



WADI PARTNERS

FOOD SECURITY AND DISASTER RESILIENCE THROUGH
SUSTAINABLE DRYLANDS MANAGEMENT
IN NORTH DARFUR, SUDAN.



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EXECUTIVE SUMMARY

Community tree nursery established
by the Eco-DRR project and managed by the
local women's group.

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In 2012-2015, the United Nations Environment Programme (UNEP) and the European Commission (EC) supported a pilot demonstration project on Ecosystem-based Disaster Risk Reduction (Eco-DRR) in Sudan. The Eco-DRR project was implemented in partnership with the National Government, the State Government of North Darfur, Practical Action, and local community-based organizations.

It aimed to reduce vulnerability to water-related hazards, in particular droughts and floods, mitigate conflict among pastoralists and farmers, and support community livelihoods through sustainable dryland management in the Kilimondo locality in the State of North Darfur. The pilot demonstration activities covered five villages (Eid El Beida, Abudelik, Waa'dha, Wad Kota and Bahr Omdurman) along a 40 km stretch of a seasonal water body, or *wadi*.

The project had three main components:

1. Undertaking Eco-DRR field interventions in a drylands context, such as improved access to water, community forestry and re-seeding of degraded pastureland;
2. Strengthening sustainable and equitable natural resource governance, such as through the establishment of a water resources management committee, demarcation of a pastoralist migratory route and improving agricultural support services; and
3. Developing local community, state- and national-level capacities for Eco-DRR implementation.

The project promoted ecosystem-based measures to mitigate water-related hazards and address

ecosystem degradation, which is one of the drivers of local conflict and vulnerability. It applied the concept of Eco-DRR in the context of drylands in order to demonstrate the benefits of Eco-DRR for livelihoods, food and water security, and disaster risk reduction. Two key aspects of disaster vulnerability reduction were addressed directly by the Eco-DRR project:

- **improving food and water security** through sustainable drylands management;
- **enhancing water resource governance** through strengthening of local and national capacities (including at state-level) in sustainable drylands management, as well as through mainstreaming Eco-DRR considerations in Integrated Water Resources Management (IWRM).

Given that Eco-DRR in North Darfur was implemented against a backdrop of protracted, local conflict among various groups, the project aimed to mitigate conflict between pastoralist and farming communities, through consensus-building over the use of land and water.

The project clearly demonstrated that Eco-DRR can be successfully applied in the context of drylands. While ecosystem-based measures are often perceived as exclusively green infrastructure such



Click above (or visit <http://bit.ly/2eZzH96>) to view the video documentary of the Eco-DRR project in Sudan

as re-vegetation and ecosystem protection, the project demonstrated that hybrid measures, such as a combination of green and grey infrastructure might, in fact, be the most appropriate approach in a drylands context in Sudan. At the same time, the demonstration activities in Kilimondo served as an entry point to build institutional capacity within the State Government of North Darfur and National Government Ministries to promote Eco-DRR within the emerging IWRM approach in Sudan.

Despite the short time frame of the project, the success of pilot field activities is evident by the strong community uptake of interventions. The communities themselves have been voluntarily replicating ecosystem-based measures such as re-seeding of pastureland and implementing a grazing ban in community forests. The awareness raised and the capacities developed within local communities and the State Government has also resulted in increased government oversight on haphazard dam constructions to ensure that upstream and downstream water usages are compatible and reduce vulnerabilities to drought and flood.

HIGHLIGHTS OF INTERVENTIONS

- **Rehabilitation of an existing water retention structure in Eware valley**, near Eid El Beida Village, by improving its structural design, has increased the durability of the structure, allowing it to better withstand heavy rains and flash floods. As a result, farmers can cultivate irrigated, fertile *wadi* soils, and therefore significantly boost agricultural production;
- Following rehabilitation of the water retention structure, an estimated 6,300 ha (15,000 faddens) of otherwise dry *wadi* land was flooded in the 2014 rainy season, which resulted in **increased water retention and a dramatic increase** (17.5 times more) **in cultivable land** upstream and downstream, therefore producing more food and closing the food gap during dry periods;
- **Approximately 315 ha** (750 faddens) **of newly irrigated land was allocated to 150 households, who previously had no or limited access to fertile *wadi* land;**
- **A community-run tree seedling nursery, run by the local women's group, was established** with an annual production capacity of more than 17,000 forest tree seedlings to support reforestation and 1,000 fruit trees;
- **Five community forests established** covering more than 24 ha and managed by local women's groups;
- **Re-seeding of 1,214 ha of rangeland** with fast-maturing pasture seeds;
- **Revolving funds for community seed and animal drugs were established in each of the five villages** to strengthen local livelihoods and provide additional economic safety nets, along with training of local farming extension agents and paravets;
- **Ten agricultural extension agents and eight paravets have been trained;**
- **A 10-person water resource management committee was established and trained** in the operation and maintenance of the rehabilitated water retention structure, as well as in broader issues related to the sustainable and equitable management of water and land resources;
- **The water resource management committee was connected to an upstream Water Forum along the same *wadi*,** to improve upstream-downstream coordination of water usage;
- **Demarcation of a 10 km migratory pastoralist route to reduce local conflict over access to water and land;**
- **Increased Eco-DRR capacity** within the National Government and Darfur State Government through two Eco-DRR training workshops;
- **Eco-DRR awareness-raising campaign** reached 200 community members in the five target villages.

4,500 farmers gained access to **more land** for **cultivation** due to **rehabilitation** of the **Eware water retention structure**



INTRODUCTION TO THE ECO-DRR PROJECT IN SUDAN

Water availability is one of the main challenges
of communities in North Darfur.

2014 © Albert Gonzalez Farran, UNAMID



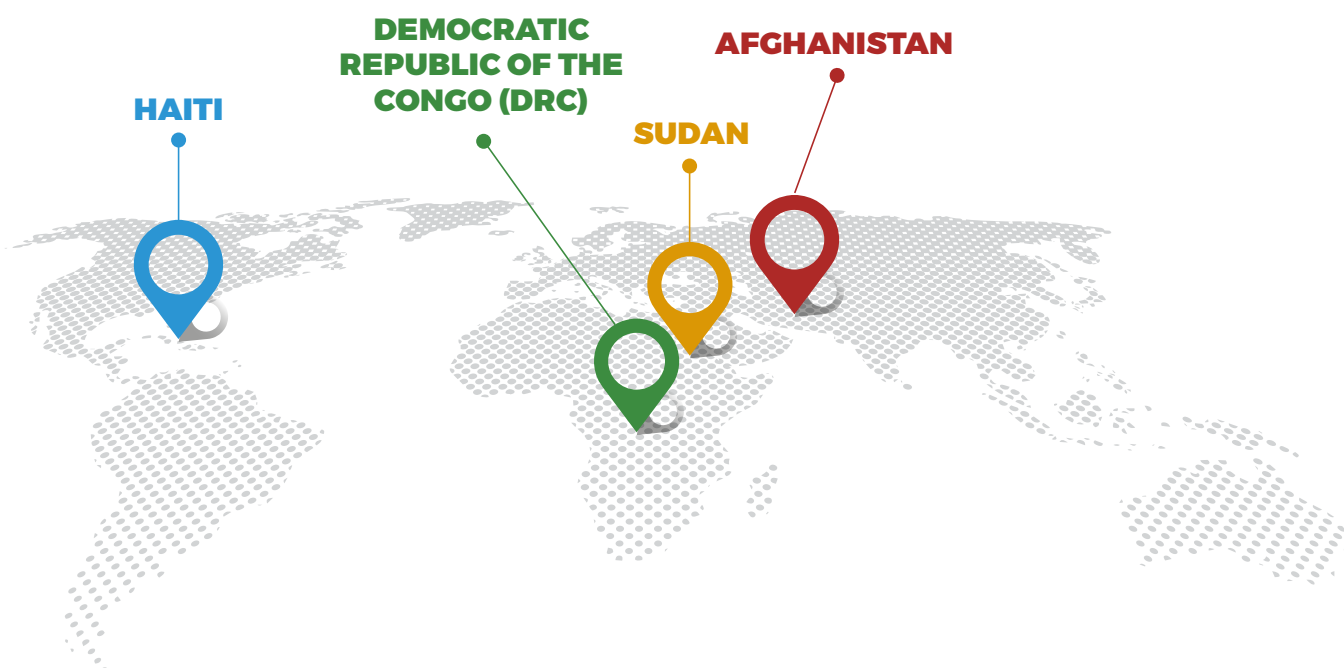
The European Commission and UNEP collaborated on a four-year project (2012-2016) to promote, innovate and scale-up ecosystem-based approaches to disaster risk reduction (Eco-DRR) in vulnerable countries and to raise greater recognition of Eco-DRR globally. While the project was global in scope, it implemented Eco-DRR demonstration projects in four countries: Sudan, Afghanistan, Haiti and the Democratic Republic of the Congo (DRC).

These four countries were selected because they presented four distinct ecosystem zones located in highly vulnerable settings in which to apply various Eco-DRR approaches. In addition, UNEP has established field presence in all four countries, providing an opportunity to leverage resources and build on UNEP's work in the countries.

In each of the four countries, the project delivered a common set of interventions, which were then tailored according to local contexts and national priorities.

THESE INTERVENTIONS INCLUDED:

- **National and community baseline assessments for mapping Eco-DRR opportunities and challenges;**
- **Field-based activities to apply and demonstrate the Eco-DRR approach and provide direct benefits to local communities, who are vulnerable to disaster and climate risks;**
- **Local and national capacity building and training workshops to support Eco-DRR implementation and promote replication of similar initiatives around the country;**
- **Strengthening partnerships and new collaborations on Eco-DRR; and**
- **Policy advocacy to inform national policy and planning processes and promote risk-informed sustainable development.**



This case study documents the experience, results and lessons of the Eco-DRR demonstration project in Sudan, which examined the relevance of Eco-DRR in the context of drylands. The Eco-DRR project was implemented in one segment of the Wadi El Ku, one of the largest seasonal water bodies in North Darfur. The target area falls within the Kilimondo locality. Through collaboration between the Government of Sudan, UNEP, Practical Action and local actors and communities, the project applied a sustainable drylands management approach to achieve food security, community resilience to water hazards (droughts and floods) and mitigate local conflicts over natural resources.

The Eco-DRR project complemented another initiative by UNEP, known as the Wadi El-Ku Catchment Management (WEK) Project in North Darfur, which is funded by the European Union and implemented during the same period (2013-2017) along the same *wadi*. The earlier start of the Eco-DRR project gave UNEP the added advantage to further design the Wadi El Ku project to take into account water-related hazards. In this regard, the Eco-DRR project helped to influence the broader planning process on Integrated Water Resource Management (IWRM) initiated by the WEK project. Both projects contributed to strengthening capacities of the State Government of North Darfur to promote and implement IWRM in the Wadi El Ku and enhance community resilience to water hazards.ⁱ

ⁱ For more information about the Wadi El Ku Project being implemented by UNEP in Sudan, please visit: <http://www.unep.org/disastersandconflicts/CountryOperations/Sudan/tabid/54236/Default.aspx>



BOX 1. OVERVIEW OF THE ECO-DRR PROJECT IN SUDAN

PROJECT AIMS:

1. To reduce the impacts of water hazards by improving the capacity of target communities to cope with long dry spells and floods through sustainable livelihood and dryland management practices;
2. To strengthen environmental governance at the local level, with respect to sustainable land and water resource management and mitigating conflict between resource users;
3. To create an enabling policy environment and develop institutional capacity at the state and national levels on Eco-DRR implementation through sustainable drylands management.

ECOSYSTEMS IN FOCUS: Drylands, seasonal water body (*wadi*)

MAIN HAZARDS TARGETED: Droughts, rainfall scarcity, floods

TARGET POPULATION: 17,500 inhabitants out of a total population of 30,000 in 5 villages (Eid El Beida, Abudelik, Bahr Omdurman, Wad Kota, Waa'dha) in the Kilimondo locality, North Darfur

IMPLEMENTING PARTNERS:

- Government of Sudan:
 - National level: the National Ministry of Environment, Forestry and Physical Development (MEFPD), and the Higher Council for Environment and Natural Resources (HCENR).
 - North Darfur State level: State Ministry of Agriculture and Irrigation of North Darfur (SMOA), State Ministry of Animal Resources, Rangeland and Fisheries (SMOARF), State Ministry of Physical Planning and Public Utilities (SMPP), Ground Water and Wadi's Directorate, and the Forest National Corporation (FNC).
- Traditional leadership: Native administration, and Village Development Committees (VDC)
- Practical Action Sudanⁱⁱ
- Community-based Organizations (CBOs): Women Development Association Network (WDAN), which is a network of over 70 CBOs, and the Voluntary Network for Rural Helping and Development (VNRHD), which has over 71 CBOs, as well as the Farmers Union, the Pastoralists Union, and Sudan Climate Change Network (SCCN)
- UN Country Team DRR Working Group: International Organization for Migration (IOM), World Health Organization (WHO), Resident Coordinator Support Office.

DURATION: May 2012 – December 2015

BUDGET: USD 250,000ⁱⁱⁱ

OTHER ONGOING PROJECTS/ACTIVITIES LEVERAGED: See **BOX 3**

ⁱⁱ Practical Action has been working in Sudan since 1974, specializing in strengthening community-based organizations and transferring low-cost technological solutions to local communities.

ⁱⁱⁱ This does not include UNEP staff and field office costs.

BOX 2. WHAT IS ECOSYSTEM-BASED DISASTER RISK REDUCTION?

Healthy, well-managed ecosystems have long been recognized to deliver multiple services, including for disaster risk reduction (Renaud et al. 2013). However, it is only over the last decade that the role of ecosystems in disaster risk reduction (DRR) has received increased global attention. Sustainable ecosystem management for DRR is now recognized as a priority measure in the Sendai Framework for Disaster Risk Reduction (2015-2030).

Ecosystem-based approaches to disaster risk reduction (Eco-DRR) have been defined as “the sustainable management, conservation and restoration of ecosystems to reduce disaster risk, with the aim of achieving sustainable and resilience development” (Estrella and Saalismaa 2013: 30). With climate change expected to magnify existing disaster risks, Eco-DRR also incorporates climate risk management and climate change adaptation as a core principle (Ibid) and shares common features with Ecosystem-based Adaptation (EbA) (UNEP 2015).

Disaster risk is often understood as a composite of three main elements that must be present: hazards (e.g. flood, storm, landslide), exposure (i.e. people or assets located in hazardous locations) and vulnerability (i.e. the range of factors – social, physical, economic, environmental, cultural and political/institutional, etc. – that shape how hazards affect or impact on people and communities) (UNISDR 2009). Therefore, a reduction in any one of these elements will contribute overall towards DRR.

If managed wisely, ecosystems, such as wetlands, forests, mangroves, reefs, seagrasses and dunes, perform important functions that can influence all three elements of the disaster risk equation – *by preventing, mitigating or regulating hazards* (e.g. forests can reduce incidence of landslides and avalanches, wetlands help regulate flooding and droughts), *by acting as natural buffers and thus reducing people’s exposure to hazards* (e.g. mangroves, coral reefs, and seagrasses protect coastal areas from storm surge impacts), and *by reducing vulnerability to hazard impacts* through supporting livelihoods and basic needs (food, water, shelter, fuel) before, during and after disasters (PEDRR 2013). In this regard, healthy, well-functioning ecosystems strengthen local resilience against disasters and climate change.

Eco-DRR builds on existing sustainable ecosystem management principles and approaches and includes a range of potential measures, such as: environmental impact assessment tools, integrated water resources management or river basin management, integrated coastal zone management, ridge-to-reef and other landscape-scale approaches, sustainable dryland management, protected area management, integrated forest management, among others (see PEDRR 2010). Eco-DRR should be implemented as part of broader disaster and climate risk management strategies, together with other measures such as engineered infrastructure when appropriate, risk-informed land-use planning, early warning and contingency planning.

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BOX 3. WADI EL KU CATCHMENT MANAGEMENT (WEK) PROJECT

UNEP, together with the European Union (EU) and the Government of Sudan, is implementing a catchment management project over three years (2013 – 2017) in a 50 km stretch of Wadi El Ku located 60-100 km north of Kilimondo locality near El Fasher, the capital city of North Darfur.

The proximity of the area to El Fasher, a regional trading hub, and home to a large population of Internally Displaced People (IDPs), has increased the demand on land and water beyond the carrying capacity of the environment and the planning capacity of the Government. The area has seen enormous population growth over the past 10 years. This, combined with the ongoing conflict, has resulted in widespread deforestation, falling groundwater levels, and increasing environmental degradation, which in turn erode livelihoods and undermine economic recovery.

The WEK project aims to demonstrate how effective and inclusive natural resource management (NRM) can improve relationships over natural resources, therefore contributing to peace-building and improving the livelihoods of conflict-affected communities. Working with Practical Action Sudan, and a committee of Darfuri technical experts, the WEK project promotes more sustainable approaches to soil, water and forest management and decision-making by natural resource users in the Wadi El Ku. The project represents Sudan's first practical demonstration of IWRM and intends to create a model for catchment management, which can be scaled up and replicated elsewhere in Darfur. The WEK project builds on the Eco-DRR approach and field intervention measures implemented in the Kilimondo locality.

TARGET BENEFICIARIES: 81,000 inhabitants in 34 communities in the northern section of Wadi El Ku, in addition to a varying number of nomadic pastoralist groups per year

IMPLEMENTING PARTNERS: State Government of North Darfur, Darfur Regional Authority, Practical Action, non-governmental and civil society organisations and community-level natural resource stakeholders

PROJECT COMPONENTS:

1. Support the development of inclusive natural resource management (NRM) systems and structures, such as a water resource management forum, within the Wadi El Ku, that are informed by appropriate levels of scientific and technical analysis and input;
2. Support community-level agricultural and livelihoods adaptation, and improved local NRM practices; and
3. Build institutional and organizational capacities needed to understand the dynamics of the change processes, reach agricultural producers, and implement and replicate successful, integrated NRM.

EXPECTED OUTPUTS:

1. A participatory, community-based catchment management system established in Wadi El Ku
2. Sustainable community natural resource management approaches demonstrated, such as village natural resource action plans, promoting community forests, introducing agro-forestry and silvo-pastoral systems, and improving community soil and water management
3. Deliver interventions to improve agricultural, NRM and value chain extension services, and train government and communities to deliver these services
4. Institutional capacity building within state-level actors to deliver NRM related services, and policy advocacy

DURATION: August 2013 – March 2017

BUDGET: USD 7.25 million^{iv} funding from the European Union (EU)

DURATION: May 2012 – December 2015

^{iv} Euro 6.45 million

MAP 1. The WEK project area (shaded in blue) in relation to the Eco-DRR project activities (yellow pins).



1.1. LOCAL CONTEXT

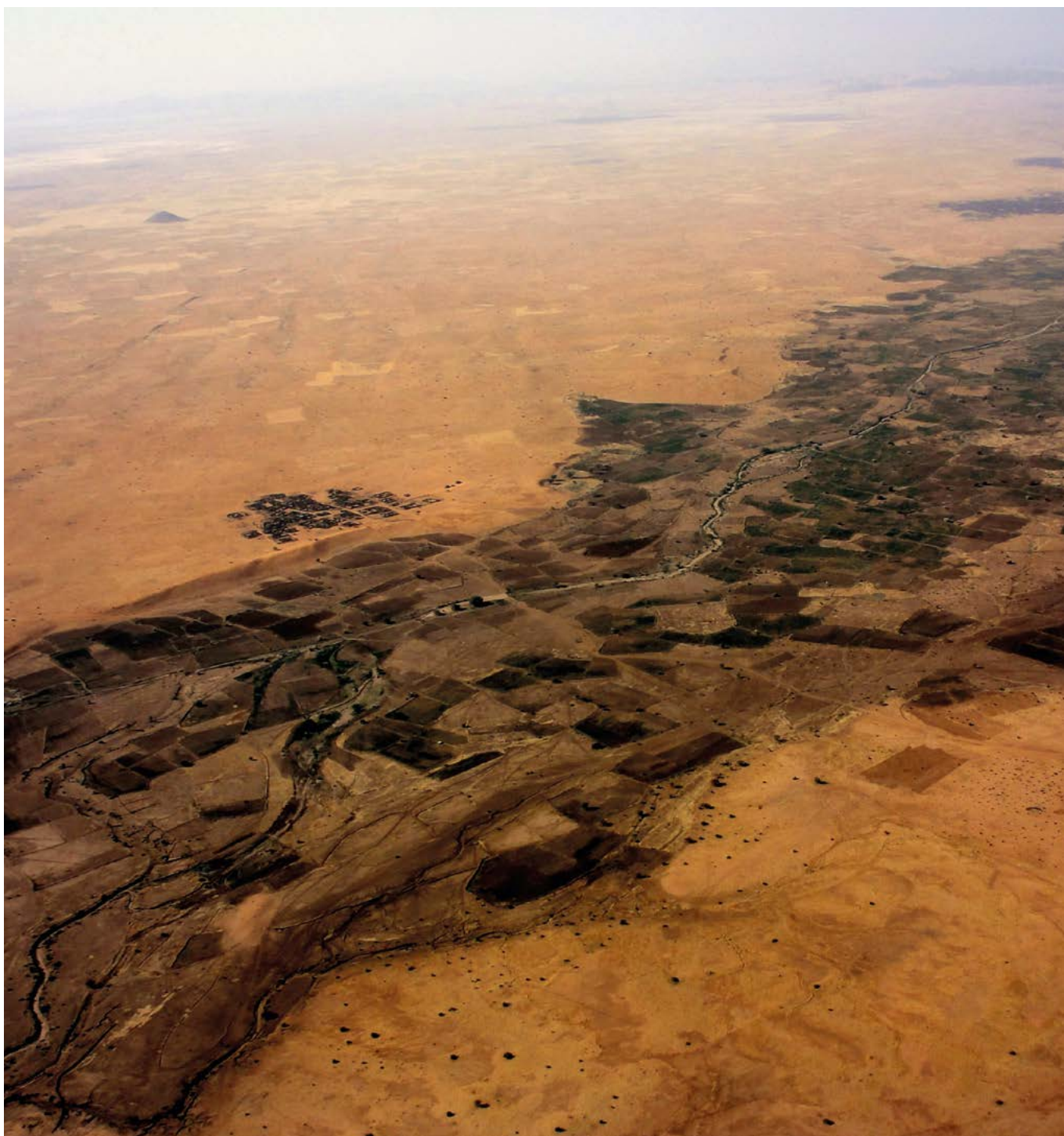
The Kilimondo locality is located in the state of North Darfur, Sudan (**MAP 2**).^v The defining environmental feature of the area is the Wadi El Ku, one of the main seasonal water ways in North Darfur that originates in eastern Jabel Marra and ultimately drains into the Nile basin. Water only flows during the rainy season (June to October). For the rest of the year, the *wadi* bed remains dry.

The catchment area of the *wadi* covers 27,000 km² and lies on the southern edge of the arid

Sahara desert. The climate is semi-arid to arid, with around 100-150 mm of rainfall annually. Variability in rainfall is high and in fact has a much larger influence on agricultural production than the average rainfall.

The *wadi* itself contains good quality, fertile clay soils, while the surrounding areas have a sandy '*goz*' soil, which is fragile and characterized by poor nutrient levels, high acidity, and low water retention capacity.

^v The Sudanese Government is structured as a decentralized Federal Republic, divided into 18 states.



Wadi El Ku, North Darfur: the dark fertile clay wadi lands are flanked by brown, *goz* sandy soils

MAP 2. Wadi El Ku is located in the Kilimondo locality, in the State of North Darfur. The area lies on the southern edge of the arid Sahara desert.



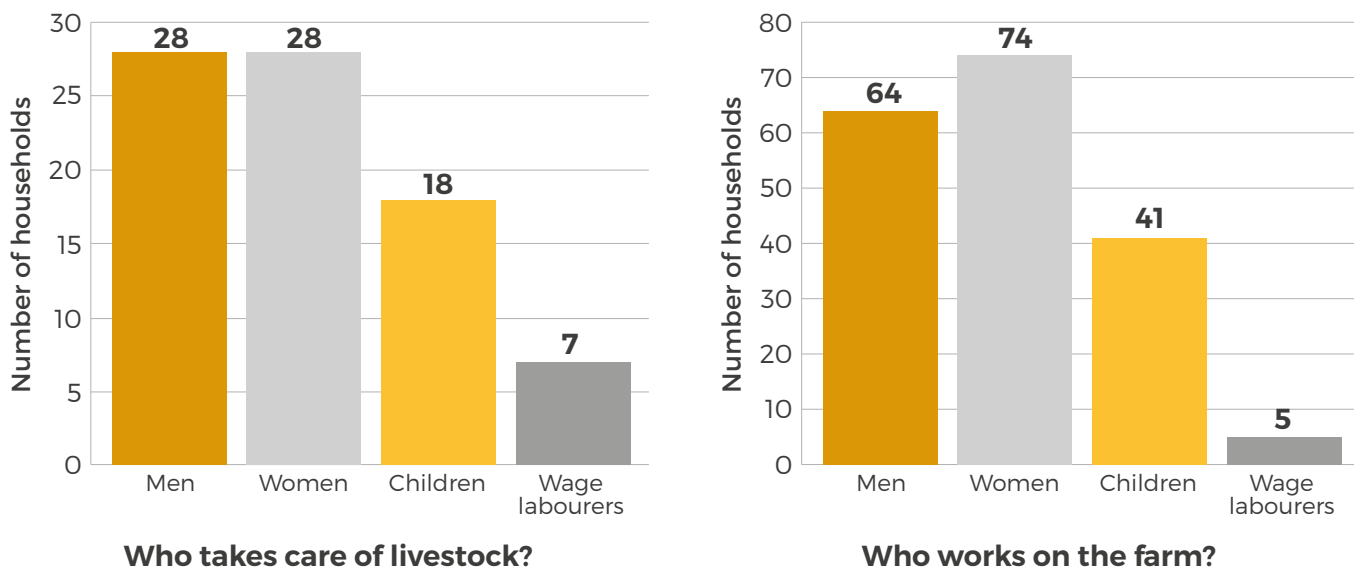


Aerial shot of village near the *wadi*



Agriculture on sandy, goz land

FIGURE 1. Women and children of the household play an important role in farming and livestock rearing.



Source: UNEP (2012) Eid El Beida household survey

Agriculture and agro-pastoralism represent the main economic activities of local communities. Therefore villages are located along the *wadi* for access to water. A number of nomadic pastoralist groups also migrate through the area and have increasingly established temporary settlements to access water resources. Pasture is generally sparse

and of poor quality, due to over-grazing. Gum Arabic production from acacia trees, which grow on pastureland, is another significant source of income for many farming families. Women and children play an important role in farming and livestock rearing activities. On farms, in particular, women are more active than men (**FIGURE 1**).



Women in North Darfur play an important role in natural resource management



Agricultural yields are higher in fertile wadi soils

Farming season on sandy soils is short (3 to 4 months at most) but on clay, *wadi* soils there are typically two, occasionally three, harvests (spanning 6-8 months). Millet is the most common crop. Most crop production is rain-fed and takes place on small plots on *goz* soils. However, agricultural yields remain low, due to the low fertility of these sandy soils. Traditionally, shifting cultivation allowed *goz* soils to recuperate after 3-5 years of cultivation, but in areas of increased population pressure, cultivation is more or less permanent, leading to extremely low yields.

On the other hand, the heavy clays that dominate the *wadi* make it much more difficult to cultivate these soils in comparison to *goz* soils. Un-mechanized agriculture is therefore a challenge when farming in *wadi*

land. However, the water holding capacity and relatively high soil fertility make the *wadi* an essential part of the local food crop and cash crop economy.

Small-scale earth embankments across wadis of North Darfur have been built to spread water for flood-irrigated agriculture and take advantage of the fertile clay soils found in the wadis. Water retention structures (earth embankments) and terraces allow farmers to grow sorghum, sesame, hibiscus, vegetables and fruits such as watermelons. Embankments also enhance sub-surface aquifers for domestic water supply and increase vegetation and rangeland fodder production. The increased utilization of wadi land makes overall water management increasingly important.

LOCAL NATURAL RESOURCE GOVERNANCE SYSTEM

In North Darfur, the native administration – a form of traditional governance that is based on the rule of the tribe and historical rights to land – is the institution most responsible for natural resource management and disaster management at the local level. Depending on the tribe, the native administrator, who often oversees multiple villages – has a different title; these include *sheikh*, *agid*, *dimilig*, etc. While modern statutory laws are in place in Sudan, in most rural areas, customary rules are respected, and traditional leaders play important roles in land distribution and natural resource management in the community.

A local administration – the lowest level of government – is also in place in the form of a popular committee and a Village Development Committee (VDCs), divided into different committees for education, water, farmers, pastoralists, women's associations etc. Local committees are in turn linked through a series of umbrella networks that include both resident and displaced communities (because of conflict), which oversee natural resource use and development planning. However, given the lack of resources, the committees play a limited role in governance.

Community-based organizations (CBOs) are also key players in natural resource management. All of the CBOs in the project area are represented by one parent network of 71 CBOs, the Voluntary Network for Rural Helping and Development (VNRHD), which was established with the support of Practical Action. In addition, different groups in the area are represented by a number of national unions.^{vi} Four such unions are active in the area: a Farmer's Union, a Pastoralist's Union, a Youth Union and a Gum Arabic Producer's Union.^{vii}

Despite their important role in natural resource use, women essentially have no role in decision-making processes related to natural resource management by the native administration, popular committees or unions. However, women are involved in the Village Development Committees and have formed active women's groups, such as The Women Development Association Network (WDAN), which is active in the Kilimondo locality.

Land tenure, as elsewhere in the Darfur region, is organized principally around tribal land grants (*Dar*) that date back to the pre-colonial Darfur Sultanate (1603-1874). The *Dar* is land held in trust for the people by the tribal leadership, and is managed by land *sheikhs*, who are responsible for administering land use. This includes allocation of land leases for farming, and designation of areas for pastoralist migration, grazing, forestry, and other uses. Land leases for farming are granted to residents of the area, which are passed on from generation to generation. The land *sheikh* also plays a role in decisions around access to water points, and reconciles and settles disputes over access to water resources, plot boundaries, animal encroachment on cultivated areas and new land clearance. Nomadic pastoralists are allowed free passage and access to pasture and water sources by the local *sheikh*.

^{vi} Unions are seen as being closely aligned with the Government.

^{vii} While the Farmer's Union date back to the late 60s, the Gum Arabic Union was only recently formed.

2

MAIN HAZARDS, DEVELOPMENT TRENDS AND CHALLENGES IN THE KILIMONDO LOCALITY, NORTH DARFUR



Community and national baseline assessments provided the primary basis for obtaining information on the major development trends and challenges related to ecosystems, ecosystem degradation and disaster risk in Wadi El Ku. Baseline assessments consisted of an in-depth household survey, community-based land-use and risk mapping and multi-stakeholder consultations. Baseline assessments also served as a basis for project design and defining the key components of the Eco-DRR interventions in Sudan. Moreover, the project drew extensively from UNEP's environmental assessments, including the "Sudan Post-Conflict Environmental Assessment" report (UNEP 2007).¹

2.1 HAZARDS AND CLIMATE CHANGE

Droughts^{viii} and floods are the most common natural hazards in the region.² Sudan is affected by two types of droughts: occasional short-term droughts due to seasonal or inter-year variations in rainfall, and long-term droughts covering wide areas due to precipitation deficits.³ Drought is particularly widespread in Western Sudan,⁴ making North Darfur one of the most drought-prone states in Sudan. There are multiple periods of deficient precipitation (i.e. meteorological drought) and crop failure (i.e. agricultural drought) on record for the region. For instance, while 1943-1971 was a period of comparatively regular rainfall and conducive for agriculture (in terms of the ability to grow rain fed millet), the period 1971-1999 brought prolonged shortage of rainfall, with 16 out of 29 years suffering a complete crop failure.⁵ Since the mid-90s the conditions have improved again, albeit with intermittent years of low rainfall.

Floods occur during the rainy season when high precipitation results in a sudden rise in water volume in the *wadi*. Lack of vegetation – due to deforestation and desertification – around the *wadi* means that water flow is not regulated, leading to flash floods, which damage weakly constructed embankments

and other infrastructure on its way. Flash floods, therefore, affect water accessibility for irrigation, and agricultural production.

With climate change, rainfall is expected to become less predictable, and droughts and flash floods will likely increase^{6,7}. The average rainfall is expected to further decrease (about 6mm/month) during the rainy season.⁸ As a result, current climate related hazards such as floods, drought, and the subsequent dust storms and heat waves are expected to intensify. In North Darfur, 20 out of the 25 driest years on record have occurred since 1972.⁹ Recurring series of dry years have already become a normal occurrence and will likely become even more common in the future.¹⁰

As a result of repeated drought cycles, agro-pastoralists and pastoralists have reduced the number of cows they own and increased the number of camels and goats, as they are more resilient during drought conditions. Farming communities have also increasingly moved towards rearing small ruminants and livestock which are more adapted to arid conditions, in order to reduce their vulnerability to drought. Pastoralists have established temporary settlements in the area to access water at village water yards.



^{viii} Drought is a complex phenomenon. Its impacts result from the relation between a natural event (i.e. deficient precipitation) and demands on the water supply, and are often exacerbated by human activity. As a result, various types of drought exist; these include meteorological drought (defined on the basis of dryness compared to a normal period), agricultural drought (defined based links between meteorological drought and agricultural impacts), hydrological drought (persistently low volume of water in water bodies, which could be exacerbated by human activity), and socioeconomic drought (when the demand for economic goods exceeds the supply as a result of a weather-related shortfall in water supply).

Consultation with women's groups



Repeated drought cycles have led cattle owners to shift livestock composition from cows to more drought resilient animals such as camels and goats.

2.2 FOOD INSECURITY AND VULNERABILITY TO DISASTERS AND CLIMATE CHANGE

The majority (80%) of North Darfur's population of 1.75 million lives in rural areas,⁴¹ where their livelihoods (farming, herding, and agricultural trade) rely directly on local, natural resources. Their exposure and vulnerability to droughts is, therefore, high.

Since the 1980s poor rainfall, combined with ecosystem degradation and conflict has resulted in regular food deficits at the household level. A recent example, in 2011 North Darfur suffered a water scarce rainy season, putting rural populations under pressure. In May 2012, there were reports of

some communities harvesting wild plants to fill their dietary needs. Increased vulnerability and lack of coping capacity to water scarcity led to the temporary displacement of many rural households to El Fasher town, the centre of North Darfur State.

It should be noted that the most critical period in terms of household food insecurity is from May to August (4 months), when people suffer from non-availability of food. Food is available on the market at this time, but people have very little purchasing power. Therefore, people often temporarily migrate to towns or to other localities which had higher rainfall, and work for grains as payment or for wages if they are based in towns.

A World Bank study in 2009 assessed Sudan to be the country most at risk from the effects of climate change on agriculture.¹² The Sudanese Government has predicted a significant long-term decline in the yields of staple millet and sorghum, due to shorter growing seasons.¹³ Other studies on winter crops in the River Nile State support this predicted trend.¹⁴ Such impacts are cause for serious concern for food security in the future,¹⁵ as previous drought and flood events have resulted in large-scale human suffering, hunger, forced migration from rural areas, and loss of livestock.¹⁶

Among social groups, rain-fed farmers and pastoralists as the most vulnerable groups to climatic hazards and prone to food insecurity. Extreme poverty and limited livelihood options make these groups the least able to cope with disasters. Rain-fed farmers have to rely on erratic rainfall in short growing seasons.¹⁷ The vulnerability of pastoralists to drought is exacerbated by social factors such as the tendency to maximize livestock herd sizes rather than quality. Development factors can also intensify vulnerability to drought. These include the lack of secure water sources that can be relied on during short dry spells.¹⁸

2.3. ENVIRONMENTAL DEGRADATION AND LINKAGES WITH DISASTER RISK

The target area experiences the major hazards (drought and dry spells, flash floods) and environmental challenges (desertification, degradation of rangelands, soil erosion, loss of biodiversity) that characterise North Darfur. Only 30 years ago, during the rainy season in North Darfur, the wadis were once lush with vegetation. Forests were part of the natural landscape, and the seasonal waters would give life to the drylands. Today, the area is experiencing severe environmental degradation. Unsustainable farming, deforestation, and overgrazing have undermined the capacity of these dryland ecosystems to support local livelihoods.

Due to increasingly variable rainfall and population growth, poor quality *goz* (sandy) soils are over-cultivated and therefore degraded. Diminishing agricultural yields have

forced farmers to cultivate increasingly larger areas of land. Agricultural expansion onto the rangeland has resulted in deforestation, which together with intensive cultivation on sandy soils, and fodder collection has caused widespread land degradation and desertification. As a result, sand dunes are encroaching on fertile land, shrinking the area available for food production. Communities also increasingly rely on harvesting forest products, because of poor levels of crop production.

For pastoralists, expansion of crop production has meant less land available for grazing. During drought cycles, pasture areas are overgrazed, as animals cannot travel far due to the lack of water.

As a result of widespread deforestation and the unplanned construction of water harvesting embankments (see section 2.4) and terraces, deep gullies and ravines have been formed over the last decade in parts of the project area. These gullies concentrate the flow of surface water, reducing the spread of water across the *wadi*. This dramatically reduces the quality and area of land available for agricultural purposes. Flash floods are also responsible for deepening gullies, and therefore the scarce rainwater is not harvested or retained for irrigation. In addition, due to the removal of the vegetation from the *goz* soils, erosion of top soil occurs further deteriorating soil fertility and land productivity.

2.4. WATER RESOURCE MANAGEMENT CHALLENGES

Since 1970, nearly 80 embankments have been built by the Government and different international and national Non-Governmental Organizations (NGOs) in the Darfur regions, with 15 such structures located in the State of North Darfur. In addition, there are hundreds, possibly thousands, of smaller earth embankments that are constructed on *wadis* by farmers themselves who hire heavy machinery. Water retention structures are often constructed in response to localized demand but tend to be unplanned, and do not take into account the wider catchment and water resource management context.

The haphazard construction of water retention structures has resulted in unregulated and incompatible water uses, which are exacerbating flood and drought risks. Embankment constructions can alter the course of the *wadi* or amount of its flow, therefore changing water accessibility to downstream communities for irrigated agriculture, livestock, and human use. There is, therefore, a clear need for better coordination of embankment constructions and water management among upstream and downstream communities, and social-environmental assessments to ensure that embankment constructions do not exacerbate the vulnerabilities of communities in Darfur.

The structures of embankments are often weak, leading to damage to the embankment during strong water flows and high rates of siltation, which reduce the water holding capacity. Due to the need for maintenance and repair, the success of water retention structures depends on the level of community participation and local ownership, as much as on the technical quality of the structures. Therefore, high engagement of communities and having the capacity to operate, manage, and repair water retention structures are an essential element of improved water accessibility and reducing the risk of water-related hazards in North Darfur.

2.5. CONFLICT AND UNSUSTAINABLE NATURAL RESOURCE MANAGEMENT

Environmental degradation has fomented local tensions between pastoralist groups and the farming communities. Nomadic pastoralists, who migrate north to the Sahel, pass through the area. They are generally allowed free passage and access to pasture and water by the local *sheikhs* in Kilimondo locality.

However, conflicts over water use and pasture can occur. One of the reasons for conflict is that farmers respond to the increasingly low productivity of the *goz* soils by expanding the area under cultivation. This, in turn, drives farmers into areas that are used by pastoralists for their migration routes, leading to local level tension and conflict.

In addition, the Kilimondo locality is representative of the wider political dimensions of conflict in Darfur. A rebel group, the Sudan Liberation Army (SLA) was in control of the area from 2004 – 2011 (from 2007-11 in cooperation with the Government of Sudan following a peace agreement), until expelled by Government forces after the breakdown of the peace agreement. Members of those tribes who were associated with the SLA during the occupation were also displaced from their villages. The SLA responded by launching surprise attacks on the villages, burning homes and stealing assets including cattle.

The Darfur conflict has exacerbated the unsustainable use of natural resources, which is also linked to the breakdown of local environmental governance structures. The fragile state of peace and security undermines the power of the native administration to regulate local rules and customs related to environmental governance. At the same time, the protracted conflict in Darfur has created an institutional vacuum within Government bodies, therefore constraining implementation of policies and regulations.

The peaceful conditions in and around the project area remain fragile. In 2014, the security situation deteriorated significantly in North Darfur, spreading to Kilimondo. Waa'dha, the capital of the Kilimondo locality and one of the target Eco-DRR villages, was attacked twice by rebel forces, resulting in a number of casualties, looting and the destruction of several Government buildings. The wider conflict led to the displacement of several thousands of households in Kilimondo, El Fasher and other parts of North Darfur, who fled to neighbouring localities. Pastoralists were forced to change their migration routes, which in turn caused tension and small-scale conflict with farming communities along the routes used for livestock migration.

3

MAIN COMPONENTS OF THE ECO-DRR PROJECT IN SUDAN

Natural vegetation in North Darfur



The Eco-DRR project implemented in the Kilimondo locality considered the key development challenges, as described in **SECTION 2**. The project was cognizant of interlinkages between a complex set of issues: food insecurity, environmental degradation, water resource management, drought risk, climate change and conflict. Given the arid climate of North Darfur, the project identified improved water accessibility and sustainable water management as prerequisites to enhancing community resilience to water hazards and improving food security.

One of the main aims of the project was to examine the application of Eco-DRR in the context of drylands. Drought, which is one of the main hazards in drylands, is a complex phenomenon that is beyond the physical lack of precipitation (as discussed in **SECTION 2.1**). Therefore, reducing the risk of drought must also take into account the complex set of factors that affect drought risk.

In addition, given that natural buffers to drought are less evident in the global literature, the Sudan case can present important insights. For instance, mangroves are known as effective natural buffers to coastal storms, and alpine forests are known to reduce avalanche risk, while there is no such equivalent to use as a natural buffer against droughts. Finally, vegetation in drylands is limited by water availability and soil types, therefore limiting options for implementing ecosystem-based measures.

The project in Sudan aimed to apply an ecosystem-based approach to sustainable drylands management in order to demonstrate the benefits for livelihoods, food and water security and disaster risk reduction (**FIGURE 2**). It also aimed to strengthen the role of women in decision-making related to natural resources and disaster risk reduction. Project interventions were designed to benefit all members of the community, in particular vulnerable groups such as landless farmers and nomadic pastoralists. At the same time, the project served as an entry point to build institutional capacity within the State Government of North Darfur and National Government Ministries to promote Eco-DRR within the emerging IWRM approach in Sudan.

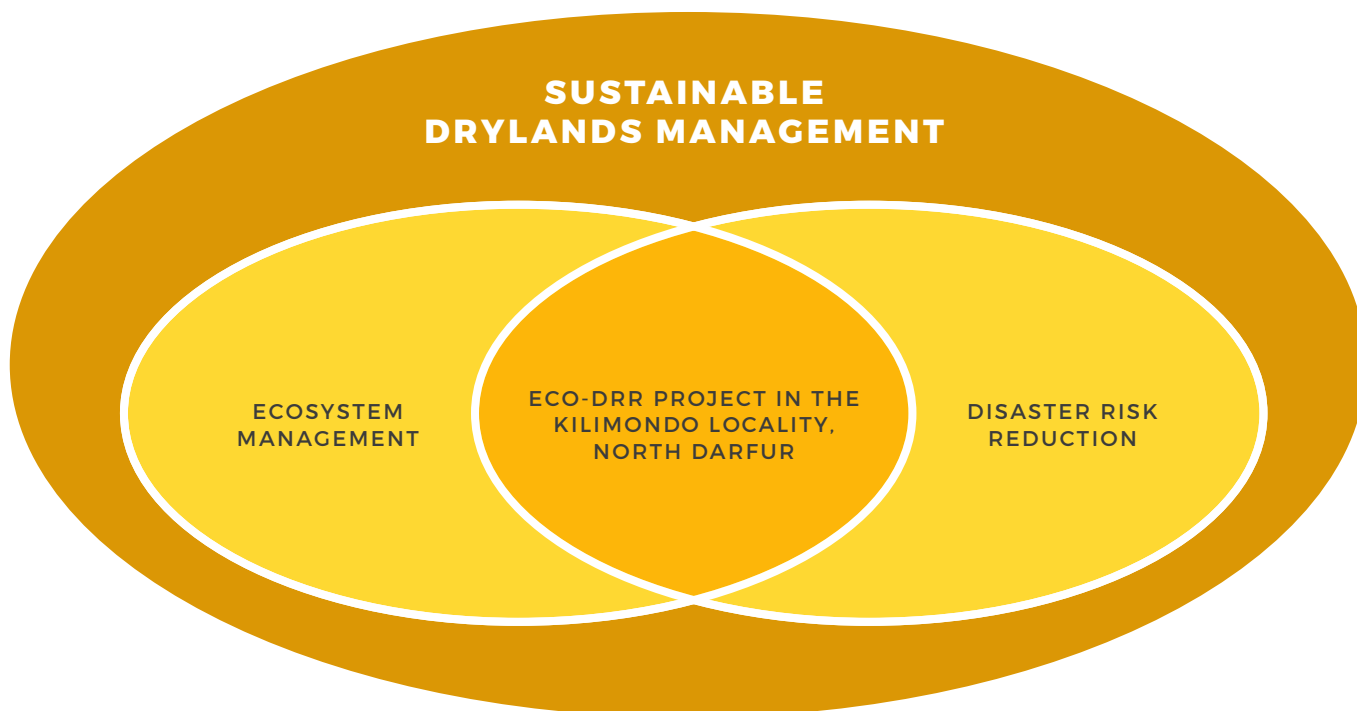


FIGURE 2. The Ecosystem-based Disaster Risk Reduction (Eco-DRR) project in North Darfur integrated sustainable drylands management, disaster risk reduction and improved ecosystem management to increase food security and community resilience to water-related hazards.



THE PILOT PROJECT IN NORTH DARFUR HAD THREE MAIN COMPONENTS, WHICH WERE CLOSELY INTERLINKED:

1

UNDERTAKING ECO-DRR FIELD INTERVENTIONS IN A DRYLANDS CONTEXT, SUCH AS IMPROVED ACCESS TO WATER, COMMUNITY FORESTRY AND RE-SEEDING OF DEGRADED PASTURELAND

2

STRENGTHENING SUSTAINABLE AND EQUITABLE NATURAL RESOURCE GOVERNANCE

3

DEVELOPING LOCAL COMMUNITY, STATE- AND NATIONAL-LEVEL CAPACITIES FOR ECO-DRR IMPLEMENTATION

3.1 ECO-DRR FIELD INTERVENTIONS IN THE KILIMONDO LOCALITY AND INITIAL RESULTS

The project implemented a number of ecosystem-based measures at the community level. These activities had several objectives. In the short term, they aimed to improve water accessibility, boost agricultural production, reduce potential local conflict over access to water and land, and re-green the landscape, while at the same time provide direct livelihood benefits to targeted communities. The project also aimed to establish locally-managed systems of water resource management, in order to sustain impacts beyond the project's lifespan.

It is important to note that re-vegetation activities (reforestation and re-seeding of pastureland) were undertaken at small scale, covering only a very limited geographic area. The intention was not to re-green the drylands landscape to its natural state, which would require interventions at a much larger geographic scale and maintenance over a much longer period, that is beyond the scope and timeframe of this project. Rather, the aim was to apply well-known Eco-DRR measures that have been proven effective in other field research and in the scientific literature, to demonstrate their applicability in the drylands context of North Darfur, and build the capacity of local and state level stakeholders through learning-by-doing.

Field interventions were applied in five villages in the Kilimondo locality, with a population of 17,500 people: Eid El Beida, Abudelik, Bahr Omdurman, Waa'dha, and Wad Kota (**TABLE 1; MAP 3**). An existing water retention structure was rehabilitated in Eware Valley, near Eid El Beida Village, improving its structural design to better withstand strong precipitation events and flash floods. This allowed local farmers in the five villages to bring large areas of fertile *wadi* land under cultivation.

A community tree nursery was established in Wad Kota, which produces seedlings for reforestation activities. Four new community forests were established (one in each village), in addition to an existing forest in Waa'dha village, which was brought under protection by the native administration and community members. Re-seeding of pastureland and

soil (gully) erosion control measures were implemented with large participation by women from the local Women Development Association Network (WDAN).

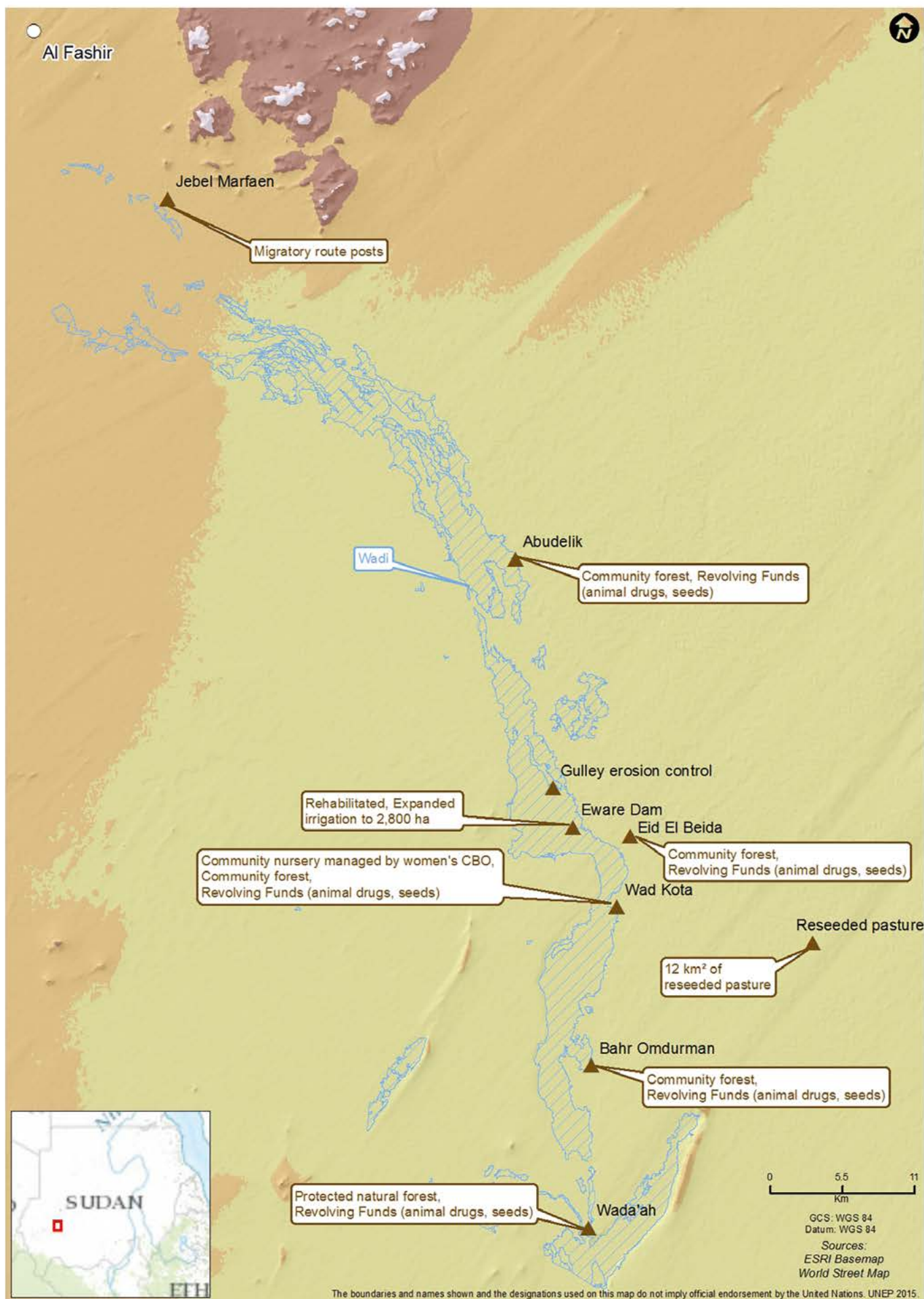
In addition, the project strengthened natural resource governance through a participatory approach (further discussed in **SECTION 3.2**) and built community capacities to sustain field activities by providing training to the water resource management committee and agricultural extension agents^{ix} in each village (further discussed in **SECTION 3.3**).

^{ix} Agricultural extension services can be defined in many ways. As a general matter, agricultural extension refers to a process of continued advice, information and informal education provided by the government (and often international organizations) to rural population to improve productivity of farms and develop abilities of rural communities to improve their standard of living. Agricultural extension agents serve as the key actors in the community to provide extension services. For more information see FAO (1985) Guide to extension training. <http://www.fao.org/docrep/t0060e/T0060E00.htm#Contents>

TABLE 1. Summary of Eco-DRR field interventions undertaken in selected demonstration sites in the Kilimondo locality

Village	Eco-DRR field interventions undertaken
Eid El Beida	<ul style="list-style-type: none"> - Rehabilitation of water retention structure resulting in 6,300 ha of newly irrigated land - Water resource management committee established - Community forest established over 4.5 ha - Revolving funds for animal drugs and seeds established - Two agricultural extension agents trained - Two paravets trained
Abudelik	<ul style="list-style-type: none"> - Community forest established over 4.5 ha - Revolving funds for animal drugs and seeds established - Two agricultural extension agents trained - Two paravets trained
Wad Kota	<ul style="list-style-type: none"> - Community tree nursery established and managed by women's CBO: annual production capacity of 17,000 forest and 1000 fruit tree seedlings - Community forest established over 4.5 ha - Revolving funds for animal drugs and seeds established - Two agricultural extension agents trained - Two paravets trained
Bahr Omdurman	<ul style="list-style-type: none"> - Community forest established over 4.5 ha - Revolving funds for animal drugs & seeds established - Two agricultural extension agents trained
Waa'dha	<ul style="list-style-type: none"> - A natural forest was put under local protection - Revolving funds for animal drugs and seeds established - Two agricultural extension agents trained - Two paravets trained
Common pastureland	<ul style="list-style-type: none"> - 1,214 ha of re-seeded pasture

MAP 3. Eco-DRR field interventions in the Kilimondo locality, North Darfur



REHABILITATION OF WATER RETENTION STRUCTURE FOR INCREASED CULTIVATION AND GREENING OF THE WADI

Water retention structures slow down rainwater flow in the *wadi* during the wet season and spread it across a wide area of the *wadi* plain, making water more available for crop production. The Sudanese Government had constructed a water retention structure in Eware valley near the village of Eid El Beida in the 1990s. At the time, the structure was 300 meters long with two sluice gates and one spillway. It provided water for irrigation of *wadi* land for up to 1,260 ha (3000 faddens)^x of agricultural land per year, which resulted in a 10-fold increase in yields as compared to farming on goz soils and which directly benefited 1,000 families.¹⁹ Neighbouring villages as far as Wad Kota also benefited by cultivating the *wadi* land.

In 1998 a portion of the embankments was washed away by the flood. In 2000 Practical Action renovated the water retention structure. However, the structure fell into complete disrepair in 2002, when sections of the earth embankment were washed away by strong floods. The extent of maintenance required at that time was beyond the financial means and technical capabilities of the local communities. Consequently, the collapse of the structure greatly impacted agricultural production.

The Eco-DRR project supported the rehabilitation of this water retention structure, using an improved design developed by Practical Action Sudan. A rehabilitation plan was developed, with work ready to start after the rainy season in 2013. However, during the rainy season, the water retention structure was subject to further damage because of the construction of a new earth embankment upstream by a private landowner. The new embankment had blocked the flow of water on the main course of Wadi El Ku and caused the formation of a second watercourse (25 m wide and 2 meters deep) running in parallel to the east. Construction of this new structure, which was undertaken without consultation with communities downstream and lacking proper design or maintenance, exacerbated heavy water flow during that period, which in turn damaged the Eware structure.

Following an inspection of the damage, it was clear that the initial technical assessment was no longer relevant. This shortcoming re-emphasized the need for a landscape-scale, watershed management approach that enables information sharing between the upstream and downstream communities in the *wadi* and informs placement of water harvesting structures in appropriate areas where they do not adversely affect downstream water users.

A new rehabilitation plan was proposed. Local communities in Kilimondo locality were consulted on the rehabilitation of the water retention structure, with the objective of understanding community interests, priorities and aspirations. Neighbouring downstream communities were also consulted on the proposed rehabilitation of the Eware structure, to ensure the work will not compromise water supply in downstream communities. A Social and Environmental Impact Assessment was conducted by Practical Action prior to structural rehabilitation to identify potential impacts, along with recommendations for mitigating negative impacts (**BOX 4**).

^x 1 fadden = 1.038 acres = 0.42 ha



Focus group meetings on Eco-DRR project interventions in Eid El Beida and the surrounding communities in the Kilimondo locality

BOX 4. SOCIAL AND ENVIRONMENTAL IMPACT ASSESSMENT

The Social and Environmental Impact Assessment aimed to:

1. Identify impacts of the Eware water retention structure on the environment and social relations linked to water use before the flood damage occurred.
2. Assess the potential positive and negative environmental impacts of rehabilitating the Eware water retention structure including potential impacts on cultivation practices, condition of the soil, forestry, and pasture, as well as ecological parameters of the local environment.
3. Examine the potential positive and negative social impacts of structural rehabilitation including, potential impacts on relations between farmers, agro-pastoralists and nomadic pastoralists, as well as impacts on downstream communities' access to water. Conflict pressure points between farmers over access to land in the wadi, and potential for conflict downstream of the Eware water retention structure were identified.

Questionnaires and community focus group discussions in project villages were used to collect information. Over 48 people from different local community segments, such as women's groups and the local administration were consulted, including sheikhs, pastoralist leaders, the popular committee and the village development committee, in addition to representatives from neighbouring downstream communities.

A number of positive environmental and social impacts were identified and addressed to the extent possible in project plans. For instance, it was determined that an increase in silting would allow continuous cultivation without the need for fertilizers or crop rotation, reduce the spacing between crops and less need for intercropping, and therefore increase agricultural yields. The flooded wadi soils would also allow two planting seasons - cereals in the summer and vegetables in the winter - thus also increasing agricultural production.

A number of negative impacts and mitigation measures were also identified. For instance, potential clearance of tree cover in the vicinity of the water retention structure to make room for crop cultivation, which would require awareness-raising in the target communities about the social and ecological importance of natural vegetation. Excessive silt accumulation could also have negative impacts, and was therefore addressed in the rehabilitation plan, through the introduction of a sluice gate. Clearance of natural fodder in the vicinity of the water retention structure to make room for agriculture could cause tension between nomadic pastoralists and farmers, and disputes over access to newly irrigable land could also arise. Such concerns were therefore taken into account in defining project activities that aimed to improve natural resource governance, for instance in defining the role of the water resource management committee and involvement of sheikhs in land attribution (see **SECTION 3.2**).

The damaged spillway was renovated, a new, longer spillway was constructed, and sluice gates installed. In addition, the old earth embankment was excavated and stronger foundations were built. The earth embankment was extended horizontally by 330 m (width 7m; height 2m) to the west in order to cover the entire cross-section of the *wadi*, including the new flow channels created after the construction of the new upstream embankment. One metre of accumulated siltation was removed from the bases of the water retention structure to increase water retention capacity. The rehabilitation work was completed by October 2014.

Combined with basic improvements to the embankment structures, the new design reduces siltation risks, and can significantly lower maintenance and equipment costs. The water retention structure will also improve water infiltration into the soil, increase crop productivity, and avoid gully erosion downstream.

Involving local community residents helped develop a sense of local ownership of the operation; 150 unskilled labourers from Kilimondo volunteered to provide in-kind contribution throughout the rehabilitation work. Community members participated in the collection of material



Community members volunteered to rehabilitate the Eware water retention structure

(e.g. stone, mud, gravel and water), masonry work on the spillways, stone-breaking and compacting of earth embankments.

Practical Action Sudan provided technical expertise, overall supervision, transportation of raw materials, and hired skilled labourers. The State Government of North Darfur also provided technical expertise, in particular, the Ministry of Physical Planning and Public Utilities (SMPP), and the Ground Water and Wadis Directorate, by conducting pre-rehabilitation assessments and endorsing recommended measures for rehabilitation of the Eware water structure.

However, there remain a number of issues in fully strengthening the structure. During the following rainy season small damage was incurred to a section of the earth embankment on the western side of the *wadi*. The water resources management committee members, who were trained on embankment maintenance and repair (see **SECTION 3.3**), successfully repaired the structure in advance of the 2015 rainy season. They put in place a gabion wall and further strengthened the structure to ensure that it can withstand high volumes of water.



New concrete spillway constructed (30 m length; 6m width)

As a result of the rehabilitation of the water retention structure, 6,300 ha (15,000 faddens) of *wadi* land was brought under cultivation, in contrast with the 364 ha previously being cultivated annually. This has boosted agricultural production for 6,000 farming households, thus benefiting up to 30,000 inhabitants (the average household size consists of five members) in the five villages (Eid Elbeida, Abudelik, Wad Kota, Bahr Omdurman and Waa'dha). As a result, food availability was also increased, and the communities were able to create food reserve stocks at household level from their harvests in 2013 and 2104.

Cultivable land has expanded both upstream and downstream as a result of increased water spreading from the re-designed water retention structure. Following rehabilitation of the structure, one community, Um Ghibesha, benefited from water spread by the Eware embankment for the first time since its original construction. Two more communities, Agato and Um Azalti, previously only benefited marginally when the embankment was functional, but after rehabilitation works, their agricultural land was fully irrigated.

Community members who participated in the end-of-project meeting reported great satisfaction with the water structure rehabilitation and the subsequent increase in crop harvest yields in 2014. They were able to cultivate several varieties of sorghum, okra, watermelon and tomatoes in the extended *wadi* areas which were irrigated; this would not have been possible in the past.

In addition, due to the heavy rains in 2014, it was possible to redirect water to fill up a community *hafir* (an underground water reservoir for storing rainwater for domestic water supply and agriculture) near Eid El Beida village. The *hafir* was there before, but there had not been enough water for the community to fill it up. As a result of the dam rehabilitation, excess water was diverted to fill the *hafir* that served as a water point for cattle belonging to the Eid El Beida community.

Efforts were made to influence community leaders to allocate land in the *wadi* to disadvantaged households, particularly those who did not have access to *wadi* land in the past. Upon agreement, the land *sheikhs* allocated 327 ha (750 faddens) of newly irrigated land to 150 households from outside the area (including migrants) who previously had no or very little access to *wadi* land.²⁰ Parcels ranged between 0.84 – 2.1 ha (2-5 faddens) per household. Land was leased free of charge according to traditional practice in the area. In addition, 4,500 resident farmers who were interested in farming more *wadi* land were allocated bigger parcels based on their capacity to cultivate.

Rehabilitation of the Eware water retention structure **increased** the area under **cultivation** **by 17.5 times**



LAND UNDER CULTIVATION BEFORE AND AFTER REHABILITATION OF THE EWARE WATER RETENTION STRUCTURE

BOX 5. MEASURING LIVELIHOOD IMPACTS: PERSONAL STORIES

During a focus group meeting in 2015, several individuals expressed how they benefited from the allocation of *wadi* land for cultivation:

- Previously landless, Suad Ahmed Abdulla (woman) was allocated 1.58 ha (3.75 faddens) of land. She used the land to cultivate sesame as a cash crop. She harvested 15 sacks of sesame seeds in the first season and sold the seeds to a village trader at SDG 500 (c. 82 USD) each, earning a total of SDG 7,500 (c. 1,232 USD). She used this money to buy food for her family, and with the extra cash she bought a cow which has now given birth to a calf.
- Busra Wardi (man), also previously landless, was allocated 4.2 ha (10 faddens), which he used to cultivate sesame. He harvested 32 sacks and sold the produce in the local village market at SDG 550 (c. 90 USD) per sack, earning a total of SDG 17,600 (c. 2,892 USD). With the cash earned, he bought 18 sheep in addition to taking care of his extended family's food needs. Busra used the crop residue as fodder for his animals.
- Another previously landless farmer, Elhadi Adam Ishag (man), was allocated 10.5 ha (25 faddens) of land. He used this land to cultivate small watermelon for its seeds, which are used for vegetable oil extraction or eaten dried and roasted (as water is scarce, watermelon fruits are used to feed animals for their water needs). Elhadi harvested 45 sacks of watermelon seeds and sold to the local village traders at SDG 270 (c. 44 USD) per sack, earning a total of SDG 12,150 (c. 1,996 USD). With the cash earned, he bought a piece of land in El Fasher town (North Darfur state capital), and a few goats and sheep. He also fed his animals with crop residues from his land.



Large areas of *wadi* land covered by water retained by rehabilitated Eware structure and released for irrigation

More access to water for irrigation has increased the communities' resilience to drought and improved food security. The year 2015 brought another poor rainy season – with more severe impacts in most places than in 2011. In most localities, agricultural production essentially ceased. According to the State Ministry of Agriculture and Irrigation of North Darfur (SMOA) the total amount of food available at the state level (including stock and non-cereal food items) in 2015 was estimated at 153,294 million tonnes, which covered only 55 percent of the annual food requirement of the population. There was a total food gap of 125,422 million tonnes.^{xi} Amongst the worst affected was Kilimondo locality.^{xi}

Due to the very poor rainy season in most parts of North Darfur in 2015, the *wadi* land could not be irrigated. According to local community members in Eid El Beida at a UNEP-organized meeting in December 2015, they could not harvest anything in 2015, as rainfall was very poor. However, they were able to use their food reserves stored from the surplus production in 2014 and bridge the food gap in spite of the water scarcity in 2015. Communities were entirely dependent on the previous year's food stock to fill their food requirement for the whole year.

In contrast, in other localities, carry-on food reserve from the previous harvest did not last more than a maximum of 4-5 months. According to Practical Action estimates, had it not been for the good harvest of the previous year, about 2,000 families would have left Kilimondo locality in 2015 in search of work elsewhere to earn food for the family.

The rehabilitation of the water retention infrastructure can have a number of additional indirect benefits, especially to the dryland ecosystem. It is still too early to measure the impacts in the short time frame of the project, however Practical Action's previous experiences in North Darfur have demonstrated clear environmental benefits, which are likely to apply in this case as well. Rehabilitation of water retention structures facilitates crop cultivation along the newly flooded areas. As normal yields in clay *wadi* soils are abundant and more stable than in *goz* soils, it encourages local communities to shift away from *goz* soil cultivation. This will likely allow natural vegetation to recover in these areas, and prevents advancement of dunes towards the fertile clay soils.

In addition, *wadi* fodder production can provide more animal feed, therefore reducing grazing pressures on already degraded rangelands. More agricultural production and income relieves dependence on unsustainable coping strategies, such as cutting of trees for firewood sale, thus further removing pressure from the natural ecosystem.

Finally, when water from the retention structure floods the buffer zone between the *goz* and clay soils, which is unsuitable for crop cultivation, it provides an opportunity for trees and grasses to regenerate, re-establishing the ecological balance and biodiversity in the area.

ESTABLISHMENT OF COMMUNITY TREE NURSERY

In order to promote environmental regeneration and re-greening of the landscape, the Eco-DRR project established a local community tree seedling nursery to support community forestry and household agroforestry activities (discussed in the next section).

WDAN and VNRHD organizations and the Wad Kota community members jointly identified land for the nursery and for community forestry plantation. Local village extension agents (discussed in **SECTION 3.3**) provided technical support to nursery establishment, and community members contributed local materials and arranged a communal working party (*nafir*) to undertake preparations for the planting and watering of seedlings in time for the rainy season.

The tree nursery was established in Wad Kota village and has a surface area of 112 m². It has an annual production capacity of about 18,000 seedlings. The women's group in Wad Kota, under the umbrella of WDAN, is managing the nursery.

By the end of its first year (2014), the nursery produced 17,000 acacia seedlings, which are suitable to local climatic conditions, and 1,000 fruit tree seedlings (primarily guava and lemon). To promote agro-forestry, acacia seedlings were planted in the natural forests and distributed to schools, clinics, and households in the five target communities. Farmers used fruit tree seedlings for agro-forestry on private farmlands.

^{xi} The worst affected were the localities of Kuma, Tawilla, Malha, Um Keddada, Kornoy, Umm Baru and Dar El Salam.



Community nursery in Wad Kota village supported by the Eco-DRR project and established by WDAN, the women's CBO

For the time being, seedlings produced in the nursery are not sold but are planted in community forests. Therefore support, albeit limited, is required in the interim. This was evidenced by the fact that in the second year (2015), the nursery was only able to produce 1,500 seedlings because they ran out of bags. This was the first learning experience of nursery management by the CBOs in the area. Practical Action, the CBO networks, and the relevant Government authority – Forests National Corporation are providing support. However, if the capacity of seedling production is increased with some support from Practical Action, the excess seedlings can be sold in the market, to ensure financial independence of the nursery. The challenges have not discouraged the women’s group from managing the nursery; they have set the goal of producing 10,000 fruit trees (e.g. lemon and guava) and 10,000 gum Arabic seedlings in 2016.

COMMUNITY REFORESTATION

Using seedlings from the community tree nursery, the project supported re-establishment of community forests with a view towards achieving a modest re-forestation of the degraded areas. A 4.5 ha (12 acre) community forest was established in each of the five target communities, covering a total of 24.3 ha (60 acres). As with the nurseries, the community forests are managed by the women’s groups formed in each village. Four of the five forests were established using seedlings from the nursery, while the natural forest in Waa’dha village was rehabilitated and is being protected from livestock grazing. In the next 3-4 years, the Waad’dha forest where the trees are already mature, will be ready for gum Arabic extraction. This will bring additional income to the women in the community who are engaged in community forest management and their families.



Trees planted in a village community forest in Bahr Omdurman in 2014

The young trees need to be protected from animal browsing over the course of 3-4 years, after which they would have outgrown cattle height. Although there are no protection measures such as fencing, community members have agreed that each family must ensure that their livestock are kept away from the community forest areas, especially where the planted seedlings are still young.

Nevertheless, the protection of the forests has not been without difficulties. Soon after planting, livestock grazed and destroyed a large number of the young seedlings. To address the issue, Practical Action discussed with the five CBOs to improve protection of forests. It was agreed that the responsibility for guarding the young tree seedlings should be shared on a rotational basis between community members. A rotating monitoring system has therefore been put in place to ensure vigilance against uncontrolled grazing.

Since then, the average success rate of community forests has improved and stands at 60%. A higher success rate could not be achieved due to the dry spell in 2015. Communities continue to monitor the survival of trees, and in 2016 each village replaced dead seedlings in their community forest with seedlings from the nursery in Wad Kota.

RE-SEEDING OF PASTURELAND

Another measure implemented by the Eco-DRR project aimed to increase the quality of pastureland. To this end, three metric tons (MT) of pasture seeds were purchased and applied for re-seeding in areas where palatable vegetation was no longer available for grazing by small livestock^{xii} Two fast-growing varieties of improved pasture seeds were selected in consultation with local communities and the North Darfur State Ministry of Animal Resources.^{xiii}



Practical Action staff and a CBO network staff inspecting the community forest in Waa'dha, December 31, 2015.

Approximately 1,214 ha (3,000 acres) of rangeland were re-seeded. Three campaigns were organised by the community to broadcast seeds in pasture areas in July 2014. The timing was selected to ensure sufficient ground moisture after intermittent rains but before the heavy rains.

Community members, including the native administration, agreed to prohibit grazing in the area for a period of three months until the grasses produced seeds for the next rainy season. The native administration strictly observed this grazing ban.

Within the first year, the seeds had grown well, and communities started collecting fodder seeds from the area for use in other areas and for future re-seeding. "Paravets", who were trained by the Eco-DRR project (discussed under **SECTION 3.3**), continue to monitor the re-seeded pasture areas and have reported that the pastures are growing well. If grazed at a sustainable level, it is estimated that the community will not need to reseed the area for another 10-12 years.

Encouraged by the success of the first re-seeding campaign, community members voluntarily collected about 10 kg of seeds in 2014 and extended the re-seeded area in Abudelik without external support. Similar re-seeding campaigns were replicated in other areas of Kilimondo locality, outside of Eco-DRR project villages.²² More voluntary re-seeding is also planned in other parts of Kilimondo locality in August 2016.

^{xii} It should be noted that pasture re-seeding was carried out by the resident communities to provide a healthy grazing ground for use by local livestock owners who generally keep sheep, goats, cows and donkeys in the periphery of the settlements. It is not meant for larger cattle herds of the pastoralists.

^{xiii} The two fast-growing varieties of pasture seeds are Berril (*Bilifaris linariflora*) and Abuasabi (*Dactyloctenium aegyptium*)



SOIL EROSION CONTROL

To address the gully erosion problem, community members, and CBOs organized a campaign across the five project villages to increase awareness of factors that contribute to gully formation and soil erosion. During the campaign, practical demonstrations of techniques for mitigating gully formation were carried out by officials from the state Ministry of Agriculture, CBO networks, and Practical Action. Such techniques included reducing water velocity by simple actions such as constructing terraces and check dams with local materials to spread surface water over large areas of the land. In addition, in July 2014 when the machinery hired for the rehabilitation of the Eware water retention structure was on site, several of the worst gullies were levelled mechanically to stop their advancement.

3.2. IMPROVING NATURAL RESOURCE GOVERNANCE

The project aimed to improve governance of land and water resources at the community-level in order to enhance community resilience to water hazards and promote sustainable drylands management. This entailed several measures, namely:

- establishment of a water resource management committee;
- demarcation of the migratory route for pastoralist communities; and
- establishment of revolving funds for agriculture and livestock drugs.

ESTABLISHMENT OF A WATER RESOURCE MANAGEMENT COMMITTEE

The newly-rehabilitated water retention structure near Eid El Beida village will require regular maintenance to ensure that it does not accumulate silt or become weakened during strong water flows or flood cycles. Therefore the Eco-DRR project supported the establishment of the Eid El Beida water resource management committee and delivered technical training on management of the water retention structure.

Construction of small earth terraces to reduce gully erosion as part of a community awareness raising campaign

In May 2013 this committee was formed, comprising of ten representatives (4 women; 6 men), two from each of the five CBOs based in the target communities. Since then, the committee has met monthly, first to review progress of the water retention structure's rehabilitation, and later to monitor its operations. The committee played a vital role in mobilizing local communities to support the rehabilitation activities.

The committee has three complementary roles, namely:

- to be responsible for the structure's operations and maintenance. The committee members have been provided with technical training to operate the sluice gates and to release excess water, which must be carried out before each rainy season to ensure that minor repairs are done so that the water retention structure is able to function optimally;
- to undertake drought and flood early warning and preparedness and promote the sustainable and equitable use of water and land resources in the *wadi*; and
- to ensure that water is proportionately distributed, and ensure maximum water spread over the *wadi* lands by opening and closing sluice gates at the right time. The dam management committee also advises the land sheik on distributing *wadi* lands to landless people.

It is also responsible for liaising with State Government and NGOs such as Practical Action, for technical and financial assistance, particularly if the task to be carried out is beyond the means and expertise of the local community in the area. The committee and the CBO networks (members of VNHRD or WDAN networks at the state level) are regularly in touch with Practical Action and the State Government for their support in times of need, such as engineering expertise and funds for renovation of the Eware structure.

The Eid El Beida water resource management committee in Kilimondo has since been institutionally linked to the larger Wadi El Ku Water Forum, established upstream with support from the WEK project. The Water Forum serves as an advisory and information sharing platform and a coordination body to ensure a holistic approach to water resource management along the *wadi*. It embodies the institutional arrangement that can eventually advise on water resource management policies and legislations. Issues related to the construction of new water retention structures along the Wadi El Ku can be discussed in the Water Forum, with the view of better linking upstream and downstream coordination on water management.

The Water Forum has been meeting monthly since its establishment in December 2015. Its 24 members represent natural resource users in the *wadi*, as well as the institutions that manage and influence the allocation and use of these resources, such as Government technical institutions, the legislative council, media, Farmers' and Pastoralists' Unions, CBOs and the CBO networks, native administration, landowners, and other representatives of communities along the *wadi*.

The Eid El Beida water resource management committee, as part of the downstream community, attends the Water Forum meetings to share information and help coordinate activities related to water and land use. By bringing these actors together and making decisions based on a shared vision, the Water Forum also strengthens relations and coordination between the Government and communities along the *wadi*.



Community-led pasture re-seeding campaign

DEMARCATION OF MIGRATORY ROUTE FOR PASTORALIST COMMUNITIES

A critical component of community-level resource governance is effectively managing access and use of water and land resources between nomadic pastoralist and farming communities, in order to reduce potential conflict over animals entering farmlands, and farms encroaching into rangelands.

With support from the Eco-DRR project, farmers and pastoralists agreed to establish a 10 km (150 m wide) cattle migratory route from Jebel Marfaen area (rural El Fasher) to Khazan Kukkul-Dar-Rezaight in Dar El Salam locality, which was demarcated by concrete posts. The different color codes of the concrete posts indicate to pastoralists the proximity to farmlands. An animal resting area of 5 km², known as *sineyya*, was also demarcated.^{xiv} State Government authorities and the villagers in Jebel Marfaen and surrounding areas fully endorsed the demarcated route.

An initial meeting was held in the office of the VNRHD in April 2014 to discuss the demarcation route, which was attended by representatives of the local native administration, local communities from the project area including people from Jabel Marfaen area, Sag El Nam and Goz Beina, the Farmers Union, the Pastoralists Union, Practical Action and VNRHD. Following this meeting, a committee was formed to oversee the demarcation of the *sineyya* and the route. This

committee was led by the Department of Natural Resources and Rangeland of the State Ministry of Agriculture (DNR-SMOA) and included the State Ministry of Animal Resources and the Forestry National Corporation (FNC), the native administration, CBO representatives, as well as representatives from pastoralists' and farmers' unions.

Demarcation was carried out in the presence of and with the help of representatives from both settled farming and pastoralist communities. Practical Action and the CBO network, VNRHD, facilitated the process of migratory route demarcation, procurement and transport of material, while community members provided physical labour. State Government Ministries provided technical support, high-level political endorsement and contributed the concrete poles used for demarcation.

The native administration from both farming and pastoralist communities are responsible for: 1) ensuring that their respective communities adhere to the agreement, for instance, that lands falling along the migratory route and *sineyya* are not converted into agriculture land, and 2) settling any grievances or disputes which could arise at the local level.

^{xiv} '*Sineyya*' are designated circular demarcated areas (around 5 km²) and evenly spaced (15-20 km apart) along the migratory route for the migratory animals to rest and graze.



Consensus was built over the location and function of the migratory route, involving local farmers, pastoralists, community-based organisations and State Government representatives

ESTABLISHMENT OF COMMUNITY-BASED REVOLVING FUNDS FOR SEEDS AND ANIMAL DRUGS

Establishment of community-based revolving funds was also regarded as an important aspect of resource governance, by helping to sustain livelihood activities and provide continued services over the longer term period. Revolving funds will particularly benefit poor farmers and cattle owners who lack the means to pay for seeds and animal drugs. With initial investment from the Eco-DRR project, two types of funds were established in each village: (i) revolving seed funds, and (ii) revolving animal drugs funds.

(i) Revolving seed funds

A revolving seed fund was established in each of the five communities to increase farmers' access to improved seed varieties of common crops. The Eco-DRR project provided a 7,000 USD initial investment for the seed fund. Following a seed assessment carried out by the CBOs in the five villages, a variety of staple and cash crop seeds were selected. These included sorghum, okra, watermelon, and tomato.

Farmers can receive seeds for the crops they intend to plant, free of charge, and must agree

to return the same quantity of cereal seeds, or in the case of cash crops the cash equivalent of the seeds used, once the crop has been harvested and sold. This system ensures the sustainability of the community seed bank for the following year. The mode of payment is flexible, and cash payments can be made in a phased manner or in kind.

The revolving funds are managed by an executive committee consisting of CBO networks from the area. The village extension agent (see **SECTION 3.3**) works as the treasurer of the fund, and is also responsible for assessing the needs of the farmers for various kinds of seeds and the collection of repayments, as well as organizing the distribution of seeds, restocking and providing regular reports on the seed fund to the CBO network.

The revolving funds established in the project area have been functioning well and repayments have been on time. During the end-of-project meeting, community members stated that the fund has made seeds available to all farmers and introduced a new variety of sorghum called *butane*, which has much higher yields than the traditional sorghum variety. An estimated 75% of the households from the five villages had accessed the revolving seed funds. In many cases, farmers paid in kind with seeds of the same quantities.



Demarcated route near Jebel Marfaen. White painted posts mean animals are free to graze nearby



A community centre in Abudelik where the village agriculture extension agent manages the revolving seed fund

(ii) Revolving animal drug fund

A revolving fund for common animal drugs was established in each of the five communities, each worth SDC 6500 (about USD 1,063). When cattle owners access the drug fund, they must pay for the cost of drugs used, as well as a financial

contribution for the assistance provided by the paravet. This system will ensure the sustainability of the fund and continued services of the paravet. The revolving funds have been a success. Communities have reported improved access to animal drugs and 97% of repayments have been on schedule.²³



Animal drug revolving fund in Abudelik. The village paravet (left), who serves as the livestock extension agent, also manages the revolving fund.

3.3. STRENGTHENING LOCAL AND NATIONAL CAPACITIES FOR MAINSTREAMING ECO-DRR IN SUSTAINABLE DRYLANDS MANAGEMENT

The Eco-DRR project also invested significantly in strengthening local, state-level, and national capacities (TABLE 2). Activities included:

- **Awareness-raising;**
- **Training workshops; and**
- **Hands-on learning activities in the field demonstration sites.**

At the local level, by involving community representatives from across the *wadi*, capacity building activities also aimed to strengthen

upstream-downstream linkages between communities through sustainable management of water and land resources along the *wadi*. Trainings delivered in collaboration with the WEK Project (see **BOX 3**) at the national level aimed to strengthen capacities in Eco-DRR as part of Integrated Water Resource Management (IWRM) in drylands.

The project ensured that women were involved in all capacity building trainings. Fifty percent of trained agricultural extension agents were women. WDAN, the women's CBO, was trained in the management of the tree nursery. Women also led the re-seeding of pastureland and gully remediation. Similarly, involvement of women in national and state level trainings was close to 50%.

TABLE 2. Local and national level trainings and workshops delivered by the project

Type of training or workshop delivered	Implementing partner/s	Target audience	Number of trainings/workshops	Number of participants trained
Management of water retention structure	Practical Action, North Darfur State Ground Water and Wadis Department, State Ministry of Physical Planning, State Ministry of Agriculture	Water resource management committee member and upstream members of the Wadi El Ku Water Forum	1 (3 days)	27 of which 10 were from Eco-DRR project area and 17 from Wadi El Ku project area.
Nursery management	Practical Action, FNC, village extension agents	Community members is Wad Kota, including women's group	1 (2 days)	18
Training of agricultural extension agents	Practical Action, Ministry of Agriculture's Department of Extension Services	Agricultural extension agents	5	10
Training of paravets	Practical Action, Ministry of Agriculture's Department of Extension Services	Paravets	1 (4 weeks)	8
Village level Eco-DRR awareness raising workshop	UNEP & Practical Action	Residents in 5 project villages	1 (1 day)	Over 200
National training on Eco-DRR	UNEP	national government agencies and civil society	1	25
Darfur State-level training on Eco-DRR	UNEP	state government agencies and civil society, community members in Wadi El Ku	1	40

DEVELOPING LOCAL CAPACITIES

Local capacity building efforts targeted primarily the five villages in the Kilimondo locality (Eid El Beida, Waa'dha, Wad Kota, Bahr Omdurman and Abudelik), but also involved representatives from villages in other localities of Wadi El Ku, who were involved in up-scaling the project interventions to a larger area of the *wadi* in the upstream section (**BOX 3**). Local-level workshops were intended to support implementation of the field interventions (see **SECTION 3.2**), but were also designed to establish locally-managed systems, which could continue to improve food security and livelihood benefits long after the project's lifespan, and enable local communities to sustain and replicate field interventions.

It is important to note that a major portion of capacity building took place in the field, as part of "learning by doing" through implementation of field interventions such as nursery establishment and management, rangeland re-seeding, and reforestation.

In addition to technical trainings, a number of awareness-raising workshops were held throughout the project period with communities from the five villages in order to galvanize community engagement in the Eco-DRR project and promote dialogue on dryland ecosystems and disaster risk management issues. The workshops included discussions on disaster management and early warning. For example, local communities living and working along the *wadi* banks were informed about the timing and risks of potential floods.

More than 200 community members and leaders participated in workshops on Eco-DRR, sustainable drylands management, and IWRM. Participants in the workshops also included community leaders from Gos Beina (Dar El Salam locality) and Sag El Nam (Kilimondo locality) that are close to the project area. The CBO networks, who participated from other villages, carried out additional awareness-training on Eco-DRR in their respective villages.



Community awareness-raising workshops were held with villagers in the Kilimondo locality



Eco DRR inception workshop in El Fasher, 2013

(i) Training of agricultural extension agents

Given the limited presence of the Government in the villages to provide agricultural extension support services, it was deemed essential to train farm and livestock extension agents from the communities. Agricultural extension village agents are considered experts in their respective communities and serve as key focal points for the Government, NGOs, and international organizations. They work primarily on a voluntary basis; however, they may charge a nominal fee depending on the service rendered.

The Eco-DRR project trained ten farm extension agents - two in each of the five targeted villages, who support their communities in sustainable farming, while also managing the revolving seed funds. They are also responsible for reporting pest outbreaks in the areas to SMOA.

In addition, eight community animal health workers also referred to as “paravets”, were trained on animal husbandry, treatment, animal drugs, feeding, and vaccination, through theoretical and practical sessions. To facilitate service delivery in the community, all paravets were provided with donkeys for transport.

(ii) Water resource management training

To ensure continued functioning of the Eware water retention structure, a three-day technical training was delivered to CBO networks from the Kilimondo locality and other localities in Wadi El Ku in December 2014. The training focused on the management, operations, and maintenance (e.g. desilting) of the embankment. Twenty-seven representatives participated, including 10 members of the Eid El Beida water resource management committee as well as representatives from other communities in Kilimondo, El Fasher, and Dar El Salam localities, who will be involved in the larger-scale WEK Project.

DEVELOPING STATE AND NATIONAL CAPACITIES

Training workshops engaged primarily with State and National Government actors in order to effectively promote Eco-DRR in sustainable drylands management, as well as strengthening cooperation between Ministries, both at national and state levels, which are working on IWRM, disaster risk reduction, climate change adaptation, agriculture and livestock production.

The Eco-DRR project also contributed to other state-level capacity building activities of the WEK project, which is promoting integrated solutions to managing the inter-linked challenges of water and livelihood insecurity, ecosystem degradation, disaster risks and climate change.

(i) National training on Eco-DRR

A three-day national training was conducted in Khartoum in June 2013, in partnership with the National Ministry of Environment, Forestry and Physical Development and the Sudan Climate Change Network (SCCN). The training aimed to raise awareness and build capacity on Eco-DRR, with a focus on water management in drylands. Twenty-five practitioners participated from national government agencies and civil society.

The training encouraged participants to identify entry points for mainstreaming Eco-DRR in Sudan’s national policies and programmes. IWRM was identified as a key measure to reducing disaster risks and adapting to climate change and weather extremes, which was reflected in the National Agenda for Action which was the main output of the training. Outcomes from this national training workshop informed the design of the WEK Project on IWRM.



Training on management of water retention structure



Participants in the National Training on Eco-DRR worked in groups to develop an "Eco-DRR Agenda for Action", 23-25 June 2013

(ii) Darfur State-level training on Eco-DRR and IWRM

A second training was organized in collaboration with the WEK Project, in El Fasher town, in May 2015 to increase the capacity of the State Government and CBOs in mainstreaming Eco-DRR in IWRM. The workshop was conducted in close coordination with the State Ground Water and Wadis Department, the Ministry of Agriculture, and the Ministry of Animal Resources and Humanitarian Aid Commission (HAC) in El Fasher. Forty participants (of whom 18 were women) attended the workshop, representing governmental and non-governmental bodies and communities located near the Wadi El Ku.

The workshop demonstrated linkages between IWRM and Eco-DRR. It also offered a south-south learning experience: Lessons from UNEP's Eco-DRR project implemented through an IWRM approach in the Democratic Republic of

the Congo (DRC), were also shared.^{xv} The DRC's experience with community- and ecosystem-based solutions generated strong interest from Sudanese participants who, despite the physical and cultural differences between Darfur's Sahelian and Congo's equatorial environments, face many similar environmental problems.

Most importantly, the workshop initiated a series of dialogues in North Darfur on the importance of establishing a forum that serves as a platform for natural resource management that is both inclusive and conscious of water-related hazards. Following these discussions, a Water Forum was established with support from the WEK Project, which plays a coordination and advisory role in water-related issues along the Wadi El Ku (see **SECTION 3.2**).

^{xv} See report of Eco-DRR project in the Lukaya River Basin, Democratic Republic of the Congo: http://postconflict.unep.ch/publications/DR Congo/DR_Congo_Eco_DRR_case_study_2016.pdf



Eco-DRR and IWRM training in North Darfur State

4

HOW DID THE PROJECT CONTRIBUTE TO DISASTER RISK REDUCTION?



As discussed in **SECTION 1**, disaster risk is comprised of three main elements which must be present: hazards, exposure (i.e. people or assets located in hazardous locations), and vulnerability (i.e. the range of factors – social, physical, economic, environmental, cultural, political/institutional, etc. – that shape how hazards affect or impact on people and communities) (see **BOX 2**).

The Eco-DRR project in Sudan aimed to influence at least one component of disaster risk, namely reducing the vulnerability of local communities to water-related hazards, in particular, drought and dry spells. Flood risk was also addressed by improving the durability of the water retention structure to withstand high water flow, as well as raising awareness about timing and location of flood risk in community awareness-raising campaigns.

Vulnerability reduction at the community-level focused on five villages (Eid El Beida, Abudelik, Waa'dha, Wad Kota and Bahr Omdurman) in Kilimondo along the Wadi El Ku. Three key aspects of vulnerability reduction were addressed directly by the Eco-DRR project:

- (1) improving food and water security** through sustainable drylands management;
- (2) enhancing water resource governance** through strengthening of local, state and national capacities in sustainable drylands management, as well as through mainstreaming Eco-DRR considerations in IWRM.

It is important to bear in mind that the Eco-DRR project is primarily a demonstration project, with field level interventions implemented within a very limited geographical area, in order to demonstrate the potential for promoting Eco-DRR in sustainable drylands management in Darfur.

4.1. IMPROVING FOOD AND WATER SECURITY

Given the high vulnerability of local communities in Kilimondo to water hazards, particularly drought but also occasional floods, the Eco-DRR project aimed primarily to improve water and food availability to vulnerable households.

The rehabilitation of the water retention structure, by improving its structural design and adding a spillway (which allows some water to flow through the structure during peak precipitation times), has increased the durability of the structure, allowing it to better withstand heavy rains and flash floods.

With the newly-rehabilitated water retention structure, the area of land under cultivation

could be dramatically expanded upstream and downstream, producing more food. As such, the Eco-DRR project improved food security and reduced vulnerability to drought for 17,500 people. The good harvest of 2014 brought about by the spread of water retention and good rainfall played a major role in bridging the food gap caused by the failure of the rainy season in 2015. Increased land for crop cultivation also targeted vulnerable households and helped them benefit from enhanced agricultural production.

Revolving community seed and animal drug funds and accompanying training of local farming extension agents and paravets have increased access to agricultural and livestock extension services, which provides additional safety nets, especially to poor households. Giving households greater access to improved seed varieties and animal care enables them to improve their production yields and better cope with climate extremes, especially long dry spells.

Local ecosystems were also partially rehabilitated through re-seeding of degraded pastureland and establishing community forests, which support pastoralist livelihoods and can provide sustainable sources of income from gum Arabic production and agroforestry. Community forests provide many benefits, which contribute overall towards enhancing environmental resilience to drought and dry spells, including:

- **protection of the *wadi* lands from sand encroachment and soil erosion;**
- **re-vegetation of degraded areas and re-greening of the landscape;**
- **additional household incomes from harvesting gum Arabic and fuel wood in the future.**

4.2. ENHANCING SUSTAINABLE AND EQUITABLE NATURAL RESOURCE GOVERNANCE

As discussed in **SECTION 1**, one of the underlying causes of high disaster vulnerability of local communities in North Darfur has been the breakdown of local institutions, which has

reduced their capacity to effectively govern the use of shared water and land resources. Therefore, strengthening local-, state- and national-level capacities for implementing Eco-DRR measures was considered key for enhancing sustainable and equitable water resource governance.

COMMUNITY-LEVEL NATURAL RESOURCE GOVERNANCE

At the local level, the Eid El Beida water resource management committee will play an important role in drought and flood risk reduction by monitoring water levels in the *wadi*, as well as ensuring sustainable and equitable management of water and land resources. The local capacity built on embankment management is key for better monitoring, regulating and utilizing water flows and providing early warning of water hazards such as drought and floods.

Women's groups received additional training through involvement in the field interventions, such as the establishment and management of the tree nursery and community forests, and were engaged in community consultations and Eco-DRR/IWRM trainings.

Demarcation of the migratory route is expected to improve access to both water and land resources by pastoralist communities, while at the same time help reduce potential conflicts over land and water use with farming communities. Since the demarcation of the route, there have been fewer small-scale disputes between pastoralists and farmers in the area.

STATE- AND NATIONAL-LEVEL CAPACITY BUILDING ON ECO-DRR IMPLEMENTATION

Awareness-raising and capacity building activities have brought greater attention to sustainable drylands management through Eco-DRR approaches. Increased local environmental awareness has resulted in concrete actions at the state level. There is now heightened community concern over integrated water resource management across the Wadi El Ku landscape, and both communities and the State Government fully recognize the negative impacts of ad-hoc embankment constructions, which result in water flow diversion and gully formation.

Kilimondo communities have become much more vocal and have requested the State Ministry of Agriculture of North Darfur to better

monitor and control the construction of water retention structures across *wadis* and ensure that water resource usage remains sustainable and compatible between upstream and downstream communities. In response, by issuing a Decree, the Ministry of Agriculture has taken action to ban ad-hoc constructions and now require social and environmental impact assessments and upstream and downstream community consultations to be undertaken for new embankment constructions.

Finally, the project took steps to link committees in order to ensure a landscape approach to water resource management. The Eco-DRR project was used to inform implementation of the WEK project which has promoted establishment of an IWRM framework in the State of North Darfur to better manage water resources in the Wadi El Ku catchment.^{xvi} The current IWRM framework has taken into account water hazards and disaster and climate risks as part of sustainable water resource management.

The Wadi El Ku Water Forum now links the Eid El Beida water resource management committee in the Kilimondo locality to upstream communities along the Wadi El Ku. The Water Forum functions as a loose network of 'volunteers' representing different institutions and interests around water and natural resources in Wadi El Ku. It therefore provides a framework for the inclusion of all stakeholders in decision-making, including migratory pastoralists.

^{xvi} There are three components to establishing functional catchment management: 1. An institutional arrangement that can take forward coordination around water and related natural resource issues; 2. A strong knowledge/science base to enable improved decision making on water and natural resources; 3. Higher level commitment - usually through policies and legislation - which enables integrated catchment management.

REDUCING AND MANAGING POTENTIAL CONFLICTS OVER SHARED RESOURCES

Given that Eco-DRR in North Darfur was implemented against a backdrop of protracted conflict among pastoralist and farming communities, the project aimed to mitigate local conflict, through improved environmental governance and consensus-building over the use of land and water. The demarcation of the migratory route, establishment of a water resources management committee, and regular consultations with diverse stakeholders have all contributed towards conflict mitigation.

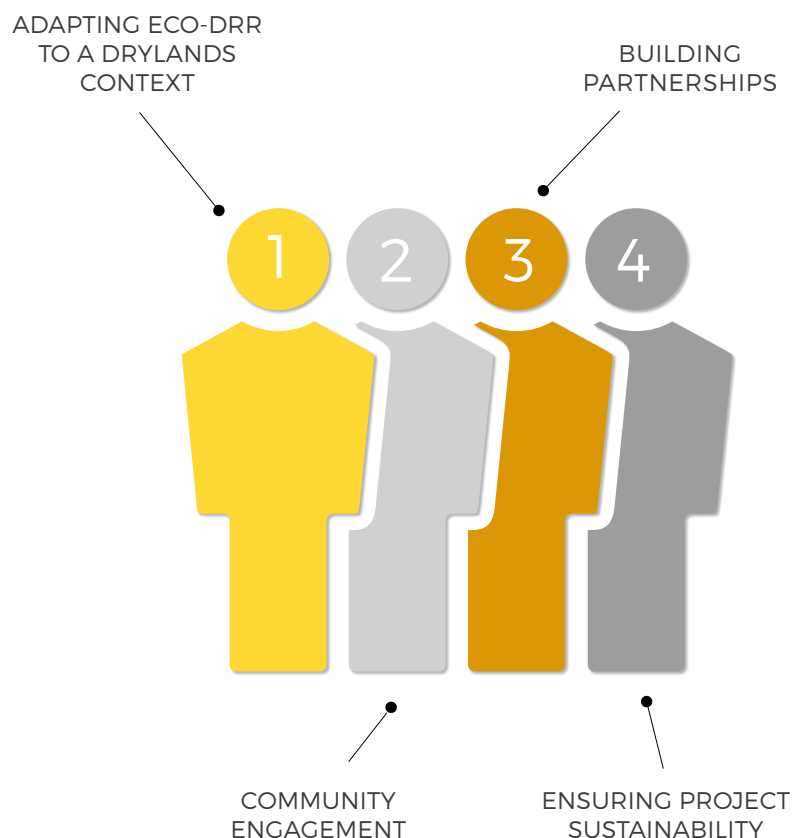
5

LESSONS LEARNED



This final section reflects on the main lessons learned from the Eco-DRR project in Sudan, in order to inform the design, implementation, replicability, and sustainability of similar Eco-DRR approaches and initiatives in the drylands of Sudan and elsewhere. The project clearly demonstrated that the Eco-DRR concept could be successfully applied to drylands if carefully adapted to the local environment, hazard and socio-economic contexts. The results and experience in Sudan can serve as a basis for learning and developing Eco-DRR approaches in other wadis in the country and across the arid region of Africa. Several factors, however, need to be considered to support project implementation, maximize results and outcomes and ensure sustainability.

LESSONS LEARNED





ADAPTING ECO-DRR TO A DRYLANDS CONTEXT

To apply the Eco-DRR concept in practice in a drylands context, the project design had to be carefully adapted to difficult local conditions. This entailed a number of challenges:

FINDING THE RIGHT INTERVENTIONS

The first challenge of the project was finding the right ecosystem-based interventions. In North Darfur where water availability is the most significant limiting factor, compounded by increasingly unpredictable rainfall, it quickly became clear that without improved access to water, any other interventions would be futile. Access to water for irrigation was on top of the communities' priority list. Without directly addressing water needs and improving livelihoods, field interventions would not have been successful (e.g. planted trees would likely be cut down for sale as firewood).

As a result, interventions were centred on the rehabilitation of an existing water retention structure to provide water for irrigation of fertile wadi soils, therefore boosting agricultural yields and increasing community resilience to droughts. Increasing water availability was also essential for implementing additional Eco-DRR interventions which aimed to re-green the landscape, such as the community tree nursery and reducing agricultural pressure on fragile *goz* soils.

The Eco-DRR pilot project demonstrated that while ecosystem-based measures are often perceived as purely green infrastructure such as re-vegetation and ecosystem protection, a combination of green and grey infrastructure (i.e. hybrid measures) might in fact be the most appropriate approach in the context of North Darfur drylands.

ADDRESSING A COMPLEX HAZARD

A second challenge was the complexity of drought as the main hazard targeted. Drought is a slow onset hazard, which is manifested in many different ways (different drivers, return cycles, intensities, impacts, etc.). Unlike rapid onset hazards such as flood and storm surge, which can be physically buffered by ecosystems (e.g. forests, coral reefs etc.), green buffers against drought cannot directly mitigate or result in reducing exposure. Therefore the focus must shift towards reducing vulnerability and building community resilience to drought impacts. The Eco-DRR project in North Darfur focused on improving food security and livelihoods of vulnerable communities, and particularly targeting more vulnerable segments of society, in order to reduce local vulnerability and improve resilience and coping capacities to drought.

HAPHAZARD WATER RETENTION CONSTRUCTION IN NORTH DARFUR

The third and biggest challenge faced by the project was related to the haphazard construction of water retention structures and lack of a holistic *wadi* management approach in North Darfur. As discussed in **SECTION 3.2**, the construction of a new embankment upstream of the Eware water retention structure by a private landowner prior to the Eco-DRR project, complicated the work at hand. The initial rehabilitation plan was no longer relevant due to the change in the *wadi* course, and a new, more costly plan was required. This in turn delayed rehabilitation work and raised the cost of structural rehabilitation, therefore restricting the budget for other activities such as re-greening the landscape. Due to the delays to find a new solution, the rehabilitation work had to be rushed before the rainy season, which undermined the quality of the work. A section of the embankment had to be reinforced the next year to better withstand strong water flows. After two years of work, the water retention structure is finally fully rehabilitated and provides a secure source of irrigation water and food security in the surrounding villages.

ESTABLISHING NEW ECO-DRR MEASURES

Implementation of the Eco-DRR project in North Darfur demonstrated that existing vegetation has a higher success rate than those newly established. For instance, the existing community forest in Wad Kota village is showing a higher survival rate of trees than the newly established community forests in the other four villages. This may be partly due to the fact that more mature vegetation is more resistant to natural and anthropogenic threats. For example, new seedlings are short and vulnerable to grazing by small livestock, while

taller trees are less at risk and require less active protection by communities in the form of a grazing ban or rotational guarding. Future projects could benefit from selecting forestry species that require minimum protection, for example unpalatable trees and shrubs.

Young vegetation is also more vulnerable to dry spells within the first few years. For example, low precipitation was partly responsible for the low survival rate of established community forests and also negatively affected the growth of re-seeded rangelands.

150 landless households

were given **access to wadi land**

for farming





COMMUNITY ENGAGEMENT

Despite the short time frame of the project, the success of field activities is evident by the strong community uptake of interventions. Communities in the five villages contributed substantially to implement field interventions, for instance by providing in-kind labour to undertake rehabilitation work on the water retention structure, re-seeding of pastureland, and nursery establishment. The involvement of local CBOs was key in mobilizing communities for Eco-DRR implementation.

However, the project confirmed that community level projects must make it least demanding of time and energy from community members, and ensure the right timing of activities to match communities' schedule, as project activities generally require voluntary work. For example, project activities, such as the training on water retention management, that coincided with peak livelihood activities, did not attract as many participants as expected.

Nevertheless, through continuous engagement, the communities themselves have become active promoters of Eco-DRR and the IWRM approach (discussed in **SECTION 4.2**). A number of additional pasture re-seeding campaigns, new migratory demarcation routes, as well as the protection and rehabilitation of an existing natural forest have also been organized by the communities and local organisations themselves.

One of the reasons for strong community uptake of Eco-DRR may be due to the "below average" rainfall in 2015, which tested the effectiveness of the Eco-DRR approach in supporting food security. Kilimondo was one of the worst localities affected by low precipitation in North Darfur in 2015. However, the household food reserves set aside

from the previous year helped the communities in the five villages to cope with rainfall scarcity. This provided clear evidence of increased community resilience to drought and rainfall variability. While prolonged drought over multiple years might again compromise food security, at present the community is clearly better equipped to cope with dry spells as a result of the project.

Field interventions that provided clear livelihood benefits were quickly welcomed by the communities. For instance, establishment of seed banks, animal drug funds and improved agricultural extension service all addressed subsistence and livelihood priorities of the community, who are continuously under pressure to manage limited resources effectively and gain income. However, other activities, such as community forestry, with less direct livelihood benefits only gained support from the community once the wider benefits of the Eco-DRR approach were appreciated through dialogue and awareness-raising campaigns.

Women as natural resource managers, in particular, expressed high commitment and enthusiasm. In the project, women served as local champions of Eco-DRR, participating actively in community consultations and decision-making meetings. Village level women's groups under the umbrella of WDAN took the lead in the establishment of the tree nursery and community forests and continue to manage these initiatives. WDAN is represented in the Water Forum and is therefore expected to further strengthen women's roles in water and natural resource management within the Wadi El Ku catchment.



BUILDING PARTNERSHIPS

The project created a number of key partnerships at local and national levels. These partnerships allowed UNEP to co-share resources and expertise, and increase the chances of continuation, replication and scale up of Eco-DRR in drylands of North Darfur and other states in Sudan.

STRENGTHENING LOCAL PARTNERSHIPS TO OPERATE IN A FRAGILE PEACE AND SECURITY CONTEXT

Operating in the fragile peace and security context has brought obvious challenges to the project, particularly restriction of movement and periodical inaccessibility of target areas. However, project implementation has been successful thanks to the long-standing and trusted presence of Practical Action Sudan and the network of CBOs in the area. The success of the project points to the fact that Eco-DRR is feasible, even in a complex security environment if there is ownership by local stakeholders and presence of strong local and national implementing partners.

CREATING LINKAGES BETWEEN CBOs AND GOVERNMENT MINISTRIES TO SCALE UP ECO-DRR

The project built capacity within the five target communities in the Kilimondo locality to manage and replicate the Eco-DRR interventions. However, it is clear that the communities alone will not be able to ensure the sustainability of interventions in exceptional circumstances (e.g. extreme

climatic events). For instance, the water resource management committee has been trained and is managing operations and maintenance of the water retention structure. Nevertheless, in the event of exceptionally high rainfall or changes in the watercourse of the *wadi*, the structure may be damaged beyond the capacity of the community alone to repair. Similarly, a prolonged drought or a series of poor harvests might lead to an economic downturn and limit the ability of beneficiaries to repay the revolving fund systems established.

It was therefore essential to connect local communities to Government bodies and ensure that the State Government takes joint ownership of the activities so that regular technical and financial support could be provided in case of major renovation needs in the future. For instance, the State Ministry of Agriculture has committed to providing continued support to the maintenance of the Eware water retention structure.

Such linkages will need to be strengthened in follow-up projects. For example, coordination among village extension agents, the Ministry of Animal Resources and the Ministry of Agriculture across North Darfur is still limited. In the long term, improving coordination between the State Government and local extension agents will be essential for improving agricultural and livestock production and extension service delivery to the communities.



ENSURING PROJECT SUSTAINABILITY

A major concern for any project is the sustainability of impacts beyond its limited lifespan. In this case, the Eco-DRR project was a 3-year intervention, which has yielded a number of successful results. Certainly, a number of challenges will constrain further up-take, replication, and scaling-up of the approach in the country. These include, for instance, highly variable climate conditions, the fragile peace and security context in Darfur region, and the lack of supporting policies on Eco-DRR and IWRM to promote sustainable land and water management in Darfur. There is also a problem with the enforcement/implementation of policies due to limited capacity and resources of the State authorities. While there is no way to guarantee that the project activities and results will be sustained, we can reflect on a number of factors that support long-term outcomes.

First, one of the most important ways that lessons from this project will be reproduced and replicated is through the CBO networks which were directly involved in project implementation. These include VNRHD, WDAN and the El Fasher Rural Development Network (FRDN), which together have over 150 village-level organizations under their umbrella. Over the years, and for much longer than the Eco-DRR project, these CBO networks have made significant contributions to food security and rehabilitation of the environment in North Darfur. The results and lessons from the pilot Eco-DRR project could serve as a successful local experience on which the CBOs can leverage additional funding to replicate and scale up Eco-DRR.

Second, local capacity-building trainings provided to communities improve the chances of continuity in the management of field interventions. For instance, the capacity built within the Eid El Beida water resource management committee is key for better monitoring, regulating and utilizing water flows and providing early warning of water-related hazards such as drought and floods. The committee has already demonstrated increased capacity to manage and resolve minor issues related to the water retention structure.

Third, the pilot Eco-DRR activities are replicated through other projects of UNEP, Practical Action and other partners. Starting from the Eco-DRR project area, the demarcated migratory route will be extended another 50km to the north through the WEK project, and 30km to the south, through a project implemented by Practical Action in consultation with the NGO Al-Ta'aifi. Therefore, the original demarcation of 10km of migratory route by the Eco-DRR project will, in fact, be expanded as part of a 120 km route. The work with agricultural extension agents will also be expanded by the Food and Agriculture Organisation of the United Nations (FAO), the State Ministry of Animal Resources, Rangeland and Fisheries of North Darfur (MOARF), Practical Action and other humanitarian actors, who are taking steps to form community-based animal health worker societies and networks in North Darfur.

Fourth, through the Eco-DRR project, partnerships were created that support project sustainability. By strengthening collaboration between CBOs, the State Government, and NGOs, long-term technical and financial support to local communities for dealing with unexpected challenges, is better assured. Future demonstration projects could also benefit from surveying potential strategic partnerships and key actors early on and identifying possibilities of scaling up the approach.

Finally, from the outset, the project was mindful that full involvement of the Government was essential not only for technical support but also for ensuring local ownership, replication and scale-up. Government experts from various institutions such as the State Ministry of Physical Planning and Ground Water and Wadis Department provided local expertise (engineering services, water management etc.). The project requested and made use of their expertise and involvement, gaining their support for Eco-DRR, beyond the lifespan of the project.

6

ACRONYMS, ABBREVIATIONS AND REFERENCES

Aerial photo of a village in North Darfur



ANNEX 1. ACRONYMS AND ABBREVIATIONS

CBO	Community-Based Organisation	MT	Metric Tonnes
DNR-SMOA	Department of Natural Resources and Rangelands of the State Ministry of Agriculture and Irrigation	NAP	National Adaptation Plan
DRC	Democratic Republic of the Congo	NAPA	National Adaptation Programme of Action
DRR	Disaster Risk Reduction	NGO	Non-Governmental Organisation
EbA	Ecosystem-based Adaptation	NRM	Natural Resource Management
EC	European Commission	PEDRR	Partnership for Environment and Disaster Risk Reduction
Eco-DRR	Ecosystem-based Disaster Risk Reduction	SCCN	Sudan Climate Change Network
EU	European Union	SDG	Sudanese Pound
FAO	Food and Agriculture Organisation of the United Nations	SLA	The Sudan Liberation Army
FNC	Forestry National Corporation	SMOA	State Ministry of Agriculture and Irrigation of North Darfur
FRDN	El Fasher Rural Development Network	SMOARF	State Ministry of Animal Resources, Rangeland and Fisheries of North Darfur
ha	Hectares	SMPP	State Ministry of Physical Planning and Public Utilities
HAC	Humanitarian Aid Commission	UNEP	United Nations Environment Programme
HCENR	Higher Council for Environment and Natural Resources	UNISDR	United Nations International Strategy for Disaster Reduction
IDP	Internally Displaced People	USD	United States Dollar
IOM	International Organization for Migration	VDC	Village Development Committee
IWRM	Integrated Water Resource Management	VNRHD	Voluntary Network for Rural Helping and Development
kg	Kilograms	WDAN	The Women Development Association Network
km	Kilometres	WEK	Wadi El Ku
MEFPD	National Ministry of Environment, Forestry and Physical Development	WHO	World Health Organization
mm	Millimetres		
MOARF	Ministry of Animal Resources and Fisheries		

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