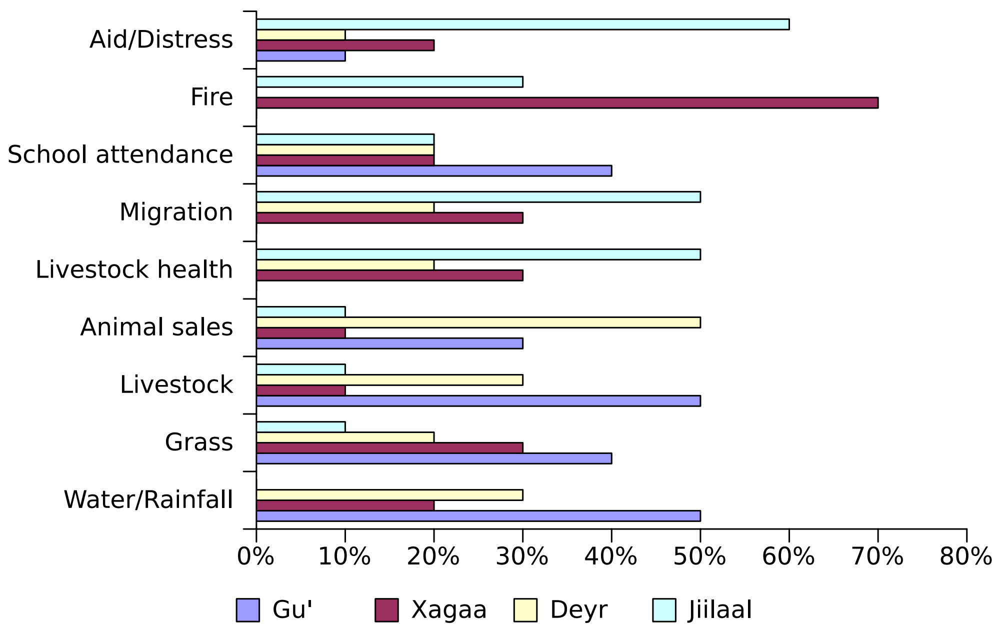


Figure 5.2: **Seasonality of major resources and activities in the settlement. The different colours of the bars represent different seasons. Jiilaal, in light blue, is the toughest month for the community with high requirement for aid, low school attendance, high migration and poor health of livestock, poor grazing and low revenues.**

Occupation	Number of households	Seasonality
Pastoralism	60%	All
Small businesses	5%	Mainly rainy season
Farmers	1%	Rainy season
Without work	34%	All

Table 5.1: **Occupations and number of households engaged in them.**

provide support in terms of supporting berkad construction and trucking water at times of urgent need.

There is a high dependence of the settlement on imports for food. Rice, flour and sugar are the major imports while the only export is livestock. In terms of livelihood diversification, the sources of income are limited to traditional occupations (table 5.1). . Among the skilled workers, there are a few masons and technicians such as mechanics. While the former work in nearby towns while the latter have migrated to larger town and cities.

Table 5.2: **Livelihoods analysis summary.**

Components	Problems	Causes	Coping strategy	Gaps in coping strategy
		Natural resources		
Pasturelands and Forests	Erosion	Uncontrolled roads	Gully plugging with stones, channel water away from roads.	Insufficient resources to do repair or maintenance at the required scale.
Livestock	Water, predators (hyena/fox)	Insufficient berkads	Construct more berkads	Insufficient resources, even to repair berkads, let alone build new ones.
Streams / drainage	Erosion	Roads, loose soils	Gully plugging with stones.	Insufficient resources to cover large area.
Forests	Deforestation	Charcoal and cutting by outer pastoralists.	They are stopped by villagers.	Only possible when there are small groups.
		Technology		
Cell phones	Battery charging	Lack of electricity	Some businessmen have solar charging stations	Expensive to pay for charge.
		Infrastructure		
Berkads	Insufficient storage Mosquito larvae breed	Lack of funds	Raise funds from NGOs	Not always available

Components	Problems	Causes	Coping strategy	Gaps in coping strategy
Roads	No maintenance Cause of erosion	Lack of funds for maintenance	Try and restrict the path taken by vehicles Make embankments to move water away	Resources not avialable. Can only work in small areas
Electricity	No supply	Not on grid	Solar panels with some persons, generator was tried.	Expensive. Insufficient storage in batteries. Generator broke down and couldn't be maintained.
Toilets	Insufficient	Financial limitations	NGO support	Individual toilets are a lower priority than other WASH interventions.
		Investments and credit		
No investment and credit	Not available	No formal set up available	Borrowing and contributions from friends and relatives.	Sometimes leads to conflict.
		Markets		

Components	Problems	Causes	Coping strategy	Gaps in coping strategy
Merchants come to Dhabar-Mamac.	Are not reliable, fail to show up sometimes.	Decline of demand for livestock.	Animals are slaughtered and consumed in the village, some are stored where possible.	Leads to substantial losses. Storage is not easy given lack of electricity/infrastructure.
Shops in village.	Only regular household items available.	Small settlement with limited purchasing power.	Go to Burao or Ceel-Afweyn for major purchases.	Distance, travel issues.
		Capacity building		
Teacher training	No expertise	Lack of coordination		
Health care	No expertise	No resources	Traditional systems used, self medication for common drugs. Problematic pregnancies and serious cases need to be taken to Burao.	Transportation during emergencies is required else the patient suffers or dies.
Veterinary care	No expertise	Lack of connectivity. No resource.	Traditional systems used.	Lost camels on two occasions, in 1996 and entirely (4000 heads) in 2006.
		Institutional support		

Components	Problems	Causes	Coping strategy	Gaps in coping strategy
Berkad construction	Insufficient support	Lack of resources both from institutions and locally.	Community contribution.	Insufficient funds and resources have led to many non-operational and incomplete berkads.
Education	Insufficient classes. Lack of teachers. Insufficient water storage.	Inability of locals to compensate for these requirements.	None	None

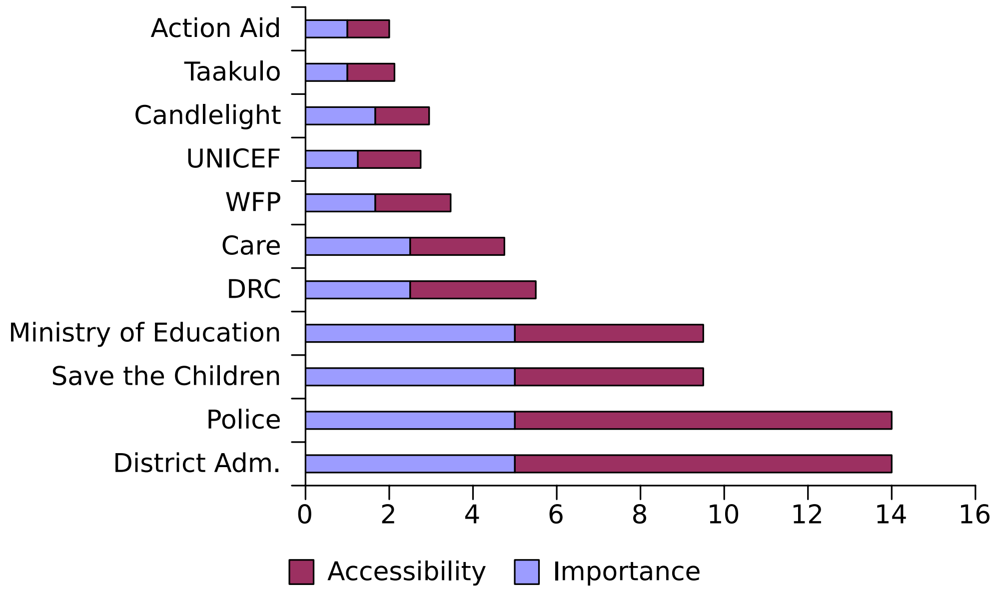


Figure 5.3: **Institutional analysis of the settlement shows the importance (blue) and accessibility (purple) of different institutions which the village was in regular contact with. The government agencies were both the most important and accessible. Among the NGOs active in the region, Save the Children scored the highest in both accessibility and importance.**

An exploration of institutional linkages between the village and other agencies in the region showed that government agencies remain highly important from the security perspective of the community and education. International agencies, including Save the Children, are also highlighted as both important and highly accessible. This is summarised in figure 5.3.

Certain precautions have been taken to reduce the chances of fire. The most significant one is the gradual replacement of roofing materials to inflammable corrugated sheets and increasing the spacing between adjacent buildings to prevent the spreading of fire.

Natural resources

Resource management and partitioning in Dhabar-Mamac is around two major resources - water and pasturelands. The community has constructed a number of berkads - traditional rainwater harvesting structures over the past decade. These were built both through community and private initiative and have been financially supported by international and local NGOs operating in the area. Many berkads are in a state of disrepair or incomplete construction as shown in figure 5.4 and summarised in table 5.3 . These rain water harvesting structures feed of existing channels. Roads, or tracks, themselves are performing the role of channels which is why most berkads are adjacent to them. This leads to associated issues of erosion and gully formation, discussed later.

Two types of pasture lands were described by the stakeholders. Reserved pastures fall in relatively fertile soils in below the hills and around the berkads and major drainage region which also supports a sparse forest comprised largely of acacia trees . The reserved pasture is meant for livestock of the settlement, especially during times of drought, the other areas are open to

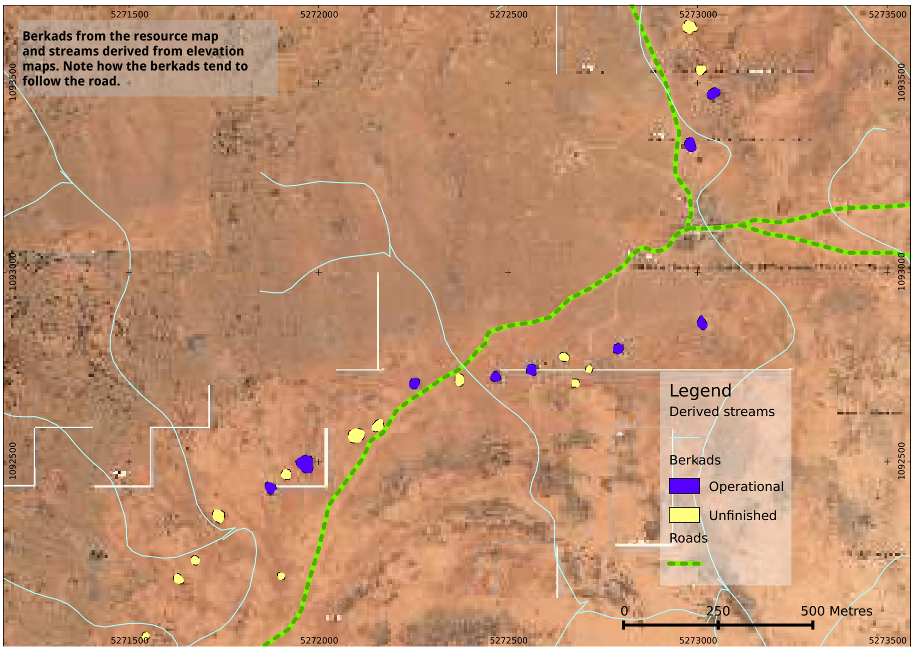


Figure 5.4: **Location of berkads in relation to drainage patterns and roads. The blue coloured polygons are operational berkads while the blue lines are streams that were derived from an elevation map. The figure shows that a large number of berkads in the village are not working (yellow). Furthermore, most of the berkads located east to west are not near any drainage lines, indicating that they are not located optimally.**

Status	Community	Private	Total
Working	3	6	9
Needing repair	0	2	2
Unfinished	2	11	13
Total	5	19	24

Table 5.3: **Status of berkads at Dhabar-Mamac.**

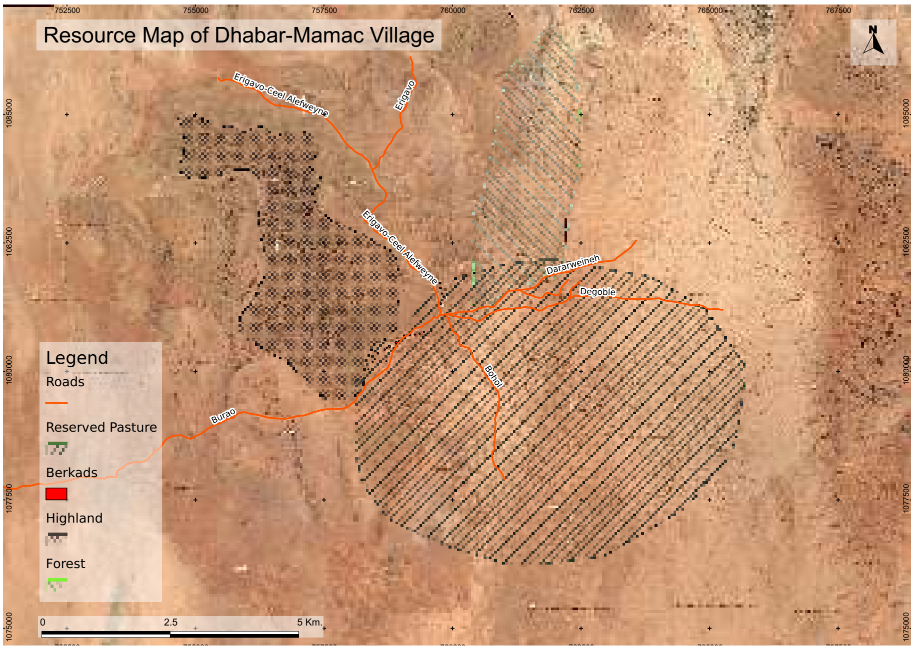


Figure 5.5: **Location of the major resources of the village. This map is an overlay of the resource mapping done with the community over a high resolution (0.6 metre) aerial image of the region downloaded from the Microsoft Bing Maps and tiled to create a single image. Hills lie on three sides of the settlement with those on the west and north-west draining towards the settlement the berkads an the forest patch. The hills on the East appear less important but also drain into the reserved gazing areas.**

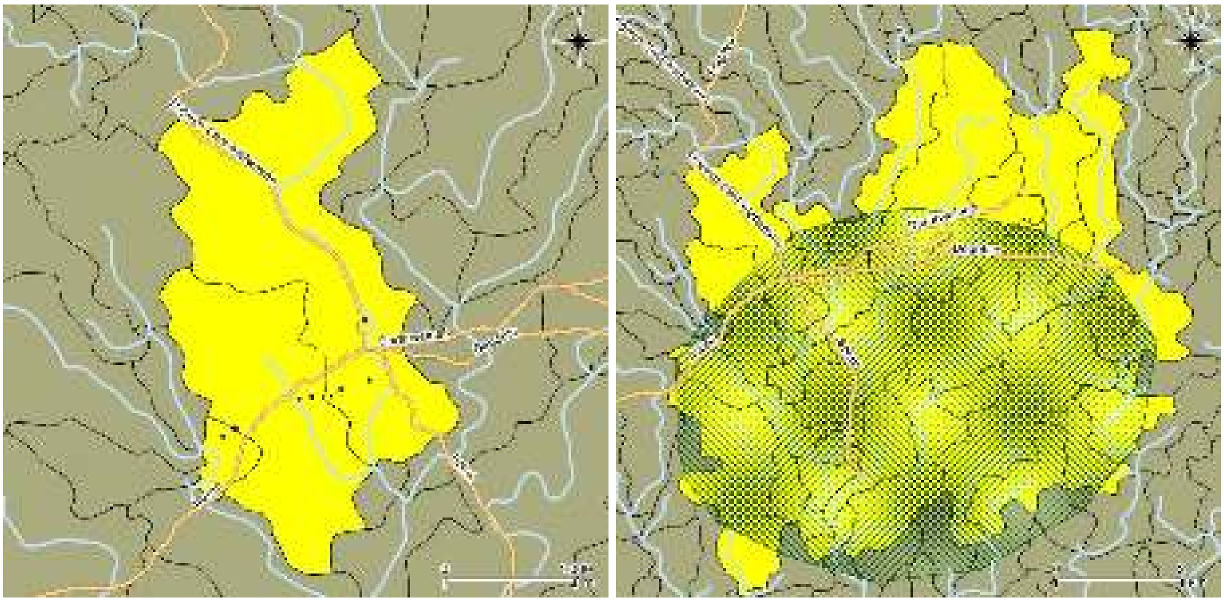
migratory pastoralists. The same system applies to the local pastoralists when they migrate to other areas. However, these boundaries are not formally defined nor enforced strictly. For instance, during times of drought and distress migratory pastoralists are permitted access, or take possession of reserved pastures. It was also noted that occasionally the migratory group is very large and powerful, in which case, the visitors have a free run of the range and none of the demarcations are respected.

Models and scenario building

The following sections describes a simple decision support application which is based on a mix of resource mapping and analysis of elevation data. Note that the routines are based on values provided by the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER), which is on board the terra satellite launched in 1999. The image provides 30m resolution. The results obtained from these routines are therefore indicative.

A basin and stream segment map was generated using and ASTER image and a watershed routine in GRASS where the threshold of the watershed size was set to approximately fifty hectares. The resulting layer was converted to vector and smoothed for display after the area statistics was copied onto the attribute table. Basins draining into the berkads and grazing areas were then selected and their combined area measured (figure 5.6).

An alternative method is to identify a catchment from a starting point in a stream - for instance, where a stream passes a berkad. This generates an isolated catchment, and while not entirely a "watershed" approach, it allows for delimitation areas specific to drainage, rather



(a) **Basins around functional berkads.** *(b)* **Basins draining into grazing grounds.**

Figure 5.6: **Watershed or basin boundaries and drainage lines or streams derived from elevation maps and set to an approximate size of 50ha. Basins coloured in yellow drain from north to south into the important resources identified by the stakeholders.**

than complete basins. This approach can be combined with the identification of basins to narrow down on specific stretches of areas for treatment in stead of treating complete basins or complete stream catchments (see figure 5.7c for a diagram and explanation). The areas under different resources and associated basins are presented in table 5.4.

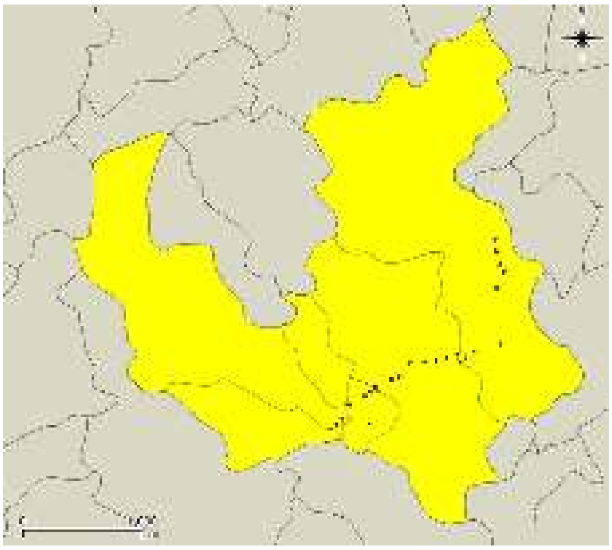
Verification by the stakeholders

This exercise was first shared and details verified with the chairman of the village and then verified with other members of the community. There was broad agreement that the resource mapping was correct and that the overlay of streams and basins consistent with observed patterns. The community also agreed that in order to address many of the issues, a larger area needed to be treated the size of which would be determined by the local drainage patterns.

Seasonal scenarios with the stakeholders were attempted on the map. However, as shown on table 5.4, they did not perceive any change in the area covered. On the other hand specific issues, such as erosion, were identified as more severe and quality of grazing areas was shown to deteriorate as the year moved on from the summer rains.

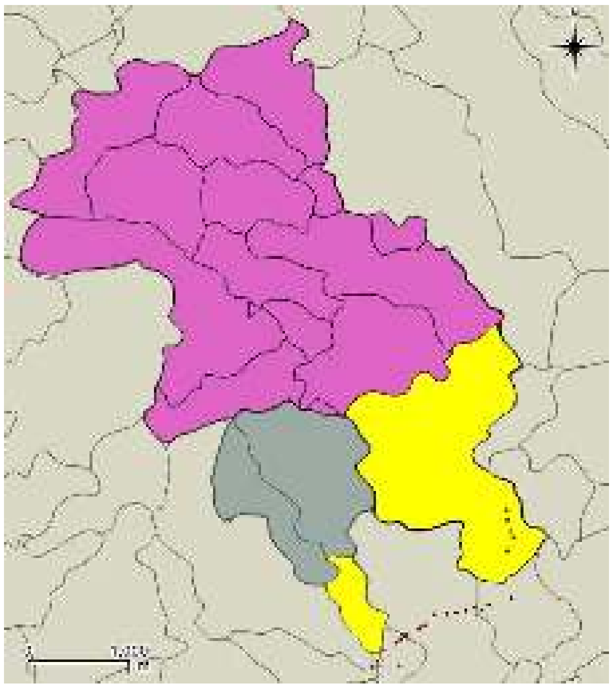
Restoration strategy

Given the background and statistical data of the village, the following restoration strategy is proposed. This has been presented to the community and suggestions and feedback has been incorporated.



(a) **The basins in which different berkads fall.**

(b) **The blue and pink show the catchment areas of streams that drain into the berkads on the west (blue) and east (pink).**



(c) **Yellow polygons indicate those basins that fall in the catchment of the streams at the location of the berkads.**

Figure 5.7: **This figures shows how areas can be selected. The smaller drainaage line on the east spreads across three basins while the larger covers over 15 basins with total areas of 215 and 1266ha respectively. However, if only the nearest basin to the berkad on the drainage is selected, the area is only 28ha for the smaller and 250ha for the larger.**

Name of resource	Seasonal Status				Description and area of resource	Basin Area
	Gu’	Xagaa	Deyr	Jiilaal		
Reserved pasture land	Productivity decreased from Gu to Jilal				Close to settlement extends to 3500ha.	6462.22ha.
Berkads	Productive	Run dry			Five basins covering hilly regions.	526.45ha.
Forest areas	Productive	Not used	Productive	Not used	780ha.	2063.51ha.
Erosion	Acute - water	Mild - wind	Mild - water	Mild -wind	All around the region, more severe near roads and channels.	Not applicable
Agriculture	Productive	No cultivation.			Under a hectare	Not applicable

Table 5.4: **Basin description and area statistics from resource map. Note that the basin statistics are generated using a minimum size of 50ha based on the drainage. The catchment statistics, on the other hand, are generated from a point identified on the stream and only cover that portion of the catchments that drains to that point.**

Prioritising areas

Four areas for soil and water conservation works were identified during the field visit and subsequent discussion. These are:

1. Catchment of berkads which need to be stabilised to reduce the inflow of silt and increase the duration of flow.

2. Roads which have begun to form gullies need to be be plugged and stabilised. Inlets into these artificial streams need to be blocked and re-oriented towards natural drainage.

3. Small check dams need to be constructed in areas where deeper gullies have already been formed.

4. Contour bunding needs to be taken up over a large area, prioritising pasture lands where soils are fertile.

Planting can be done in all areas along soil and water conservation structures, however given the high pressure from grazing, planting needs to be accompanied with protection using tree guards or through fencing. Three kinds of vegetation restoration needs to be explored:

1. Existing forest areas which can be inter-planted with suitable species.

   Those suggested by the FMNR[8,4] experience include *Acacia albida*, *Acacia macrostachya*, *Acacia nilotica*, *Bauhinia rufescens*, *Eucalyptus camaldulensis*, *Leuceana leucocephala*, *Mangifera indica*, *Parkia biglobosa*, *Parkinsonia aculeata* and *Ziziphus mauritiana*. It should be noted that some of the suggested tress such as *Prosopis juliflora* are known to be invasive exotics and ought not to be used.

2. Enclosures where energy plantations can be initiated to supplement fuel requirements of the settlement. Again, species which are suitable for this region need to be identified.

   Among those listed in the FMNR documentation are *Bauhinia reticulata* , *Combretum* spp., *Ziziphus spina* , *Z. mauritiaca*, *Faidherbia albida* and the drought resistant shrub *Guiéra senegalensis*. These species have been used successfully in the Niger as part of the "farmer managed natural regeneration" effort.

3. Based on experiences from other regions, a small area may be earmarked as a fodder bank for emergencies. This will need to be fenced and should ideally be close to the settlement so it can be protected from livestock. Species used in the Niger region include *Andropogon gayanus, Bracharia ruziziensis, Pennisetum pedicellatum, Pennisetum purpureus* and *Stylosanthes hamata*.

Linking activities with income generation and livelihood options

Given the high level of dependence on livestock and farming, it would be appropriate to involve the communities directly for implementing watershed restoration activities. Different activities can be earmarked for different groups to ensure incomes are spread equitably.

While the use of machinery may be necessary, it will be done in cases where manual labour is impractical from an efficiency and economic point of view. The combined use of machinery and labour will also be considered for activities such as contour bunding and preparation of areas for fodder plantations.

Management frameworks

A clear management framework is already in place in Dhabar-Mamac. This involves individuals elected to represent WASH committees who are used to coordinate and administer assistance from NGOs in the area. The system ensures participation of all stakeholders, including women and children and is designed to be transparent and accountable to the village as a whole.

Opportunities for watershed development

Given that this is the first project of its kind in the region, this settlement provides a number of opportunities for initiating the pilot.

1. It is located between two distinct drainage basins and faces moderate levels of problems which can be realistically tackled by the community given adequate levels of support.

2. The size of the areas for treatment are reasonably small and restoration can be focussed to restore and protect specific and measurable resources, namely waters, forage, forests and erosion control.

3. Dhabar-Mamac is a permanent settlement, even though a large section of its population remain migratory pastoralists. This permanence ensures that the watershed region immediately around the settlement can be managed on a continual basis.

4. There is a clear community leadership in place which facilitates the institutional aspects of watershed restoration - i.e. formation of user groups and committees. Dhabar-Mamac has and continues to receive support from local and international NGOs and also has links with some government departments.

5. Restoration works for this project can be taken up in stages and through successive pilots and field trials. This will allow a wide range of interventions to be tested prior to extending the work to other parts of the watershed. This also provides valuable time for capacity building of both the stakeholders and the implementing agencies.

6. The village is only half an hour away by jeep from the district capital of Ceel-Afweyn.

Acknowledgements

We thank the people of Dhabar-Mamac for enthusiastically participating in the surveys and meetings which were held over a three day period. In particular, we express our gratitude to Isma'il Ali Mohamed, the Chairman of Dhabar-Mammac village. Other participants were Ibrahim A/Rahman Mohamed, Saeed Adan Diriye, Hassan Kahin Warsame, Muse Adan Diriye, Saleban Dhunkal Ali, Ibado Jama Daad, Amina Hussein Salaad, Adan Jama Diriye, Mohamed Jama Abdulle, Fadumo Ahamed Hassan, Aisha Saleban Dhunkal, Hawa Adan Diriye, Fadumo Mohamed Salaad, Jawahir Mohamed Abdulle, Yussuf H.Adan, Amina Yussuf Madhafan, A/ULahi Adan Diriye and Roda Jama Du'ale.

Yasim, the driver for Save the Children, enthusiastically participated in the exercises, took photographs and cheerfully drove us around terrain better suited to camels and goats. His help allowed us to collect ground control points for a wide area around the settlement which added significantly to the accuracies of the maps.

Bibliography

[1] Scoones, I. & Institute of Development Studies (Brighton, E. *Sustainable rural livelihoods: a framework for analysis* (Institute of Development Studies Brighton, 1998).

[2] Farrington, J., Carney, D., Ashley, C. & Turton, C. *Sustainable livelihhods in practice: early applications of concepts in rural areas*, vol. 42 (ODI, 1999). URL http://www.odi.org.uk/resources/docs/2877.pdf.

[3] Allan, C. & Curtis, A. Nipped in the bud: why regional scale adaptive management is not blooming. *Environmental Management* **36**, 414–425 (2005). URL http://www.springerlink.com/index/X3187H460R2JK660.pdf.

[4] Cunningham, P. J. & Abasse, T. Annexe 10: Reforesting the sahel: Farmer managed natural regeneration. *situation actuelle et perspectives* (2005). URL http://www.worldagroforestry.org/downloads/publications/PDFs/WP13809.PDF#page=81.

[5] Tempia, S. *et al.* Mapping cattle trade routes in southern somalia: a method for mobile livestock keeping systems. *Revue scientifique et technique* **29**, 485 (2010). URL http://sahsp.info/SiteContent/Documents/Others/Cattle%20Trade%20Routes.pdf.

[6] ISRIC world soil information. http://www.isric.org/. URL http://www.isric.org/.

[7] Venema, J. Land resources assessment of somalia. Technical Report L-13, FAO-SWALIM, Nairobi, Kenya. (2007).

[8] Bayala, J., Kalinganire, A., Tchoundjeu, Z., Sinclair, F. & Garrity, D. Conservation agriculture with trees in the west african sahel–a review. *ICRAF Occasional Paper* **14** (2011). URL http://www.worldagroforestry.org/downloads/publications/PDFS/OP17114.PDF.

[9] Waters-Bayer, A. Local innovation and participatory innovation development: The concepts and their application in livestock-related research and development. *ESAP proceedings* 3 (2005). URL http://esap-ethiopia.org/Publications/Proceedings/12th_Proceedings.pdf#page=23.

[10] Riché, B., Hachileka, E., Awuor, C. B. & Hammill, A. Climate-related vulnerability and adaptive capacity in ethiopia's borana and somali communities. *Manitoba: International Institute for Sustainable Development* (2009). URL http://typo3.fao.org/fileadmin/user_upload/drought/docs/7_Climate_Change_study,_Full_Assessment_Report_FINAL.pdf.

[11] Reed, M. *et al.* Who's in and why? a typology of stakeholder analysis methods for natural resource management. *Journal of environmental management* **90**, 1933–1949 (2009).

[12] McCall, M. K. & Morelia, M. pgis-psp–lsk. *Human Ecology* **30**, 215–226 (2010). URL http://ppgis.iapad.org/ppgis/pdf/PGIS_PSP_LSK_Biblio_may_2010.pdf.

[13] Hijmans, R., Cameron, S., Parra, J., Jones, P. & Jarvis, A. Very high resolution interpolated climate surfaces for global land areas. *International Journal of Climatology* **25**, 1965–1978 (2005).

[14] Giannini, A., Biasutti, M., Held, I. M. & Sobel, A. H. A global perspective on african climate. *Climatic Change* **90**, 359–383 (2008). URL http://www.springerlink.com/index/415661jkrrxqqx28.pdf.

Appendix

Appendix A

Review of appropriate field methods

This section covers various gaps that were identified during interactions and exercises with various field teams based in Somaliland during the study. The section also presents examples of outputs from the various data collection exercises and GIS/remote sensing analysis which resulted in a partial filling of some of the gaps. Internal capacities need to be built in a number of these methods in order to implement participatory resource restoration and management.

Action research techniques can fill in important gaps in our knowledge of natural resources and their management. The term action research implies that research carried out involves the primary stakeholders, not just as respondents, but as active collaborators. Therefore the community needs to be aware of the objectives of the research and a willing partner in its implementation. The field teams therefore need to be actively engaged in the design of action research projects and the analysis of the data collected along with the stakeholders. A couple of examples of possible research have been provided in the appendix.

The high level of acceptance and respect that Save the Children has earned amongst local communities is a major asset which provides a springboard for launching a range of collaborative projects with local communities, across a wide spectrum of areas, not just NRM. Many of the methods and tools presented here are generic in nature and are meant to be adapted prior to use.

There are a wide range of publications dealing with participatory and other survey tools and techniques[9]. The purpose of this section is to list out the major tools and explain how they may be applied in the natural resource management context. The actual methods can easily be referred to from the literature provided in the bibliography section[1].

Participatory methods

These refer to tools and techniques wherein the respondent is actively involved not only as a source of data, but in its presentation and analysis. Participatory methods allow respondents to interact with the observer and each other and are usually, but not always, based on a consensus view. It is therefore important that the observer is aware of hierarchies and representation of

[1]Another, locally adapted outline of methods is provided by Riche.et.al., 2009[10].

differing stakeholders during a session.

The following kinds of participatory methods need to be understood by action research teams in order to implement a NRM project. This is by no means an exhaustive list, but more of a bare minimum.

Stakeholder analysis: to help identify the various stakeholders and their relation with each other with specific focus on strengths in number or proportion of the community and influence wielded in the community and in relation to other stakeholders. Identification of stakeholders often precedes other participatory exercises as it helps the observer creating “focal groups” so that domineering interests don’t affect outcomes of participatory exercises.

Institutional analysis: an extension of stakeholder analysis to discern the linkages different stakeholders have with institutions or external stakeholder groups active in the area. These could be government agencies, non-government relief and development agencies or private interest groups. The exercise results in a matrix of access and importance from a stakeholders perspective. A theoretical treatment of the subject can be found in Reed et.al., 2009[11].

Resource mapping: knowing the location, extent and quality of important resources is a fundamental requirement for their management. Resource mapping is an interactive exercise, often running into many days, which builds a birds eye view of the resources used and required. The exercise can be moulded into describing seasonal changes, identification of opportunity and problem sites, conflict zones and other areas of interest. Further, resource mapping can easily be integrated with geographical information systems (GIS) by fixing real world coordinates to the landmarks identified during the exercise. The outputs of the exercise can then be digitised and overlayed on other geographical data such as remotely sensed images. Integrating resource maps in this way allows an agency to develop regional scale maps[2].

Historical mapping: this exercise builds a time-line of important events over a generation or longer, in a community. Each historical mapping exercise has a focus or theme. It provides the observer a context in terms of recurrence of crisis or opportunity and the response of the community to this crisis. It also identifies major “shocks” that a community may have gone through in the past and consequently is an index of vulnerability of the community to natural or other disasters.

Seasonality: natural resource based livelihoods are strongly influenced by seasonal patterns in resource availability. These are often triggers for important social and cultural events and, influence economic processes and signal the arrival of disease or other health related hazards such as abundance of vectors or contamination of water sources. Seasonality

[2] An example can be downloaded here http://www.feralindia.org/drupal/content/village-resource-handbook

mapping is usually done in a focussed group and in a focussed context to ensure observations and consistent across resources and resource use by stakeholders.

Vulnerability analysis: a major advantage of the sustainable livelihoods framework[3] is that it facilitates the identification of livelihood related vulnerabilities and coping strategies that are adopted by stakeholders. This information can be crucial to tackle specific gaps in coping strategies or to design strategies to tackle the causes of vulnerability itself.

Other non-participatory and semi-participatory data collection techniques

Schedules

Stakeholder analysis conducted using participatory exercises is an efficient way to develop a general understanding of the structure and composition of a community. However, it is also important to determine specifics about assets, income and expense, investment across various sectors and influence over management of community owned resources. This is often done best through one-on-one household surveys conducted either with the family as respondents, or specific stakeholders within the family, such as women. Survey teams need to be in a position to run such schedules based on a sampling design which is usually random or a stratified random sample of the settlement. These schedules need to be designed so they are efficient and don't "exhaust" the respondent. The design has to be done based on specific questions or hypothesis. Finally a data entry facility and database needs to be designed to hold the information in a readily retrievable format.

Electric sensors and data loggers

Electronic sensors exist for a range of parameters that are important from a water resources point of view. These are simple to operate, usually requiring little more than the observer dipping the sensor into a sample of water. Sensors of this type provide a range of readings such as electrical conductivity (related to total dissolved solids), salinity, turbidity and pH.

There are a range of data loggers which require little or no intervention on part of the community, other than protection from physical damage or theft. Often individual "contacts" in the community are asked to inspect the loggers to see if they are functional and may be involved in replacement of batteries and/or data cards. Among the automated loggers that require little or no interventions are meteorological stations comprising of rain gauges, temperature loggers and occasionally wind speed/direction and light meters.

Automated level recording stream gauges are another important field equipment which fall into a second category of needing some intervention from the community. These loggers are essentially re-set at the beginning of each rainy season and are often attached to a stilling well

[3] For more resources: http://www.livelihoods.org/

assembly which in turn is part of a flow measurement structure, either a V-notch or a flume. The intervention required for such devices relates to their susceptibility to shifting due to the force of water, or more often, developing leaks along their sides or structural defects which allow the water to flow unrecorded.

Global Positioning Systems

GPS are the third set of equipment which can be used very cost effectively in conjunction with primary stakeholders. These are inexpensive hand-held units which can be used to track ranges, mark landmarks such as drinking water points and for navigating to prior known points or along a route. GPS units can be equipped with sufficient memory so that tracks are logged for over a month and the user need only switch the unit on and off and replace the battery if it dies down. This is a particularly attractive option in the present situation where little is known about the movement patterns of migratory pastoralists[5].

Photographs

Photographs provide a vital source of information. Present data cameras are equipped with GPS units geo-tagging photographs is now a common practice. There are a host of software which allow photographs to be archived by time and location, including tools which allow them to be embedded in relational databases. Such tools are rarely utilised as a means of comparison and change detection and are also being integrated into GIS[4]. There are a host of measurements which can be taken using "scaled" photographs. Software packages such as imageJ[5] open up a host of possibilities in terms of quantitative data collection through stakeholders.

Data analysis and presentation

A fundamental requirement of participatory and action research is the vetting of the final draft by the primary stakeholders. This requires the "technical" staff to analyse the data and make it available in a visual yet informative fashion to the primary stakeholders. The same data can be presented in more technical forums to the scientific and professional community.

One of the major gaps of participatory data collection efforts is that the information is either lost, or not shared beyond the specified project and its funders. Important lessons learnt are therefore lost and efforts made in collecting data are wasted. Often this leads to respondent fatigue, wherein the concerned community gets tired of repeated "PRAs". This is partly due to the tendency of participatory exercises remaining on brown sheets or photographs. Data is not transformed to a digital format, often because data collection is done with the perspective of developing a background understanding. There, however, a number of straight forward means

[4]For instance the Event Visualisation Tool http://biodiversityinformatics.amnh.org/open_source/evis/index.php

[5]http://rsb.info.nih.gov/ij/

of making participatory data available for more formal statistical analysis and before-after comparisons.

Make data numerical

Many participatory techniques require respondents to compare between variables. For instance, an institutional analysis requires stakeholders to assign an importance and an accessibility value to agencies that they interact with. These Venn diagrams are highly suited to analysis and simple presentation as shown in figure 5.3. Another example of ensuring data is suitable for analysis is a seasonality exercise results of which are presented in figure 5.2. Data such as these also provides a useful monitoring tool and time series of such data can easily be collected and compared to see changes in resource utilisation or stress as a measure of success of a given projects. Finally, such data can easily be visualised and thereby made available to a semi-literate or illiterate audience which allows them to evaluate it and use it as a basis for discussion.

Using maps or GIS

Maps provide a highly informative and visual means of sharing information. There are a range of techniques to represent spatially explicit data on a map which includes thematic maps where different colours or patterns are assigned to attributes. Maps can also display bar charts - such as different water quality readings from water sources and allow a mix up of different "layers" of information. A number of GIS related tools allow time series analysis of spatial data and animations which help visualise changes in a region over time.

There are a growing number of participatory GIS tools and techniques available today[12][6]. These are based on one basic procedure - that of geo-referencing all spatial data collected during participatory exercises. Participatory GIS also involves a number of field methods which allow rapid surveying of areas both for horizontal (x,y) coordinates as well as for elevation.

Putting data on maps has important implications for its integration with other tools. For instance, this data can be used to calibrate and validate hydrological and land-use change models. These in turn are increasingly being integrated with regional climate change models. The linking of participatory methods and action research with site specific hydrological models would address two major issues:

1. The ability to make climate predictions and localised models available to primary stakeholders who presently depend on external agencies to bring this data to them in palatable forms.

2. To provide modellers access to near real-time feedback and monitoring of field conditions, including data loggers, training sites and ground control points.

[6] A slighted dated manual is here http://www.feralindia.org/drupal/content/field-methods-participatory-gis.

In addition, the creation of participatory GIS maps is often less cumbersome than traditional participatory mapping. The availability of high resolution imageries and aerial photographs facilitate the direct digitisation of layers and population of databases during the mapping session itself. This does away with the errors associated with drawing un-scaled maps on the ground, transferring them to paper and then to a GIS. Quality of the data can also be verified by collecting ground control points.

Appendix B

Data - Requirements and Gaps

This section presents the various gaps that exist in available information from a natural resource management perspective. A short discussion on how they may be filled and the kind of resources that will be required to do so is also presented.

Environmental and Ecological

Meteorological

Meteorological data for the region is collected either by UN agencies such as the FAO or by universities and government institutions active in the area[1]. Resolution of the data is a major issue that confronts any user, be it a field worker or a modeller. One way of addressing this issue is to interpolate available datasets as was done by Hijmans[13]. However, the best way is to have finer grids of monitoring stations. Parameters that are required include precipitation, temperature, relative humidity, wind speed and direction and light intensity. The role of local feedbacks in temperature are known to have an important feedback into the precipitation systems in the Horn of Africa[14], further underlining the need for better monitoring, particularly of temperature and rainfall. The needs for fine grained precipitation data is even more crucial for site specific hydraulic models.

Hydraulic

Ungauged watersheds are the single largest obstacle for setting up and testing localised impacts of watershed restoration on stream flow or for hydraulic models. In the absence of stream flow data and measurements of sediment transport (or other parameter of interest), it becomes very hard to link up local management decisions with predictive models. A modeller is then constrained to utilise "likely" scenarios to calibrate models and the predictions are also unvalidated. This doesn't mean the models are not useful, in fact some such as the Soil and Water Analysis Tool (SWAT) are used widely because they estimate "reasonable values" for missing

[1] `http://www.fews.net/Pages/default.aspx`, `http://www.faoswalim.org/subsites/climate/index.php`,

parameters. These models are known to predict discharge from streams in the region of 70% accuracy in some cases. However these predictions need to be considered as rough estimates.

Flow data can be collected on site using a mix of automatic loggers and direct observation. Installation of V-notches or flumes in small streams in conjunction with water level loggers can automate the logging of flow rates. However this is not viable for larger streams where construction of flumes can be very expensive. In the latter case, a stilling well is used and the stream profile is measured to determine the cross section of flow at various heights. Flow meters are then used during flow events to measure the velocity of the water at different lengths. In instances where this is not feasible the “floating orange” method is used.

Water

The central theme of the study is to enhance and manage existing water resources through various restoration practices. There is, however, a large gap in knowledge about existing water resources. This ranges from spatial information about the location and type of natural and artificial water harvesting structures and the type and location of aquifers and potential for sustainable ground water exploitation. Quantitative information about the potential yield of water and size of aquifers or surface source on a seasonal or finer temporal resolution is missing. Qualitative information about the quality of water in terms of biological, chemical and physical contaminants and constituents is limited to the UNICEF sampled wells. This too is likely to have a seasonal pattern which is inadequately covered. Finally, social information about the use of each of these water sources, whether they suffice, their management and investments made in their creation and upkeep is lacking.

Collecting the qualitative information requires relatively in-expensive electronic meters and portable water testing kits. It can be done through community volunteers. Similarly social and spatial information can be easily collected using participatory mapping and physical site visits. Quantitative information, on the other hand is more involved and will require geological surveys, modelling of catchment areas and extraction experiments, the latter not always being an option as it may deplete or be seen to deplete the scarce resource.

Soil and Geology

Most models dealing with soil transport and ground water recharge depend on a range of data on soil taxonomy, its physical properties (particularly texture) and behaviour when wetted - percolation rates, transport capacity, drainage and erosivity. Likewise, the configuration of geological formations determines the layout of aquifers, their recharge and exchange between ground and surface water systems.

Such data is usually available at very coarse scales and models therefore have routines to interpolate values for their purposes. Else this task is left to the modeller. In both cases, the accuracy of the models is compromised, particularly for finer scale predictions. Data on soils and geology for this region is available from the SWALIM site[2] which has compiled data at scales ranging from 1:100,000 to 1:1,000,000.

Soil and geological surveys are usually very expensive to conduct on large scales. However on site specific scales measurements of texture and class can be done simply using the "soil triangle". Soil water potential and moisture is usually measured using probes, tensiometers for the former and time domain reflectometry (TDR) or capacitance probes for the latter.

Geological surveys utilise a range of observational techniques from the study of land forms and outcrops to satellite imagery. Direct observations include the study of deep bore-holes and the use of electromagnetic and seismic surveys. Collection of geological data is expensive and usually such surveys are carried out by governments, oil exploration agencies[3] and on smaller scales for identification of drinking water aquifers at the site level. Such surveys can yield vital information in terms of availability of ground water. Identification of sufficiently large aquifers with potable water could go a long way in addressing the drinking water and perhaps agricultural requirements of these villages. Issues of sustainability and recharge remain important and the latter can, in some cases, be addressed by suitable water conservation and recharge structures.

Ecological

There are large gaps in available data on species composition and functional aspects of plant communities in the project area. Without this understanding, restoration efforts can only be directed towards a general increase in soil moisture with the expectation that it will lead to overall productivity. A check list of important plants, those preferred by livestock could be collated from the pastoralists and cross-verified to arrive at scientific names through a review of literature or discussion with experts in research institutions.

A number of ecological methods can be used to measure other important parameters from the perspective of restoring pasturelands and monitoring their conditions under different rates of grazing pressure. Four kinds of information are required:

1. An understanding of ecosystem dynamics. These would require monitoring of species composition, richness, abundance and turnover on a seasonal as well as geographic basis.

2. Analysis of productivities of different species and their relative importance to livestock as food sources. Further, a nutritional and metabolite comparison of different species would provide insights into feeding preferences.

3. From the restoration point of view, research on nursery techniques to raise and re-introduce different species of forage as well as important tree and shrub species is important.

4. There are a number of important questions pertaining to the carbon fixation done by these extensive grassland ecosystems which would help in our understanding of the carbon cycle.

[2] http://www.faoswalim.org/Geology%20and%20Soils

[3] Such as AOI which operates in parts of the Horn of Africa.

A mix of field surveys, participatory discussions, in-situ and ex-situ nurseries, exclusion plots and laboratory techniques is required to achieve the above. Costs of such work vary from human resources and simple fencing to elaborate laboratory set ups to analyse plant and soil nutrients, plant metabolites and estimates of carbon from soil cores.

Socio-economic and NRM

The last census in Somlia/Somaliland was completed in 1975. Recognising this, the government of Somaliland constituted a national archive and public records office in February 2012. The SWALIM site provides data on settlements across Somaliland. This is important and reasonably recent (2008) baseline information including locational details and appears to have been collected through direct GPS readings and primary surveys.

Rapid rural appraisal techniques can be used to re-generate substantial parts of the census data, however such surveys are very expensive at national scales and will have to be limited to selected project sites and to parameters required for measuring project success. A mix of household schedules and street mapping exercises can be used to build this dataset locally. Such indicators need to be listed and recorded at various stages of projects which seek to improve livelihoods and reduce vulnerabilities.

Other participatory surveys described in section A can be used to generate a number of socio-economic datasets, however a sampling based scheduling of specific interest groups would be required to extract statistically relevant data for conventional social and economic indicators. The costs of such an exercise will depend on the extent, however it would not be very large for a single site comprising adjacent watersheds and communities living and using them.

Community based NRM projects often generate a set of socio-economic data for the project area as a routine. This is because the data needs to be current and specific to project objectives. The choice of data is governed by project objectives and indicators evolved to measure its success. These are usually listed in the logical framework analysis or equivalent of the project.

Livestock

Necessary information about livestock can be split into:

Ragelands including seasonal extents, migratory routes and patterns, quality of forage including species composition and structural composition (grasses/herbs, shrubs, trees) and availability of other resources such as water and salt.

Livestock related information includes type of livestock, their management in terms of veterinary care and periods of reproduction (seasonality) and susceptibility to disease.

Market and commerce related information covering different products and yields from different type of livestock on a seasonal basis, location of markets with differentiation between local and export markets and between kids of goods and prices they fetch.

While settlement based surveys can provide reasonable estimates of livestock related data, data for consolidated, region or higher scales is harder to access. Among sources of such in-

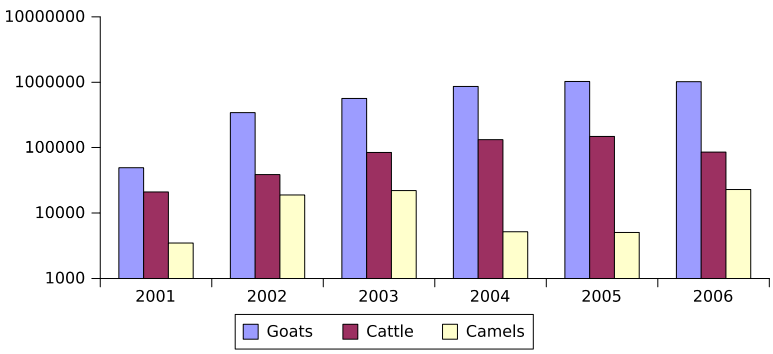


Figure B.1: **Export of livestock, adapted from http://intrepid.co.ke/somaliland/?page_id=84. Note y axis is log scaled. The graph shows a stagnation of the exports of sheep and goats, a drop in the sales of cows and a recovery in the sales of camels from a slump during 2004 and 2005.**

formation are the FAO/SWALIM site which has maps of rangelands covering cover and runoff rates and the The Food Security and Nutrition Analysis Unit - Somalia (FSNAU) [4] which maintains records of the livestock trade among other statistics. Statistics available from the site of Somaliland Chamber of Commerce, Industry and Agriculture (upto 2006) show a stagnation in the export of goats, a decrease export of cattle and a recovery to previous levels for export of camels (figure B.1).

Natural resources

Data on natural resources for the Horn of Africa and Somaliland is hosted on FAO and related sites. This includes land cover classification, seasonal productivities based on NDVIs and hydrology data which have been derived using remote sensing. SWALIM also shares a database on different water resources including structures built for water harvesting. However this is dated and misses out large tracts of the study site.

Natural resources encompass a range of data, usually spatially and temporally explicit and tied to parameters of quality and dependence. It is not possible to anticipate all resources that are being used and managed by a community, consequently data pertaining to natural resources is usually collected in group discussions and participatory mapping exercises. It is usually incrementally built upon and fine tuned over time.

Some information about the resource base and productivity can be derived from satellite imageries. However this is limited by both spatial and temporal resolution of the images and procuring sufficiently high resolution images across regions is quite expensive. Among the layers that can be derived from remote sensing are elevation related which include likely locations of streams, stream accumulation and extents of watersheds. Indices also exist to estimate amounts of vegetation, soil, soil moisture and to identify features such as bare soils and rocks and water bodies. Finally, sufficiently recent and fine grained multi spectral images can be used to derive land cover and land use information for a region.

The availability of high resolution (sub metre) true colour images on services such as Bing and Google allow a merger of resource mapping with GIS and remote sensing. This opens up a

[4] www.fsnau.org/.

range of possibilities as the two techniques can be highly complementary. For instance, it is possible to have an image trained and ground control points collected by local residents. Resource maps once drawn on the ground can be transferred to a GIS platform either in a consultative discussion with stakeholders or by collecting GPS locations of landmarks and transferring them onto a GIS.