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SLMP Training for Field Practitioners on Low Cost Soil and Water Conservation

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Contents

Integrated Watershed Management

Zertoot is a small stream that flows down from the high mountains, crosses rangelands and runs through the village of Katili in Nangarhar, before emptying into a larger river lower down. Every day, herders graze their flocks of sheep and goats in the extensive rangelands in the upper section of the valley. At the same time, villagers are collecting shrubs to carry them home as valuable firewood for cooking and heating. A herd of Kuchi nomads occasionally crosses the vast rangelands in search of fresh fodder for their livestock, while lower down in the valleys the villagers of Katili are fetching water for drinking, cooking and washing as well as for irrigating their fields.

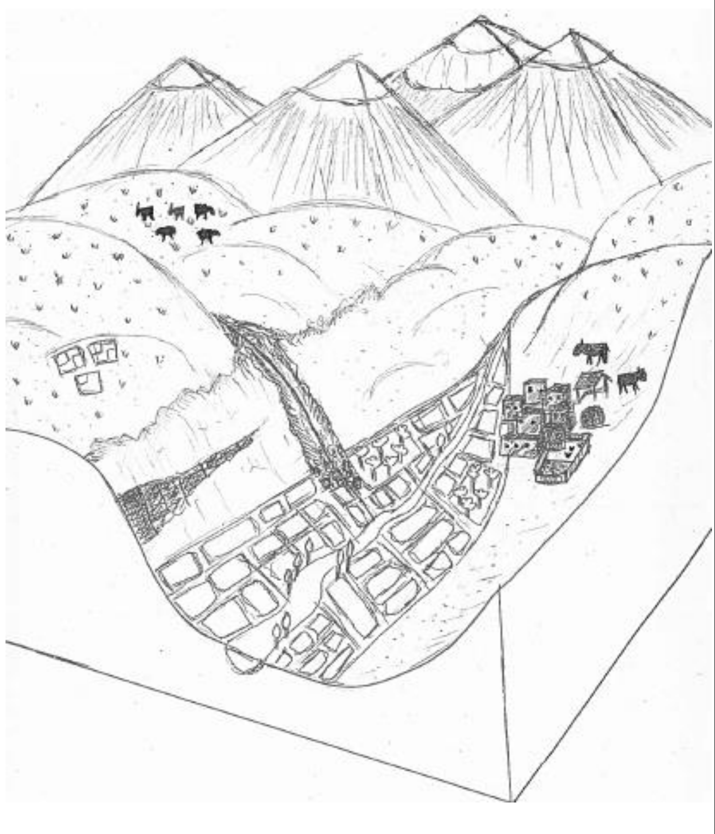

Figure 1: An example of a watershed in Afghanistan (Helvetas Swiss Intercooperation, 2014)

Natural resources (such as water, soil and vegetation) have many different uses, all of which are important to the livelihood of local communities. In many cases natural resources are considered common-pool resources and used by many different stakeholders. This is also the case in Afghanistan, where many different people use a watershed and its resources. These users may have different objectives and/or conflicting interests with regards to the use of natural resources. It is therefore important to address a multitude of users and work towards an integrated use of watersheds.

Watershed management

"A watershed refers to an area of land where all of the water that is flowing over or under it drains into the same place. It includes rain, snow, melt, streams and rivers, lakes, ponds and wetlands. A watershed is separated from adjacent watersheds by a geographical barrier such as a hill or a mountain, which is known as a 'water divide'. Watersheds drain into larger basins in a hierarchical pattern, with different watersheds combining into one larger river basin" (ILEIA, 2009). A watershed can serve as a unit for planning and intervention, for example in the frame of geographical or livelihood projects. This is called "**watershed management**".

A watershed is not only a hydrological entity but a socio-political unit as well. The sustainable use of watershed resources (e.g. soil, rangelands) depends much more on **individual behaviour**, **local governance structures** and the **values** of a society than on technical solutions. To address both natural and socio-political aspects, watershed management needs to take a multidisciplinary and participatory approach, a so-called **Integrated Watershed Management** (IWM) approach. It is the **interaction** of interventions, combined in IWM, and ranging from education, economic incentives, regulations and their enforcement that leads to systemic change (Simonovic, 2009). The concept of IWM is presented in Box 1.

Box 1: Definition of IWM

"IWRM is a process that promotes the coordinated development and management of water, land and related resources in order to maximise the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems. Integrated management has to be applied through a complete rethinking of water management institutions – putting people at the centre." (SDC, 2005)

Reconciling up- and downstream users' interests

Land ecosystems are interconnected by the flow of water (incl. sediments, nutrients, etc.) in a watershed. Upland activities have many off-site effects, which can have both positive and negative effects on downstream areas. At the same time, a great deal of important economic and political infrastructure for upland users is located in the lowlands, making upper and lower catchments within a watershed highly interdependent.

In Afghanistan, upland activities rely particularly on pasture resources used by lowland villagers or transhumant nomadic pastoralists. Lowland villagers also depend on the capacity of the upland soils to retain water, which is crucial to ensure water infiltration and prevent devastating flash floods. Annex 1 provides a short summary of upland/lowland production systems in Afghanistan.

> **Box 2: The principles of good governance**
>
> - Participation
> - Accountability
> - Transparency
> - Efficiency and effectiveness
> - Equity and inclusiveness
> - Rule of law

Communication and relations between the different up- and lowland users are not always easy. There may be an imbalance in terms of wealth and power between the different users, which can feed inequality (and even conflict). Agreement on the use and management of natural resources among all different stakeholders and compliance with good governance principles (see Box 2) are key. Uncoordinated management can lead to the overexploitation of natural resources and land degradation. This in turn triggers soil erosion, landslides and flash floods, which will affect seriously all the different users who depend on the watershed for their livelihoods.

Sustainable Land Management

Sustainable Land Management (SLM) is a multi-disciplinary approach that seeks to counteract land degradation and restore ecosystems through **natural resource management** and **soil and water conservation measures**. SLM is implemented in a given watershed (a defined reference area) as part of an IWM approach. For more information, please refer to the Concept Note on Sustainable Land Management.

SLM is also key to **Disaster Risk Reduction** (DRR). This is of specific relevance, as Afghanistan has in recent decades been increasingly affected by extreme weather and climate events (e.g. droughts, floods) that put people, infrastructures and ecosystems at risk.
In addition, water resources, forestry, rangelands and agriculture are highly vulnerable to climate change, which can have severe and direct impacts on people who depend on these resources for their livelihood (e.g. rural farmers and herders). **Adaptation to climate change** offers strategies (see Box 3) to cope with the impact of climatic hazards. Mainstreaming climate change adaptation and disaster risk reduction in IWM is therefore a necessity. Please also refer to the Concept Note on Climate Change and Disaster Risk Reduction.

> **Box 3: Disaster risk reduction and climate change adaptation**
>
> Adaptation strategies such as conservation agriculture are key to coping with the degradation of ecosystems as a result of climate change.
>
> Disaster risk comprises three separate elements – hazard, exposure and vulnerability. Disaster risk reduction aims to decrease the damage caused by natural hazards by promoting resilience and reducing the exposure and vulnerability of people, infrastructure and environments to weather and climate disasters. (FAO, 2011)

Community-based watershed management

The sustainable use of natural resources depends far more on social and economic aspects than on technical solutions. **Community-based watershed management** offers an interesting approach to IWM, as it lays particular emphasis on participation and the sustainability of interventions. The following issues need to be addressed if there is to be equitable and sustainable management:

- Access and property rights related to natural resources;
- Participation and ownership of involved stakeholders;
- Gender/social equity (who benefits, who is excluded?);
- Social organisations, their governance and accountability mechanisms;
- Conflict prevention, transformation and solution;
- Cost-benefit analysis of interventions.

For more detailed information refer to the Concept Note on Community-Based Watershed Management.

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Interesting videos

Helvetas Swiss Intercooperation Afghanistan, Watershed Management in Afghanistan. Available at: https://www.youtube.com/watch?v=FuFbHZgzjnY

Helvetas Swiss Intercooperation Nepal, Water Resource Management Programme. Available at: https://www.youtube.com/watch?v=9OwVo73eJ6g

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Upland production systems

Pastoralism

Pastoralism is the extensive use of rangelands for livestock production, which strategically uses **mobility** to adapt to the erratic climatic pattern of upland watersheds (rangelands).

In Afghanistan 1 to 2 million people are **nomads**, commonly referred as **Kuchi** (*to move*). The majority of Kuchi are completely mobile and **move across watersheds** along long-range (up to three months) migration routes; others are semi-nomadic and make shorter migrations (one to three weeks)**.**

Kuchis are Afghanistan’s main provider of meat, wool and dairy products (e.g. *qurut*). They also play an important part in connecting regions by bringing goods to remote areas (Jacobs and Schloeder, 2012).

Pastoral systems rely completely on the **upper part of the watersheds (rangeland pasture)** for their survival. Subsequently, they have been particularly affected by the violent droughts, land conflicts and war of recent decades, and have had to abandon their nomadic lifestyle. In actual fact, they represent 70% of the internally displaced population in Afghanistan (Jacobs, Schloeder, 2012).

The Kuchi are organised in **clans,** and in 2006 the government created the “Independent General directorate of Kuchi” (**IGDK**) in order to negotiate and take decisions with them. Its purpose is to address “all social, economic and political issues affecting the Kuchi across Afghanistan, regardless of ethnicity” (Jacobs and Schloeder, 2012).

Mixed production systems

Sedentary upland livestock systems

In sedentary communities, almost every household relies on livestock within its farming system, keeping one or two milking cows (usually stall-fed with a **cut-and-carry system**) and small flocks of sheep and goats. Sedentary farmers make use of upland areas primarily to graze their small flocks. The small-ruminant flocks are generally left to **graze in the uplands regions** near villages (classified as *local rangelands* in customary laws), where they come from in the morning and return to every evening. In these areas, the grazing is often **continuous** (thus contributing to overgrazing).

The reliance of these land users on the upper part of the watershed is only **partial** (or indirect), as they generally also rely on irrigated agriculture or other activities more associated with lowland production for their livelihoods.

Rain-fed agriculture

Rain-fed agriculture in the uplands usually represents a change in land use, as land previously used for pasture is ploughed and sown for crop production (e.g. wheat). Conversion to rain-fed agricultural land often leads to significant soil erosion, with all its attendant consequences. Furthermore, this factor tends to cause conflicts among local communities and contributes to barriers nomadic migration.

Lowland production systems

In the fertile lowlands, the production systems that depend directly on water and land are **livestock production** (e.g. diary, poultry) and **irrigated agriculture**. These downstream activities are closely dependent on the water storage capacity of upstream regions and thus indirectly dependent on the sustainable land management of upland areas.

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Sustainable Land Management

Upland ecosystems of Afghan watershed are predominately rangelands that can be divided into different land-use systems (see Box 2 below). These ecosystems provide important services to the communities: forage for livestock (central to the livelihoods of more than 80% of the rural population), firewood, medicinal plants and other activities. They also provide possibilities to buffer or store water. However, at present, many watersheds in Afghanistan are becoming ever more heavily degraded, thus resulting in the deterioration of their important **ecosystem services** (see Box 1), with severe consequences for both downstream and upstream users. Mismanagement of ecosystems and the inappropriate or over-exploitative use of natural resources contribute to land degradation, which in turn increases the risk of flash floods and land erosion.

In Afghanistan, many factors trigger land degradation, increasing the vulnerability of rural livelihoods (see Box 3). In particular, the weak governance structures at local level often hinders sustainable use of watershed resources. Local governance structures (e.g. CDCs and community-based organisations) are key to successful management of common-pool resources such as water, rangelands and forests. **Community-based approaches** focus on the principle of subsidiarity: the local community takes responsibility for the management of natural resources and ecosystems on which they depend for their livelihood. For more information please refer to the Concept Note on Community-Based Watershed Management.

Box 1: Definitions

"An **ecosystem** is a dynamic complex of plant, animal, and microorganism communities and their nonliving environment interacting as a functional unit. Humans are an integral part of ecosystems." (Meith, 2009)

Ecosystem services are defined as all the benefits that humans receive from ecosystems. These benefits can be direct or indirect, and the way they are used and managed will (positively or negatively) influence the ecosystem's long-term survival and resilience.
The Millennium Assessment clarified four main categories of ecosystem services: **supporting** (services that are necessary for the production of all other ecosystem services e.g. soil formation), **provisioning** (e.g. food), **regulating** (e.g. purification of water from soil, carbon sequestration), and **cultural** (e.g. ecotourism, sanctuary in a natural area) (Meith, 2009).

Box 2: Land use in Afghanistan's uplands ecosystems

Land Use Systems

- **Extensive grazing land** (grazing on natural or semi-natural grasslands, grasslands with trees/shrubs or open woodlands for livestock and wildlife)
- **Rain-fed agricultural land**, annual cropping (results usually from a change in land use)
- **Mixed land** with silvo-pastoralism or agro-pastoralism (open woodland and grazing land, agriculture and grazing land, etc.)
- **Sparsely vegetated or bare land** (unmanaged or used by pastoral communities)

Land Users

- Nomadic population (Kuchi)
- Sedentary villagers
- Semi-nomadic population

For more information see Concept Note on Integrated Watershed Management

Note: Land users are not a homogeneous group and do not necessarily share common objectives and interests. There may be conflicts over the use of natural resources, and so conflict-sensitive management is key.

Sustainable Land Management (SLM) is an integrated approach that addresses the sustainable management of land, water and other natural resources, and the services they provide. SLM seeks to counteract land degradation, reclaim degraded areas and ensure the **resilience** of the ecosystems, their services and resources.

Box 3: Causes of land degradation in Afghanistan

- **Overgrazing**, either by an overabundant number of livestock heads or through excessive grazing (for too long). Occurs primarily near villages in the valleys, where the stock is left to graze continuously by sedentary villagers, and in areas where nomadic communities' use of traditional routes is blocked.
- **Excessive harvesting** of wood and shrubs for firewood, usually through the uprooting of bushes by local communities for subsistence (and/or by commercial operators).
- **Change in land use** through the conversion of rangelands into rain-fed cropland. In semi-arid areas, ploughing of rangelands and conversion to rain-fed farming contributes significantly to soil erosion, in particular on sloping grounds.
- **Climate change** tends to increase the effects of land degradation due to an increase in extreme events such as droughts and floods.
- **Indirect drivers** such as poverty, power relations, governance structures, war and conflict, etc.

SLM is based on **conservation measures** to prevent, mitigate or rehabilitate damage to ecosystems and their services:

- **Prevention:** SLM measures maintain and enhance ecosystems' resilience, their functions and services;
- **Mitigation:** SLM measures reduce on-going degradation and avoid further degradation;
- **Rehabilitation:** SLM measures regenerate the profound land degradation, restore ecosystems and re-establish ecosystem services.

Box 4: SLM: An integrated approach

In order to be effective in the long term, SLM requires the partnership of all the stakeholders concerned (public, private and civil society) at all levels:
- Local (e.g. CDC, local community)
- Regional
- National and (International)

SLM includes integrated management approaches and requires the partnership of different stakeholders at all levels (local, regional or national level as shown in Box 4).

Low-cost soil and water conservation

Soil and water conservation (SWC) measures enhance the productivity of the land through the implementation of various vegetative, agronomical, structural and management measures (see Box 5). If successfully applied and maintained by the community, these measures lead to better management of land resources (soil, water and vegetation) and "have the potential to reduce land degradation and simultaneously address concerns such as water scarcity, land use conflicts and climate change" (Liniger et al., 2007).

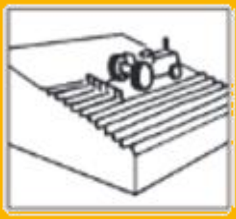
Soil and water conservation measures create a **water buffer**, storing water in the watershed and simultaneously improving soil conditions, which in turn prevents flash floods and controls land erosion. Often, water storage in a watershed is associated with large surface reservoirs and mega dams. However, water can be efficiently stored across the landscape through **low-cost** and **small-scale** measures, so called **Low-cost Soil and Water Conservation (LCSWC)** measures.

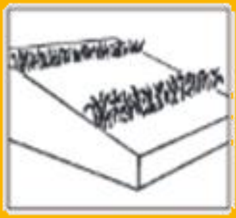
LCSWC measures are more likely to be adopted by resource scarce communities, facilitating the upscaling of SLM in a watershed. LCSWC measures are:

- Affordable,
- Use local resources (including materials and labor),
- Simple and easy to use,
- Use of indigenous knowledge, practices and approaches,
- Easy to maintain,
- Flexible and resilient,
- Environmentally friendly.

The implementation of effective LCSWC measures is a long-term undertaking and requires continuous management and **maintenance** efforts. For more information please refer to the corresponding Concept Note on Community-based Management and Concept Note on Maintenance.

Box 5: Low-cost soil and water conservation measures



Vegetative and agronomical measures

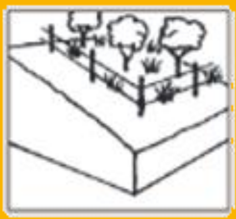
- Hedgerow / live fences / hedges
- Shelter belts
- Improvement of vegetation cover
- Conservation agriculture
- Agroforestry / Agro – silvo – pastoralism

These measures are crucial to improve **soil structure** and **water infiltration** through the restoration of vegetation in highly degraded areas, in particular slopes.


Structural measures

- Trenches and bunds
- Terraces
- Fascines / palisades / brush layering
- Check dam
- Cut-off drains / drainage ditches / waterways
- Water reservoirs / Kanda

These measures are important to check **runoff** and **harvest water**, they mainly address erosion and prevent flash floods. They can be combined with vegetative measures.

Management measures

- Grazing Management

Usually address situations where uncontrolled use has led to degradation.

Pictures: Liniger, 2007

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Climate Change and Disaster Risk Reduction

The global climate is changing; extreme weather events such as drought or flood are becoming more frequent and more intense. Higher temperatures are changing global water cycles; snow and glaciers are melting; the sea level is rising and rain patterns changing. Farmers and other rural people, who depend on land and water for livelihood, are seriously affected by these changes. There is a strong consensus that humans contribute significantly to climate change. Greenhouse gas (GHG) emissions from industry, transport, agriculture and others are causing higher temperatures, and extreme weather and climate events.

Climate change refers to a **long-term change in the state of climate**, which can be identified by changes in the means and/or changes in variability. In contrast, climate variability refers to the natural variations of the climate (FAO, 2012). The **Intergovernmental Panel on Climate Change (IPCC)**[1] uses the term climate change to refer "to any change in climate over time, whether due to natural variability or as a result of human activity" (IPCC, 2014).

Climate change's impact on agriculture

Weather and climate events, and changes in temperature and precipitation can have a serious impact on agricultural production and food security. For instance, agricultural yields may increase in the short term in some regions of the world due to higher temperatures, whereas they could decline drastically in other regions due to changes in precipitation. In the long run, however, climate change - increased evapotranspiration, rainfall variability, variations in river runoff and groundwater recharge, and associated extreme weather events, such as droughts and floods - will have significant negative effects on agricultural production in most countries (IPCC, 2014) (see Figure 1).

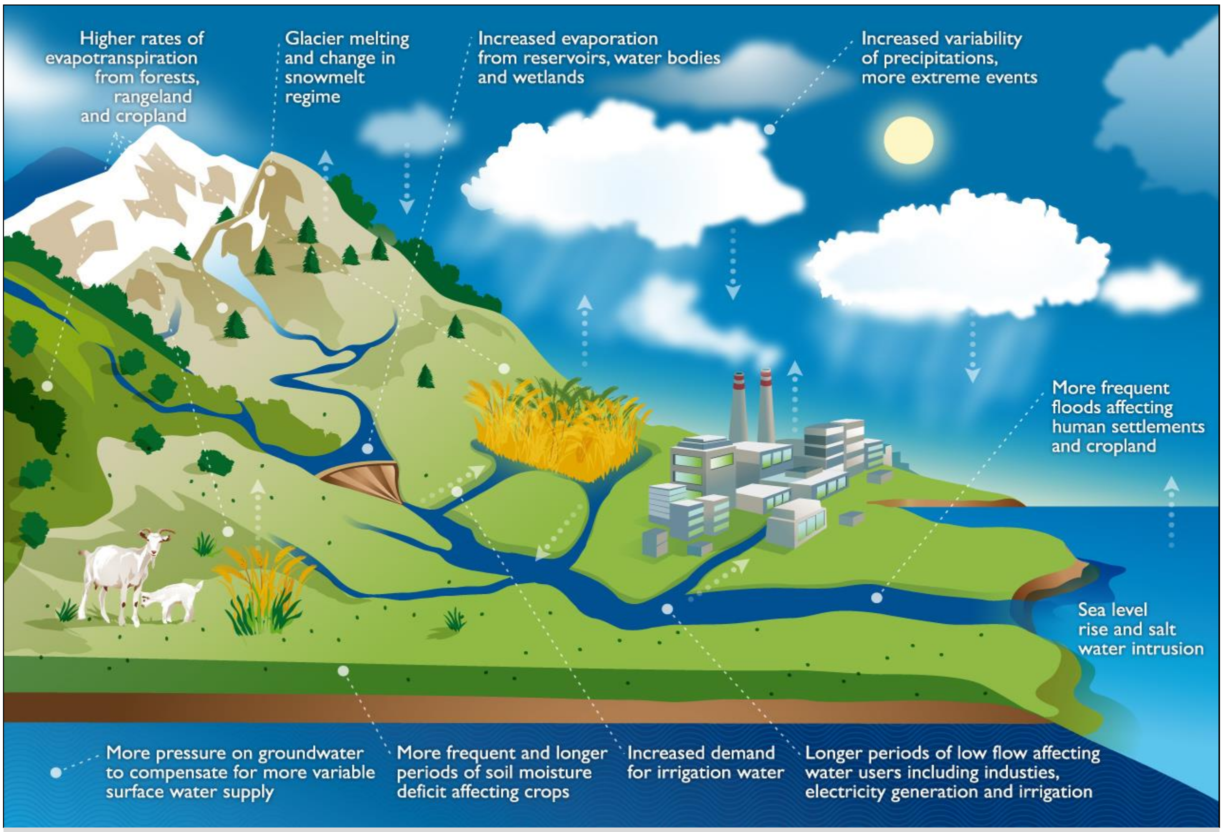

Figure 1: Impacts of climate change (FAO, 2011)

[1] International body for the assessment of climate change established by the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO) in 1988

Moreover, the availability and reliability of water supplies will be drastically reduced, especially where water is already scarce. Water scarcity will accelerate in future due to increased demand for water as competition for water grows due to population growth and the degradation of many water sources.

Climate change in Afghanistan

The key hazards in Afghanistan include periodic drought, floods due to untimely and heavy rainfall, flooding due to thawing snow and ice, increasing temperatures, frost and cold spells, hail, thunder and lightning along with "120-day winds[2]" (UNEP, 2009). Moreover, water shortages - especially increased soil evaporation, reduced river flow from earlier snow melt and less frequent rain during main cultivation season – are very likely to become the biggest challenges to agricultural production in Afghanistan. Large areas of agricultural land will probably become marginal without significant investments in water management and irrigation. Climate change is thus having severe impacts on the country's production and food security (DFID, 2008). On the other hand, Afghanistan contributes very little to global GHG emissions, for these differ significantly between countries and regions, farming systems and the type of agriculture.

Disaster risk

These weather and climate events put people, infrastructure and the environment at risk. The **disaster risk** is composed of three elements: hazard, exposure and vulnerability (see Figure 2).

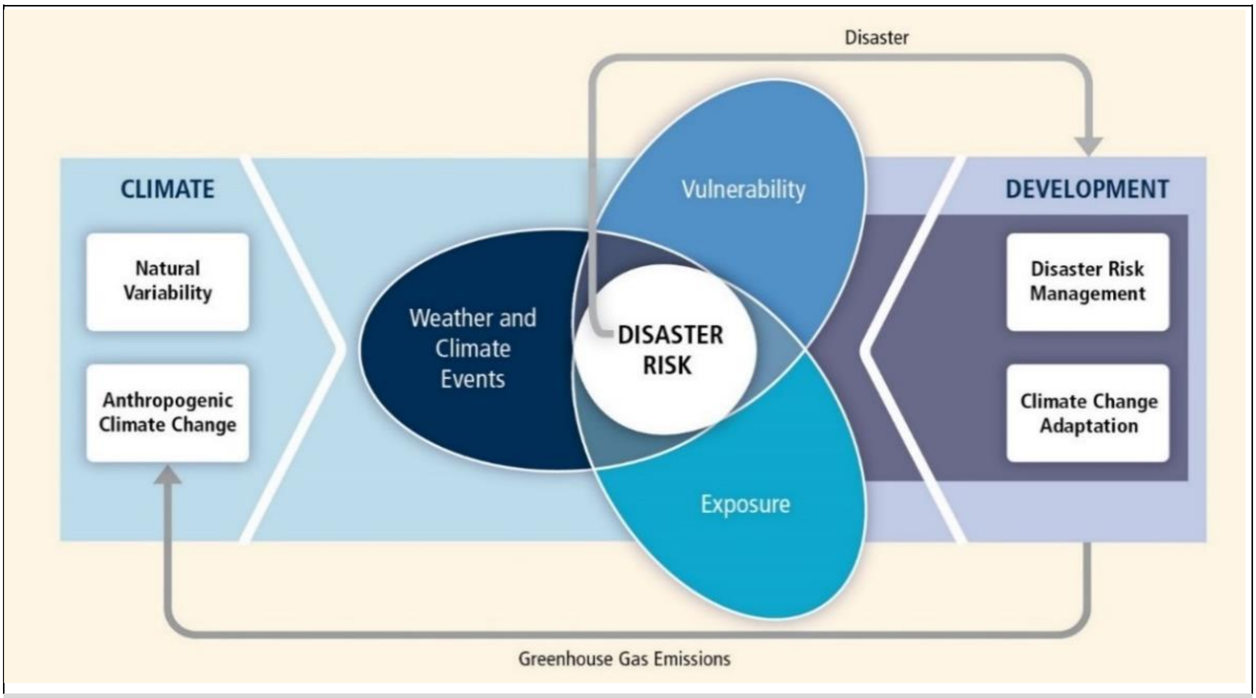

Figure 2: The risk of disaster depends on three elements, the hazard, and the vulnerability and exposure to this hazard (IPCC, 2014)

Hazard is the potential occurrence of a weather and climate event (for example a flood) that may cause loss of life, injury or other health impacts, as well as damage and loss of property, infrastructure and natural resources. **Exposure** is defined as the presence of people, assets and resources in places that could be adversely affected. **Vulnerability** is the propensity or predisposition to be adversely affected. **Capacity** refers to all resources available to an individual, community, society or organisation to reduce vulnerability and deal with the consequences of disasters. Among families, communities and regions there are differences in vulnerability, exposure and capacity. Some people, infrastructure and environments are more resilient to disasters than others. **Resilience** is the ability to anticipate, absorb, accommodate or recover from the effects of a hazardous event (IPCC, 2014).

Climate change is closely linked to disaster risk management. Disaster risk management aims to reduce the damage caused by natural hazards through promoting resilience, and reducing the exposure and vulnerability of people, infrastructure and environments to weather and climate disasters. **Adaptation** refers to the process

[2] Strong wind in west Afghanistan from July to September

of adjustment to actual or expected climate and its effects in order to moderate harm or exploit beneficial opportunities. **Mitigation** refers to interventions to reduce the sources or enhance the sinks of GHG (IPCC, 2014).

Climate-smart development

The successful managmenet of climate change calls for a new development paradigm that integrates climate change into strategies and plans, and relates to policy and finance. Climate-smart development requires a holistic approach that incorporates disaster risk management and adaptation into development goals and planning processes (UNDP, 2014).

Climate-smart agriculture is a pathway towards rural development and food security. It builds on the following three pillars (FAO, 2011; FAO, 2013):

- Sustainably increasing agricultural productivity and incomes;
- Adapting and building resilience to climate change;
- Reducing and/or removing GHG emissions, where possible.

The UNFCCC[3], the international environmental treaty with the objective of stabilising GHG concentrations in the atmosphere, and NAPA[4], which provide a process for the Least Developed Countries such as Afghanistan to identify priority activities that respond to their urgent and immediate needs to adapt to climate change, are important at international and national levels (for Afghanistan see UNEP, 2009). At community level, CRiSTAL is a tool that helps to plan adaptation strategies (see Box 1). CEDRIG (Box 2) is a broader tool for climate-compatible development; it includes the three aspects of mitigation, adaptation and disaster risk reduction.

Box 1: CRiSTAL

CRiSTAL – Community-based Risk Screening Tool Adaptation and Livelihoods – is a project-planning tool that helps to design activities in climate change adaptation at the community level.

A User Manual helps development workers to design activities. iisd.org

Box 2: CEDRIG

CEDRIG – Climate, Environment and Disaster Risk Reduction Integration Guidance – provides guidance for integrating climate change mitigation, adaptation and disaster risk management into development cooperation.

A Practical Handbook guides development workers through the process. (SDC Network Climate Change & Environment)

Adaptation to climate change in Afghanistan

Water resources, forestry and rangelands and agriculture are the sectors most vulnerable to climate change in Afghanistan. Crop failure, reduced yields and stress on livestock due to climate and weather events will affect the most vulnerable people in the country – farmers and other rural people. Mainstreaming climate change in rural development is therefore key.

Climate change adaptation measures strengthen the resilience of people, infrastructure and natural resources to climate change. It necessarily involves a response combining policies, financial investment and institutional and technical solutions. Moreover, adaptation strategies need to address different levels, from field and farms to community, regional, national and global levels.

Section B of the Climate-smart Agriculture Sourcebook presents improved technologies and approaches to sustainable farm management for planners and practitioners. Cropping and livestock adaptation strategies involve different institutional and technical solutions at different levels, and these often coincide with sustainable agriculture and livestock management practices. For water, investments in management and polices are crucial, and activities need to be implemented in irrigation schemes, watersheds, river basins and at national level (FAO, 2013). Some of the practices are summarised in the following, as well as being presented in Figure 3.

Soil: Improving soil water storage, controlling soil erosion, improving soil structure by increasing soil organic matter, boosting nutrient management and carbon sequestration (FAO, 2011).

[3] United Nations Framework Convention on Climate Change
[4] National Adaptation Programmes of Action

- ecosystem-based approaches;
- conservation agriculture;
- integrated nutrient and soil management;
- mulch cropping;
- cover cropping;
- alterations in cropping patterns and rotations;
- crop diversification;
- using high quality seeds and planting materials of adapted varieties;
- integrated pest management;
- integrated weed management;
- grasslands management;
- water and irrigation management;
- landscape-level pollination management;
- organic agriculture; and
- land fragmentation (riparian areas, forest land within the agricultural landscape).

Figure 3: Practices and approaches for climate change adaptation (FAO, 2011)

Water: Increasing capacity to store water in the soil and in reservoirs (surface and underground); increasing the capacity to access water on-farm; water harvesting, enhancing the soil's capacity for water retention; on-farm water retention and enhancing infiltration rates; establishing efficient and effective irrigation practices (FAO, 2011).

Cropping: Maintaining healthy soils to enhance soil-related ecosystem services and crop nutrition; cultivating a wider range of species and varieties; diversifying cropping patterns; using quality seed and planting materials of well adapted, high-yielding varieties; adopting the integrated management of pests, diseases and weeds.

Livestock: Grazing management, improving feed management, alterations in ratio crop-livestock or crop-pasture, improved breeds and species, housing adaptation, improved manure management (FAO, 2011).

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Sustainable and equitable management of natural resources within a watershed (e.g. water, rangelands, etc.) depends much more on social and economic aspects than on technical solutions. Community-based approaches focus on the principle of subsidiarity: the local community (the smallest administrative unit) takes responsibility for the management of natural resources and ecosystems on which they depend for their livelihood. For this, the following issues have to be addressed: 1) clarify access and property rights related to natural resources; 2) promote an equitable participation of all different stakeholders (taking into consideration gender and social equity); 3) define social organisation, governance and accountability mechanisms for the management of natural resources; 4) involve conflict prevention, transformation and solution frameworks; 5) analyse cost-benefit of interventions through proper monitoring and evaluation; and 6) strengthen stakeholder capacity. Please refer to Box 3 for an overall overview of these key aspects.

Access and property rights

One of the most important issues is to clarify access and property rights related to natural resources**.** In many cases, natural resources are considered **common-pool resources** (in contrast to private goods). Access to and property rights regarding common-pool resources are complex. According to Ostrom and Schlager (quoted in Galik et al., 2015), common-pool resources are defined by a bundle/combination of **decision-making rights** and **use rights**, which may vary from access, withdrawal, management, exclusion and alienation for the different stakeholder groups (see Figure 1). Some researchers have recently suggested that alteration rights (which encompasses changes in land use, see Galik et al., 2015) should be added to these rights.

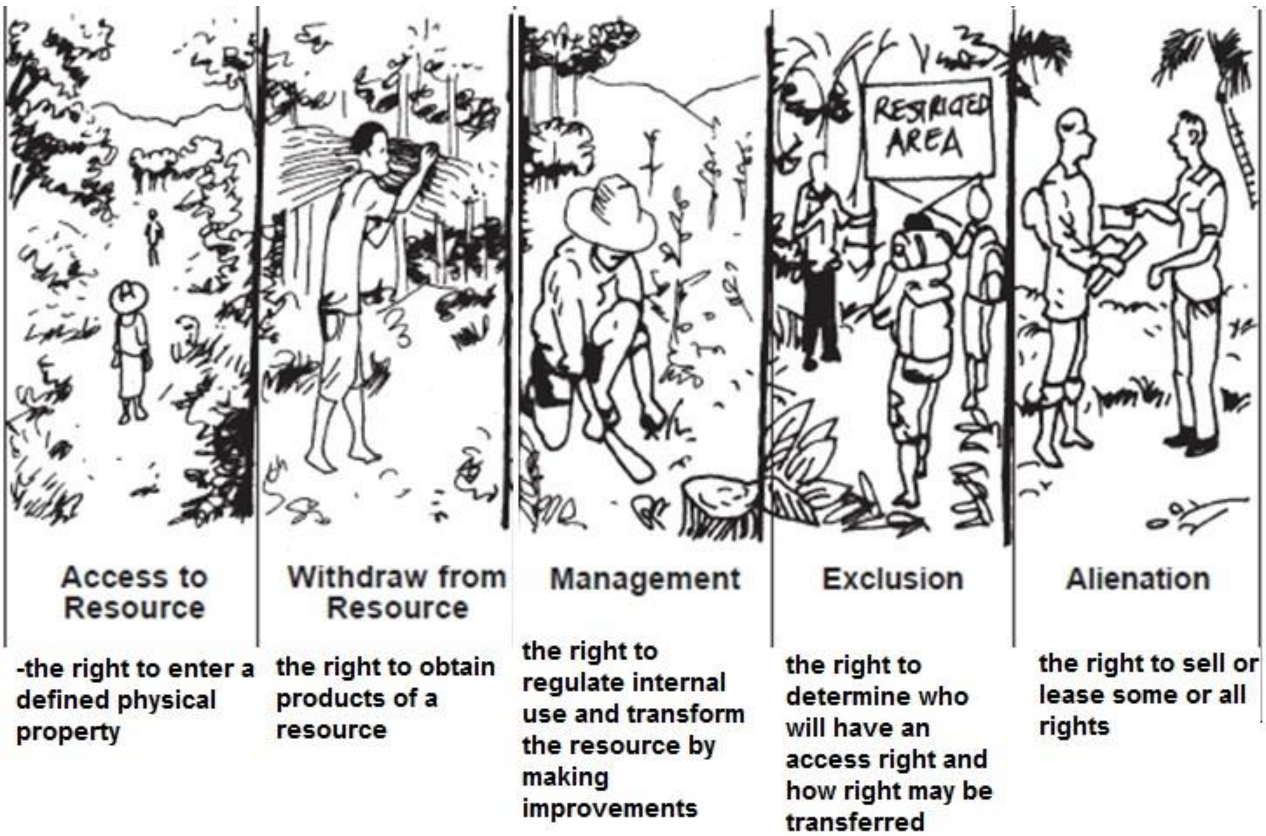

Figure1: Bundle of resource rights according to Ostrom and Schlager, 1992 (Quoted in Galik et al., 2015).

Insecure and/or limited access and property rights can undermine the sustainable management of natural resources, as the different stakeholder groups are discouraged from managing natural resources with a long-term vision.

Afghan law guarantees access and withdrawal to all users who depend on natural resources for their livelihood, under certain management conditions:

The Land Policy (2007) and Law on Managing Land Affairs (2008) stipulates that the country's **rangelands** are public property or owned by the government. The government intends to encourage community-based management that acknowledges traditional knowledge and assets, and favours environmental sustainability.

The Water Law (2009) in Afghanistan stipulates that use of **water** is free for everybody, but foresees coordination and service delivery units at several levels, from River Basin Councils to Sub-river Basin Councils and Water User Associations (WUA). This legal framework is based on customary law, which tends to give water management responsibility to water-masters (so-called *mirabs*).

Participation and co-management

Afghanistan's watersheds are used by a multitude of users and for a great variety of purposes – livestock grazing, collection of firewood, medicinal plants and as source of water, etc. These combination of uses, stakeholders, interests, conflicts, rights and regulations have given rise to a complex set of circumstances. A coordinated management effort is thus required and should result in participation and cooperation between the different stakeholders groups (government, private sector and civil society) in order to promote efficient and effective watershed management.

Box 1: Co-management

Co-management is when "(…) social actors negotiate, define, and guarantee amongst themselves a fair sharing of the **management functions, entitlements, and responsibilities** for a given territory, area or set of natural resources" (Ismail et al., 2009).

At **watershed level**, several community-based organisations (e.g. water user association, herder's alliances) as well as local decision-making bodies (e.g. Community Development Councils – CDC) have to co-exist and cooperate. **Co-management** is of particular interest when several institutions/organisations (from the civil society, private sector and government) are involved and have to find ways to negotiate and cooperate together. In this setting, stakeholders with conflicting interests will have the opportunity to negotiate and find compromises. This is of particular importance in fragile and conflict-affected situations where conflict-sensitive management is key. Box 1 presents a short definition of co-management, and Annex 1 gives a schematic overview of the three steps of co-management (organising, negotiating, and learning by doing).

Rangeland management is a good example to underline the importance of co-management. Rangeland resources are used by different communities and for different purposes (uses), but also sporadically by nomadic groups (Kuchi). The **overall decision-making bodies** on these resources should therefore include members of all the different user groups in the dialogue, e.g. members of *shuras* and/or Community Developing Councils for sedentary communities, and representatives of the IGDK (Independent General Directorate of Kuchi) for nomadic groups.

The situation is different at **community level**. The involvement of all different community members (e.g. sedentary farmers, herders and other rural people) in a participatory manner is best achieved through the establishment of a **community-based organisation** (CBO), e.g. a herders' alliance. This can be an existing CBO or a newly formed one. For more information about social organisation, governance and accountability at the community level, please refer to the next paragraph. In a CBO particular attention must be paid to the gender, age and well-being of all the members so as to share the benefits fairly within the community.

Social organisation, governance and accountability

The greatest challenge in community-based management is to create a functioning governance structure at the community level – a so-called **community-based organisation** (CBO). If it is to work well, a CBO needs to be organised and managed in accordance with the principles of **good governance** (see Box 2 and the Concept Note on Good Governance). Only a functioning CBO can handle the responsibility for an equitable and sustainable management of natural resources (e.g. water, rangelands, forests) in the community. For more information about forming a CBO, please refer to the Concept Note on Working with Groups and Box 2.

The form of a CBO may vary according to the natural resources involved and the group's objectives:

- **Water:** Typically involves Water User Associations (WUA), River Basin Councils, Irrigation Associations or Watershed Committees. These organisations are accountable to water users in the fertile lowlands (lower watershed catchment) as well as upland areas of a watershed (upper watershed catchment).
- **Rangelands:** Ideally, a Rangelands Committee or a Herders' Alliance would take over responsibility. However, rangeland management is a very complex issue, as users are highly heterogeneous (sedentary villagers vs. transhumant, nomadic pastoralists).
- **Forests:** Forest committees try to bring together the various forest users (local communities and external stakeholders) and/or different types of user (for timber, medicinal plants, fruits, meat, poaching, etc.).

Box 2: Characteristics of a successful CBO

- Members have a shared interest.
- Members decide democratically on the group's goal, objectives and action plan. The group's purpose is recorded in a written document (bylaws).
- Members **participate** regularly in decision-making and activities, and share the benefits.
- Members elect the group leaders and other duty-bearers (accountant, secretary). Group leaders are **accountable** to their members.
- Groups develop their own **rules,** which are observed by all members. The rules assure an **effective functioning** of the group and **equitable access** for all members to the services or benefits.
- Groups keep proper records (e.g. minutes of meetings) and accounts for the sake of **transparency**.
- Groups establish a conflict resolution mechanism.

Regardless of the CBO's form, the most important things is to draw up (through a participatory approach) an **action plan** defining the management activities (refer to Concept Note on Participatory Planning for Watershed Management). However, this action plan should be continuously adapted in line with local conditions. This is called **adaptive management.** Adaptive management requires an up-to-date and continuous information flow to allow people to take informed decisions. Therefore, a continuous monitoring and evaluation system is of the utmost importance. Monitoring and evaluation allows for the provision of 1) timely information for decision-making (steering); 2) evidence of project effectiveness, which is crucial within the framework of up- and downward accountability; and 3) knowledge and experience for learning purposes. For more information about monitoring and evaluation refer to the Concept Note on Monitoring and Evaluation.

Conflict management

The management of natural resources may generate conflicts, and these often present a major challenge to the functioning of CBOs within communities, as well as to co-management at watershed level. While it is important to address these issues, they are extremely complex and among the most hotly contested in many countries. It is therefore important to address the issues of ownership of natural resources, the allocation of power to manage and control natural resources, and the sharing of benefits from them. **Conflict-sensitive project management** is key to implementing natural resource management in a successful, sustainable and equitable way. For more information please refer to the Manual and Field Guide for Working in Fragile and Conflict Affected Situations.

Box 3: Key aspects of Community-Based Watershed Management

Clarifying resource access and property rights	**Land, forest and water law** Consult a country’s different laws and regulations (at national, regional and community level) to identify ownership of natural resources and clarify the bundle/combination of **decision-making rights** and **use rights** which may vary from access, withdrawal, management, exclusion and alienation for the different stakeholder groups.
Identify all different watershed users and stakeholders Concept Note on Participatory Planning for Watershed Management	**Stakeholder analysis** Stakeholders are **individuals**, **groups** or **institutions** affected directly or indirectly by the natural resource and can therefore influence its management. A distinction can be made between **primary stakeholder** (people directly affected by the resource and its management) and **secondary stakeholders** (interested in the resource but not directly affected by it: government, NGOs, private sector, etc.).
Social organisation and governance Concept Note on Good Governance Concept Note on Working With Groups	**Community-Based Organisations (CBOs)** A big challenge is to create a successful governance structure at the community level that promotes participation and ownership of local stakeholders. A community-based organisation (CBO) can take over this responsibility. However, if a CBO is to work well, it is key to follow the principles of good governance and introduce conflict resolution mechanisms.
Participatory planning and adaptive management Concept Note on Participatory Planning for Watershed Management	**Action plan** An action plan defines objectives and sets milestones to achieve the desired change. Due to the great complexity of natural resource management, an action plan should be continuously adapted to local circumstances.
Continuous monitoring and evaluation Concept Note on Monitoring and Evaluation	**Participatory Monitoring and Evaluation (M&E)** M&E is required for steering purposes, up- and downward accountability and learning. It is crucial for adaptive management as well.

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Preparing and organising for the partnership

- A neutral moderator (from the government or an outsider) identifies the key issues and concerned parties in an area.
- The moderator goes to one party at a time to get their views on the issues and suggestions for solutions.
- Bring multiple parties together to develop or renew a partnership.

Negotiating co-management plans and agreements

- Encourage the partners to agree on a common goal.
- Create an easy atmosphere for each party to express their opinions and listen to others.
- Let the parties negotiate what should be done to achieve the common goal and the responsibilities and benefits of each .
- Agree on the rules and regulations that all parties should follow including sanctions and punishments for disobedience, and when to review the rules.

Implementing and revising the plans and agreements

'learning-by-doing'

- Each party goes back to fulfill their own responsibility in implementing the collectively agreed plans.
- Meet periodically to review progress and identify new problems and solutions.
- Review the rules and regulations periodically as negotiated, but none should upset previously agreed rules.
- If acute conflicts appear, the parties should go back to the negotiation stage and keep the process going.

Annex 1: The Co-management Approach (Ismail et al. 2009).

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Good Governance

Good governance is key for an equitable (fair and impartial) use of natural resources. The management of natural resources should build on participatory and collaborative approaches involving community participation in decisions, responsibilities and management of the natural resources, in close collaboration with other stakeholders.

Governance can be described as the totality of institutions, rules and traditions that steer, rule and regulate the processes within a social or political system, e.g. state, organisation or community. Governance can be characterised by rules and values, power, structure, organisation and processes within a social or political system and can operate at different levels – international, national, provincial, and district or community level.

GOOD GOVERNANCE refers to the quality of the cooperation and division of roles between the state (government), private sector and civil society, in particular how decisions are taken and who gets to participate. Good governance is characterised by the following principles:

- Participation,
- Accountability,
- Transparency,
- Efficiency and Effectiveness,
- Equity and Inclusiveness,
- Rule of Law.

Figure 1 gives an overview of the six principles of good governance. Moreover, the six principles are explained in detail with regards to Water User Associations (WUAs) in Annex 1.

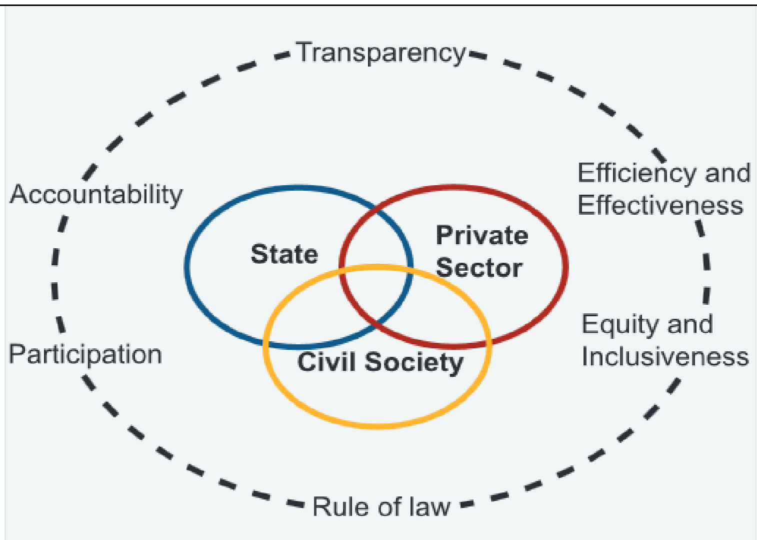

Figure 1: The concept and six principles of good governance (Helvetas, 2009)

Good governance relates to the relationships between and among different kind of institutions. It involves the public sector (state) orienting its work towards citizens' concern in a transparent and accountable way, the private sector acting with social responsibility, and citizens being able and motivated to participate in, and contribute to, public decision-making in the frame of **civil society organisations**. Good governance ensures that political, social and economic priorities are based on broad consensus in society and that the voices of the poorest and the most vulnerable are heard and taken into account in decision-making (Helvetas, 2009).

Civil society organisations

Civil society includes organised forms that are not from the government or for profit, and these range from structured and formal Non-Governmental Organisations (NGOs) to informal grassroots groups. Civil society organisations are often self-initiated and regulated (individual citizens develop autonomous, organised and collective activities) and have voluntary membership (interest groups, associations, cooperatives, political parties etc.). Civil society organisation can also operate at different levels - from international to community level. **Community Based Organisations (CBOs)** are defined as community-level organisations (based on membership) which pursue the goal of improving the living conditions of their own members (Helvetas, 2009).

In Afghanistan the Community Development Councils (CDCs) are important civil society actors at community level, but other organisations like watershed committees and farmer organisations also play an important role. Box 1 on the next page gives some examples of important CBOs in rural Afghanistan.

Box 1: Examples of CBOs in rural Afghanistan

- CDC
- Watershed Committee
- Rangeland committee
- Water User Association
- Mirab systems
- Community bakeries
- Farmer organisations
- Seed banks
- Marketing association
- etc.

Farmers, herders and other rural people - especially women and members of disadvantaged groups - should be empowered to participate in civil society organisations, such as the CDCs, to enable them to make their voices heard. Moreover, many CBOs need initial support to manage their organisation sustainably and in the framework of good governance. Capacity building of local communities should emphasise governance aspects alongside technical aspects. Such an integrated approach helps to improve livelihoods and manage common resources in an equitable and sustainable way.

Equitable and sustainable resource management

Management of natural resources is closely linked to local governance. Farmers, herders and other rural people, both women and men, depend on natural resources for their livelihood. In many cases, natural resources are considered common goods (in contrast to private goods) and property rights may vary from access, withdrawal, management, exclusion and alienation for the different stakeholder groups. Good local governance is key to supporting the equitable and sustainable use of these common goods (also called common pool resources) within and between communities, up- and downstream, and also among different social groups and between the various stakeholders.

Good governance should consider the following aspects (Helvetas, 2009):

- Empower the rural population to formulate, claim and obtain their rights to manage and use their surrounding natural resources;
- Empower the rural population to identify, formulate and demand the type of support and services needed;
- Support attitude change and capacity building amongst service providers (public and private) to assure that appropriate support and services are increasingly delivered efficiently, effectively and equitably;
- Promote the development of clearly defined policies and legislation, foresee, and encourage the development of local private sector that respects equitable benefit-sharing.

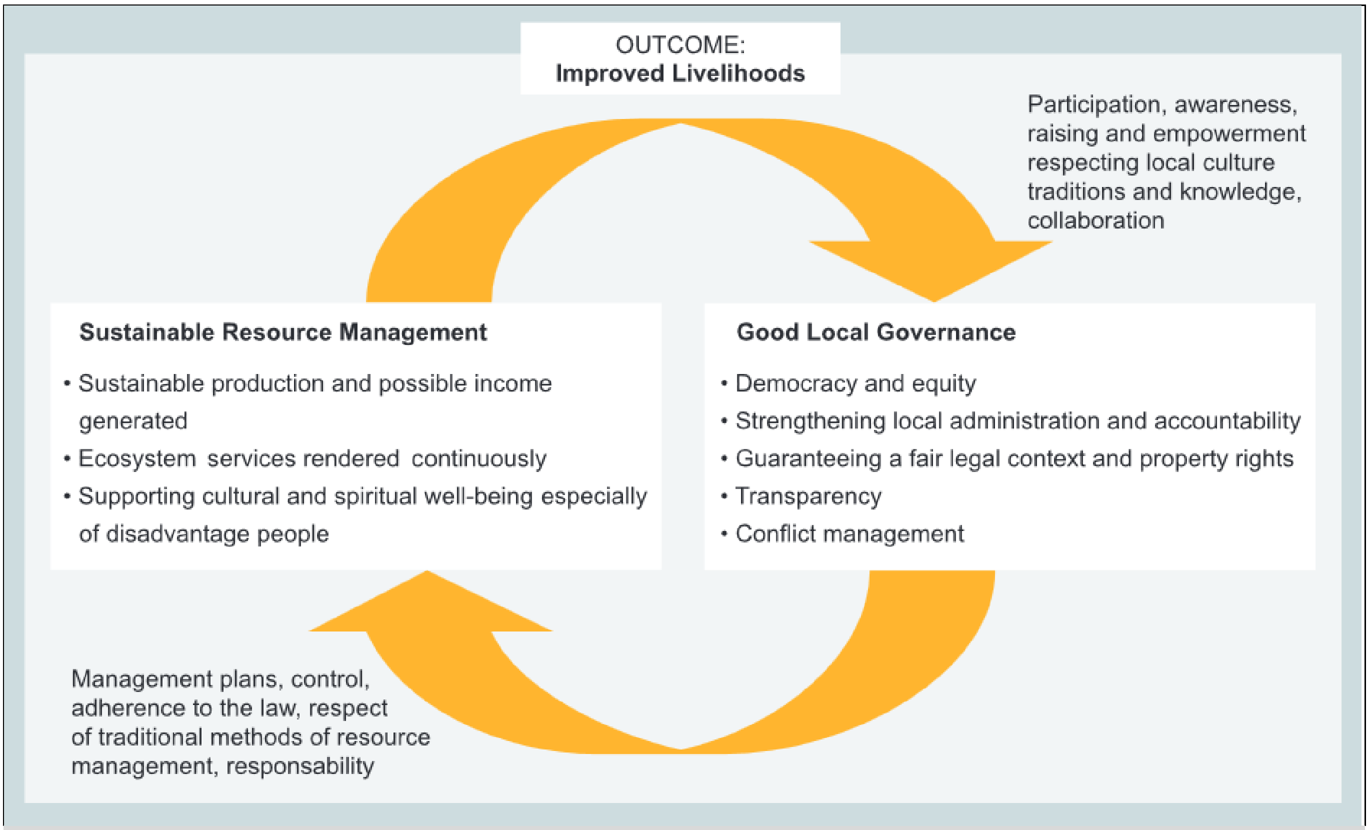

Figure 2: Linkage between sustainable resource management and good local goverance (Helvetas, 2009)

Even then, conflicts may occur, which often present a big challenge for the functioning of CBOs. While it is important to address these issues, they are extremely complex and some of the most contested in many countries. Therefore, it is important to address the issues of ownership of natural resources, allocation of power to manage and control natural resources, and the sharing of benefits from natural-resource. Conflict sensitive project management is key to implementing natural resource management in a successful, sustainable and equitable way.

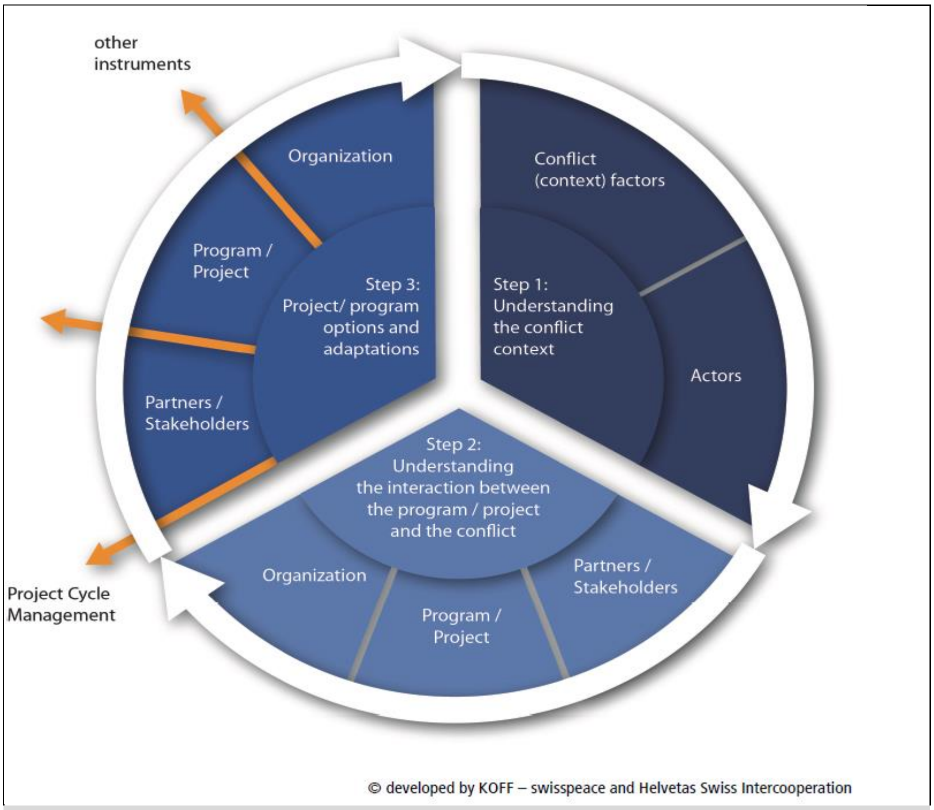

Figure 3: Conflict-sensitive Project Management in 3 steps (KOFF, 2012)

Conflict sensitivity

"Do-no-Harm" is a conflict-sensitive development planning and management tool. Conflict sensitivity is the ability to (KOFF, 2012) (see Figure 3):

1) Understand the context, in particular to understand tensions and issues with a potential for conflict and the issues with the potential to mitigate conflict and strengthen social cohesion;
2) Understand the interactions between interventions and the context;
3) Act upon that understanding, in order to avoid unintentionally feeding into further division, and to maximize the potential contribution to strengthening social cohesion and peace.

For more information, please refer to Helvetas Guidelines on Natural Resources and Conflict as well as KOFF, 2012.

Further reading and references

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Annex 1: Good Governance in Water User Associations

Governance principle	What does it mean?	An example related to irrigation governance (Water User Association)
Participation	Participation includes not only the representation of the people but also their active, free, effective and voluntary participation in decision-making processes, especially if directly affected. Citizen engagement based on civic education is crucial.	WUA members (men and women) attend the WUA general assembly and ask questions to the WUA executive about the information presented.
Transparency	Transparency means that relevant information is freely accessible to the concerning stakeholders.	The budget (income and expenditure) of the WUA is posted outside the WUA office, so that it can be reviewed by all WUA members.
Accountability	Accountability is broadly defined as the obligation of power holders to take responsibility, and to be answerable and liable for their actions and choices. Power holders are those who hold political, financial or other forms of power.	The WUA makes the schedule for water distribution, but does not provide the water according to this schedule. An institutional space exists for WUA members to take up this issue with the WUA executive and receive an explanation for why the schedule was not kept.
Equity and Inclusiveness	Equity and inclusiveness deal with the inclusion of all groups of a society, especially the most vulnerable and marginalised. In addition, questions of equitable or equal sharing of benefits and burdens are raised, bearing in mind that eventually both the process and the outcome have to be considered fair by the people.	The WUA takes special measures to ensure that water reliably and equitably is distributed to women-headed households and tail-end users.
Efficiency and Effectiveness	Processes and institutions produce results that meet the needs of society while making the best use of the resources at their disposal. It refers to the extent to which the expected results of a particular project have been achieved, and also includes aspects of sustainability.	Farmers (WUA members) implement efficient water-use techniques, ensuring that more water is available to their downstream neighbours.
Rule of Law	This principle focuses on fair legal frameworks that are enforced impartially. It also contains full protection of human rights, especially those of minorities. The processes by which the laws are enacted and enforced are fair and efficient. Access to independent justice is assured for everybody.	The rules of the WUA concerning who can use the water and when are equitably and fairly applied to all WUA members.
Source: HELVETAS Swiss Intercooperation		

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Working with Women and Men

The word commonly used when referring to the differences between men and women is **gender.** Gender refers to the social, behavioural, and cultural attributes, expectations and norms associated with being a woman or a man in a given society. It does not concern the biological differences between women and men.

The concept of "Gender Equality" is based on the recognition that women and men have equal rights as human beings, and should also have equal opportunities and equal responsibilities in realising their potential. However, gender equality does not always mean striving for equal numbers of men and women in all activities, or treating men and women in the same way. Men and women often have different needs and priorities, face different constraints, have different aspirations and contribute to development in different ways (HELVETAS Swiss Intercooperation, 2012).

Figure 1: Afghan girl and boy

Women are more likely to be excluded from decision-making than men – from the household up to the highest levels of government. They also have less access to and control over resources such as finance, land and income. Girls are more likely to experience discrimination than boys – for example, they are more likely to be withdrawn from school. While gender inequalities are pervasive across all countries and social groups, it is women living in poverty who are most acutely affected (SDC Gender Equality Network, 2014).

Women in agriculture

Both women and men make significant contributions to the rural economy, but worldwide it is women who make up the majority of the agricultural labour force. Moreover, for most women who are economically active, agriculture is their primary source of livelihood. However, women have more limited access than men to resources such as land, water, finance, productive assets, technology, services, market, agricultural training and information, see Annex 1. For female-headed households, access to resources and services is particularly limited. Improving women's access to resources and services will boost the rural economy and increase food security worldwide. Thus, gender equality and women's empowerment play an important role in reducing poverty and reaching sustainable development, as was recognised in the UN Millennium Goals and will remain an important part of their follow-up.

Figure 2: Women play a central role in fruit processing in Afghanistan (rootsofpeace.org)

Women in Afghanistan

In Afghanistan the role of women is shaped by socio-cultural factors such as restricted mobility outside the village, restricted ability to work outside the compound as well as the lack of ownership of the majority of productive assets (Grace, 2004).

However, many women play an important role in agricultural production in Afghanistan and are involved in different tasks and functions. These roles and responsibilities need to be recognised, especially if there is a male shift to off-farm work. Women carry out many activities inside the compound and their activities are thus often rather invisible. More effort is needed to understand the roles and responsibilities of women and men and how these can both underlie and serve to reinforce gender equity, food security and rural development in Afghanistan (Grace, 2004).

Gender in rural development

Gender mainstreaming is a strategy to achieve gender equality in development. It means recognising that women and men often have different needs and priorities, face different constraints and opportunities, and contribute to development in different ways (UN WOMEN, 2014).

Governments, the international community and civil society need to work together to eliminate discrimination under the law, to promote equal access to resources and opportunities, to ensure agricultural policies and programmes to be gender aware and to make women equal partners for sustainable development. Increasing women's access to land, livestock, education, financial services, extension, technology and rural employment is a way to boost agricultural production, food security, economic growth and social welfare (MICCA, 2014).

In Afghanistan the *National Action Plan for the Women of Afghanistan* (NAPWA) and *the Afghanistan National Development Strategy* (ANDS) shape the national frame in gender issues. Moreover, Afghanistan also ratified the *Convention on the Elimination of All Forms of Discrimination against Women (CEDAW)*.

At present, most programmes and projects on agricultural interventions in Afghanistan target the "household" as the beneficiary. This usually translates into working with men, given that they are the more visible farmers, usually own the land and because working with women is considered more difficult (Grace, 2004). Gender mainstreamed programmes should include and support women through understanding their different needs, interests, roles, opportunities and constrains, as well those of men:

Figure 3: Women are often responsible for the dairy cow (IFAD/Melissa Preen)

Gender-blind development refers to the absence of any proactive consideration on how gender norms and unequal power relations affect the achievement of activities. Example: *Women rear cows and men are approached to form a primary dairy cooperative.*

Gender-aware development refers to the explicit recognition of local gender differences, norms and relations. Example: *Women keep cows and are approached for extension activities in clean milk production, while the men are informed about the importance of dairy cooperatives, as the assumption is that there are restrictions on women leaving their homes.*

Gender-exploitative development refers to approaches that take advantage of rigid gender norms and existing imbalances in power. Example: *As men are normally involved in marketing, they are approached and organised into primary dairy cooperatives; no attempt is made to contact women, even though they do the milking of cows and goats.*

Gender-accommodating development, on the other hand, acknowledges the role of gender norms and inequalities, and seek to develop actions that adjust to, and often compensate for, them. While such projects do not actively seek to change the norms and inequalities, they strive to limit any harmful impacts on gender relations. Example: *The facilitation of cow rearing and the development of a primary dairy cooperative is done on a household basis, so that both husband and wife can participate and become cooperative members.*

Gender-transformative development actively strives to examine, question and change rigid gender roles, norms and imbalances of power as a means of reaching outcomes (e.g. increasing agricultural productivity and the livelihood situation) while also promoting more gender-equity. Example: *Women keep cows and men and women are approached to discuss milk marketing problems. Men agree that it would be best to allow their wives to form a cooperative, as milk has always been the domain of women. Where appropriate, young men assist in organising the milk collection.*

To prevent interventions from having negative gender implications, it is imperative to conduct a **gender analysis** prior to interventions in order to understand the specific constraints and opportunities that exist for men and women in the agriculture-livestock sector in different contexts. The video participatory gender analysis from HELVETAS Swiss Intercooperation Bangladesh presents a good introduction into gender analysis.

Gender in training and extension

Training and extension in agriculture needs to address men and women to contribute successfully to food security. Especially for activities which are the main preserve of women, e.g. backyard poultry, goat rearing and homegarden cultivation, there is an ultimate need to interact with women farmers. In the cultural settings of Afghanistan, where women and men are expected to maintain separation, one way forward is to provide separate training and extension to women and to men farmers. This requires female extension staff, which is however often lacking due to severe recruitment and mobility issues. To effectively reach women farmers in Afghanistan agriculture extension services need to address the gender gap by training and employing more female staff. Women extensionists can play a very important role model, both in encouraging other women, and in increasing the respect by men for female extension staff (SDC, 2011).

Another important aspect to consider is, that illiteracy among women remains high (87.4%) in Afghanistan and very few women have formal education (UN WOMEN, 2014). Women may find formally presented material like graphs and charts difficult to understand. Extension material needs therefore to be packaged in pictures, role plays and stories, to be adequate for illiterate women as well as men. For illiterate individuals videos, songs and theater are also helpful tools. The training events need also to be proper timed and in the right location to allow female farmers to attend. The location of training needs to provide spaces where women are comfortable and to which they can travel without difficulty. Thus, the time availabilities of and suitable location for women and men farmers may differ due to their different roles and responsibilities.

Gender should be addressed already in the planning and implementation process of agricultural training and extension. It is of upmost importance to always consider the gender aspect to reach sustainable development.

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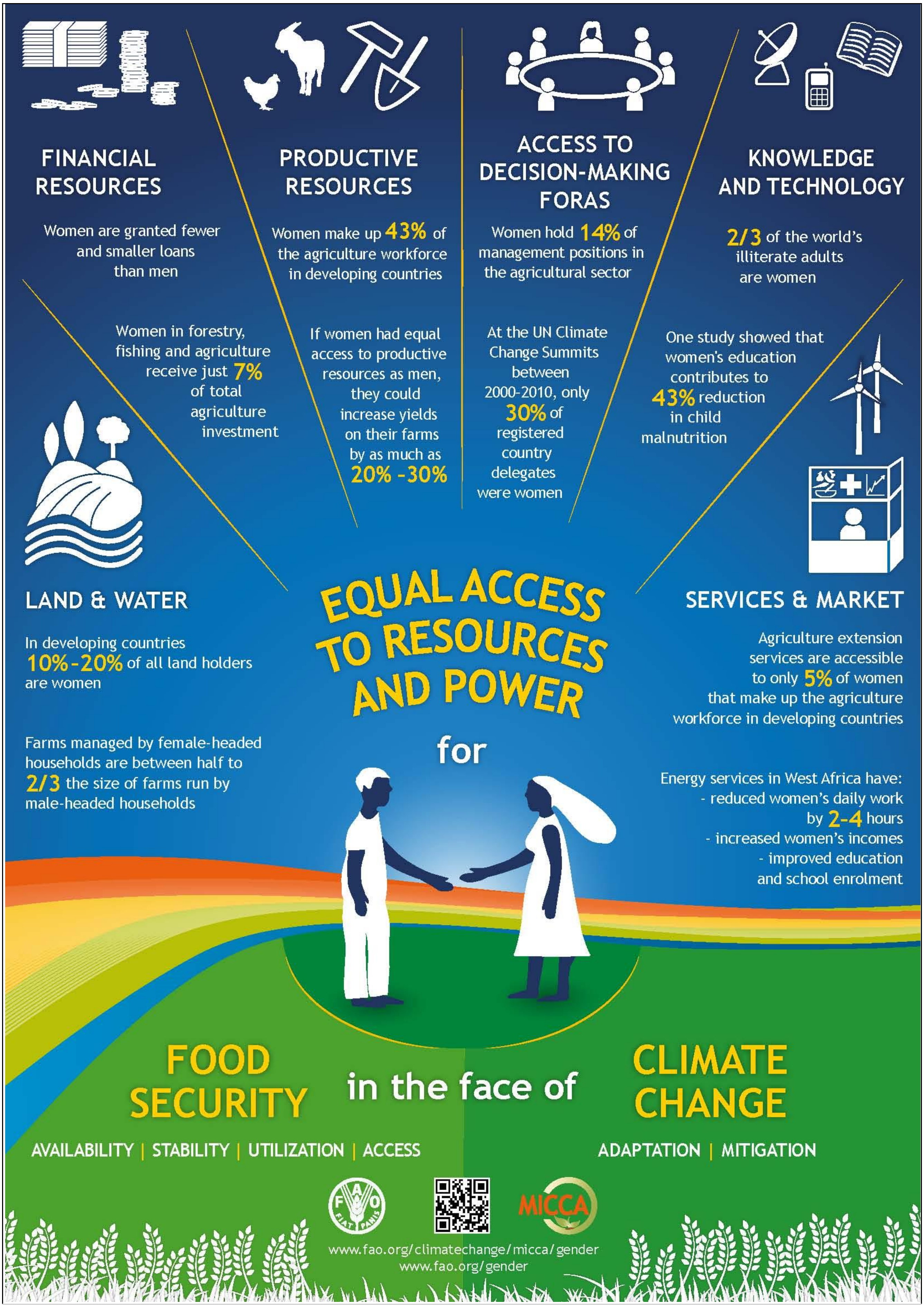

Annex 1: Gender inequalities in the access to resources and power (MICCA, 2013)

Structural SWC Measures

Structural soil and water conservation (SWC) measures are implemented to **prevent devastating flash floods** and **control land erosion** in the uplands/rangelands of watersheds**.** In some regions, structural SWC measures may also be used to **collect and harvest rain water,** including for use in the fertile lowlands. This is not the case in the Central Highlands of Afghanistan, though.

In line with the R3 concept (see Box 1), the different functions of structural SWC measures are to:

- Manage water runoff and infiltration,
- Increase water drainage and storage in the uplands,
- (Collect and harvest water for use in the fertile lowlands.)

The uplands/rangelands of Afghanistan mainly require **water runoff and infiltration management**. On sloping land terraces, trenches and bunds reduce the quantity and velocity of water runoff and extend the time span for water to infiltrate into the soil system. Increased water infiltration prevents water runoff and thus devastating flash floods. Moreover, it helps vegetation to grow, which also decreases water runoff and increases infiltration. In regions with sufficient rainfall, an area in the uplands can also serve as **external "catchment area" for collecting/harvesting rainwater.** This water needs to be safely drained to storage facilities in the uplands and/or down into the fertile lowlands. Spillways on terraces, waterways protected by check dams and tied ridges can provide **safe drainage** from uplands to lowlands (especially during flash floods). (Haile, Herweg, & Stillhardt, 2006; Oweis, Prinz, & Hachum, 2001; Studer & Liniger, 2013; WOCAT, 2007)

There are many different structural SWC measures available, each with different functions (see Box 2). Structural SWC measures need to be chosen based on clear selection criteria, then adapted to local conditions (see Box 3) and they might need to be implemented together with management measures (Concept Note Community Based Watershed Management). Some of them can be complemented with vegetative and agronomic measures (Concept Note Vegetative and Agronomic SWC Measures).

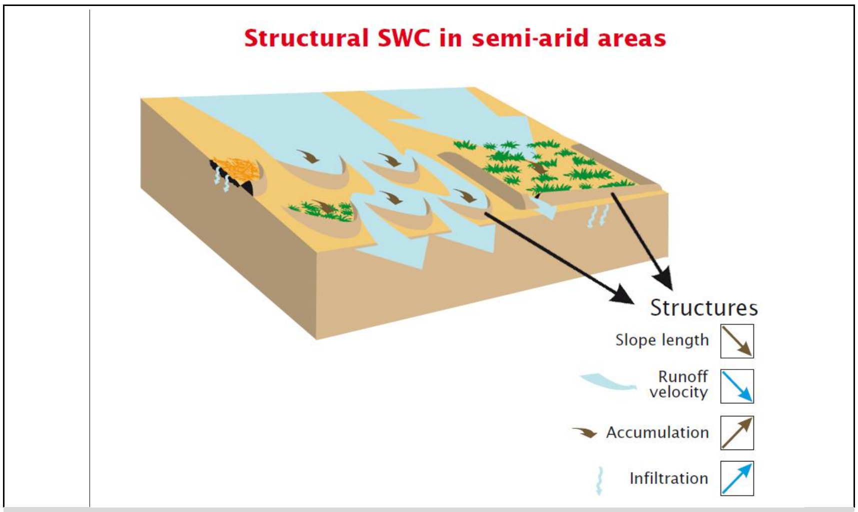

Figure 1: Effects of structural measures on land (increase: ↗, decrease: ↘). (Drawing by Karl Herweg, adapted (Haile, Herweg, & Stillhardt, 2006))

Box 1: The R3 concept

R3 aims to design and integrate different combinations of **water buffering** techniques to better manage natural water recharge and extend the chain of water use. The core of R3 is a combination of:

- **Recharge:** adding water to the buffer,
- **Retention:** reducing the speed of the natural water cycle,
- **Reuse**: making water to circulate as much as possible, e.g. reuse of wastewater for irrigation.

The main buffering strategies are:

- Groundwater recharge and storage,
- Soil moisture conservation in the root zone (e.g. with vegetative & agronomic measures),
- Closed tank storage (e.g. Kandas),
- Open surface water storage.

www.bebuffered.com
Rain Foundation & NWP, 2014

Box 2: Overview of structural SWC measures

Structural SWC measures often lead to a change in slope profile; are of long duration or permanent; involve major earth movements and/or construction with wood, stone, concrete, etc.; and often require substantial inputs of labour or money when first installed.

Measures for managing water runoff and infiltration:

- Trenches and bunds; e.g. contour trenches, stone lines, soil bunds, eyebrow pits (to catch and retain all incoming water runoff and hold it until it infiltrates into the ground or evaporates),
- Terraces,
- Walls, barriers; palisades, fascine, brush layering (obstacles to movement of soil or sand),
- Check dams.

Measures for collecting/harvesting water, safe water drainage and storage:

- Open land (without vegetation),
- Cut-off drain / drainage ditches / waterways (constructed across a slope and designed to conduct runoff safely from hill slopes to valley bottoms. They are often supported by check dams),
- Underground channels, e.g. Karez,
- Water reservoirs, e.g. Kanda.

Box 3: Criteria for the selection and design of structural SWC measures

- Problems & needs
- Expected rainfall
- Soil characteristics
- Availability of resources and construction materials
- Labour availability and cost

Trenches and bunds

Trenches and bunds are dug along the hillside contour line to promote the infiltration of rainfall and prevent soil erosion. They reduce the risk of flash floods and help the establishment of vegetation due to increased soil moisture in the trenches and bunds. It is important to lay out contours properly or they may channel the water and increase water runoff. An A-frame is used to lay out the contour at the same level along a hillside (see Box 4). Some criteria to be considered before building trenches and bunds are listed in Box 5, and the limitations of trenches and bunds are mentioned in Box 6.

There are many different types of trenches and bunds, for example:

- Contour trenches with soil bunds,
- Contour trenches with staggered and continuous design,
- Stone lines,
- Eyebrow pits.

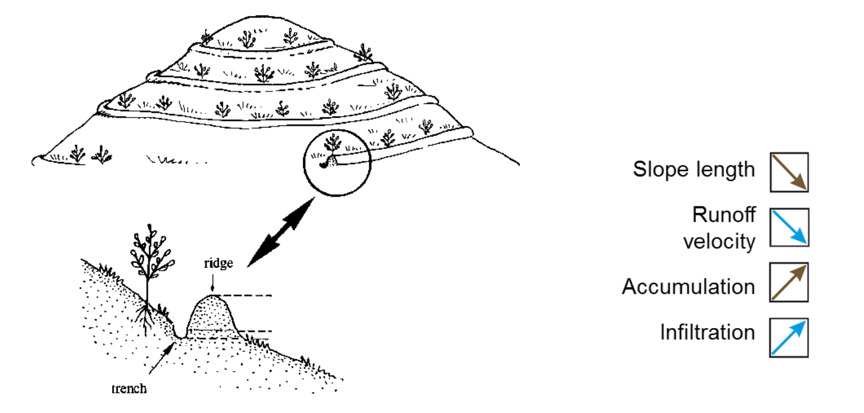

Figure 2: Contour trenches with soil bunds (ILO / UNDP, 1993)

Box 4: Using an A-frame to mark the contour lines

An A-frame is used to find places of the same level along a hillside and consists of:

- 2 straight poles (2m)
- 1 shorter pole (1m)
- A small rock or bottle as plumb-line
- A pen or pencil
- Some nails and string

For locating the contour lines:

1. Place a stick at any convenient point on the slope (=benchmark).
2. Place the A-frame horizontally on the slope and make sure the first leg of the A-frame stays on the benchmark.
3. Shift the second leg until the plumb-line settles at the centre of the A and place a second stick where the leg rests.
4. Without moving the second leg, swing the first leg 180° until the frame is perfectly levelled again. Place the third pole, and repeat.

Hesperian, 2015


Figure 3: Contour trenches with continuous bunds (HELVETAS Swiss Intercooperation Afghanistan, 2015)


Figure 4: Contour trenches with a staggered design (HELVETAS Swiss Intercooperation Afghanistan, 2015) WOCAT sheet


Figure 5: Stone lines (HELVETAS Swiss Intercooperation Afghanistan, 2015)


Figure 6: Eyebrow pits (Helvetas Swiss Intercooperation Afghanistan, 2015)

Box 5: Criteria to be considered before building trenches and bunds

- Expected rainfall
- Soil infiltration capacity
- Steepness of slope
- Availability of resources and soil/stones
- Possibilities for complementing structural measures with vegetative measures

Box 6: Limitations of trenches and bunds

- Establishment costs are high
- Soil disturbed during digging and fine clay deposits in the trenches which reduces infiltration
- Loss of land for production due to trenching

Terraces

Terracing is a technique used in many places around the world to convert a slope into a series of horizontal step-like structures with the aim of:

- Controlling the flow of surface water runoff by guiding the runoff across the slope and conveying it to a suitable outlet at non-erosive velocity;
- Reducing soil erosion by trapping the soil on the terrace; and
- (Creating flat land suitable for cultivation.)
  (Shrestha et al., 2012)

Terraces can be made in a variety of ways. They are built using light equipment or by hand. The three main types of terrace are bench; level or contour; and parallel or channel. The single most important rule when establishing a terrace is to make sure that it does not form a channel for moving water. The criteria to be considered before building terraces are listed in Box 7. The limitations of terraces are mentioned in Box 8.

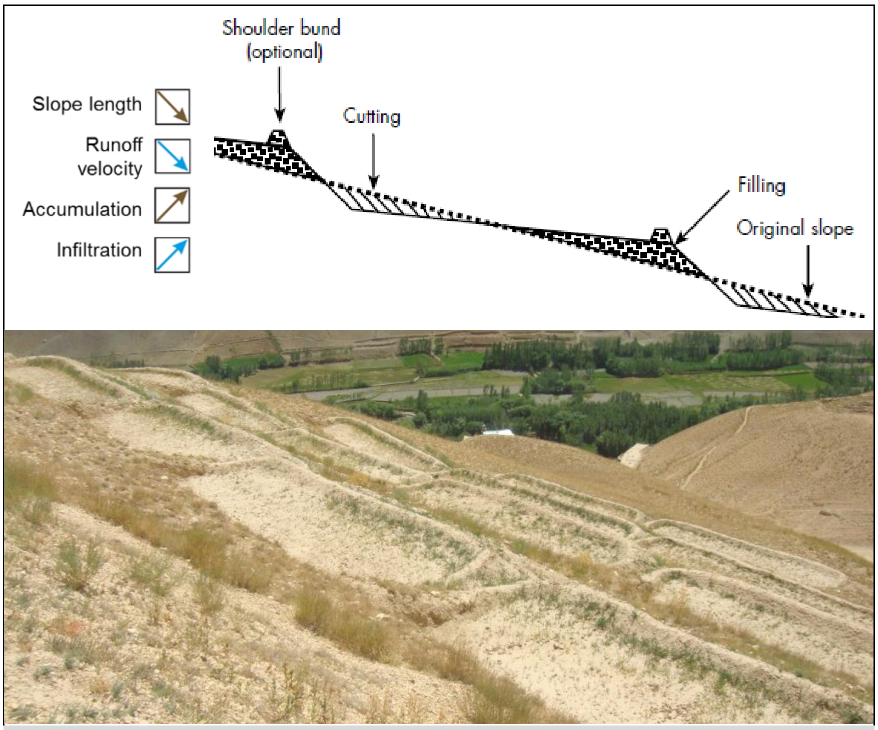

Figure 7: Design of terraces with growing vegetation
(Shrestha et al., 2012, Helvetas Swiss Intercooperation 2015)

Box 7: Criteria to be considered before building terraces

- Steepness of slope
- Needs and intended use
- Soil depth and soil properties
- Availability of resources and construction materials
- Labour availability and costs

Box 8: Limitations of terraces:

- Height of terrace can cause instability if not maintained
- Structures occupy part of the area (loss of arable land)
- Frequent maintenance is needed to avoid loss of arable land
- Drainage of excess water can be problematic when the gradient is low or diminishing - sometimes water overflows
- Waterlogging, especially on clay soils
- Land management becomes more complex

Fascines, palisades and brush layering

Fascines, palisades and brush layering are bioengineering structural techniques used to increase slope stability in a variety of ways. They are built with living branches to control erosion, increase the infiltration ratio, reduce runoff and adjust soil moisture. Some basic considerations for bioengineering techniques are listed in Box 9. The limitations of the techniques are mentioned in Box 10 to 12. (Shrestha et al., 2012)

Box 9: Basic considerations for bioengineering techniques

- Problems and needs
- Availability of resources and construction material
- Water requirements of vegetation

Fascines

Fascines are bundles of living branches bound together to form a sausage-like structure, placed in a shallow ditch or trenches and covered with soil. They put out roots and develop into a strong line of vegetation. (Shrestha et al., 2012)

Box 10: Limitations of fascines

- Large amount of straight and long plant material is needed
- Only drain a limited amount of water
- Don't form a physical barrier immediately

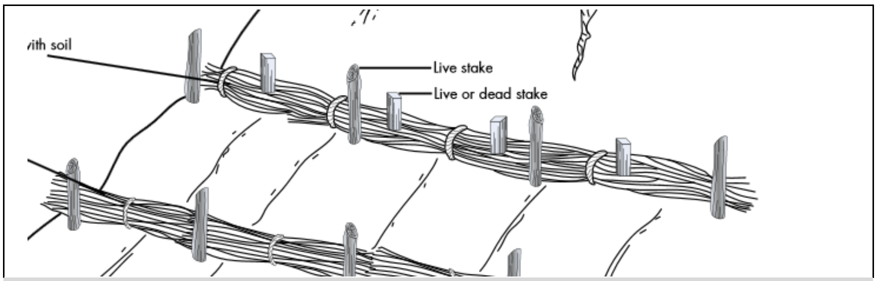

Figure 9: Construction of fascines on a slope (Shrestha et al., 2012)

Brush layering

In brush layering, living branches are interspersed between layers of soil to stabilize a slope against shallow sliding or erosion. Fresh green cuttings are layered in lines across the slope. (Shrestha et al., 2012)

Box 11: Limitations of brush layering

- There is generally a lower success rate in establishing cuttings planted direct on site compared to planting seedlings from nurseries

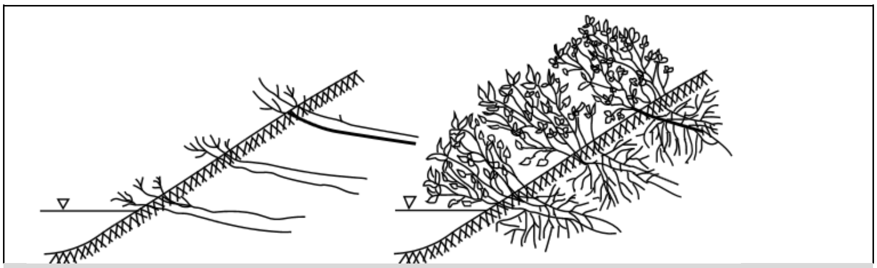

Figure 10: Construction of brush layering: first step (left), growing shrub (right) (Shrestha et al., 2012)

Palisades

A palisade is a live fence placed carefully to trap debris (falling stones) moving down the slope, armour and reinforce the slope and increase the infiltration rate. Palisades are used to prevent the extension of deep narrow gullies and the erosion of V-shaped rills by forming a strong barrier which stabilizes the gully floor and traps material moving downhill. It is a wall consisting of stems and branch parts driven into the ground very close to each other in a simple, easy-to-build and cost-effective way. (Shrestha et al., 2012)

Box 12: Limitations of palisades

- Their application is limited to small and narrow gullies.
- There is generally a lower success rate in establishing cuttings planted direct on site compared to planting seedlings from nurseries.

Figure 11: Construction of palisades (Shrestha et al., 2012)

Check dams

Check dams are small and low drop structures built across a gully or channel to prevent it from deepening further. The dams decrease the slope gradient, reducing the velocity of water flow and the erosive power of the runoff. The velocity, and thus the erosive capacity, is controlled by the size and location of the dams. They also promote the deposition of eroded materials to further stabilize the gully or channel. Check dams can be constructed from a wide range of materials including wood, rock, concrete and masonry. Some of the crriteria to be considered before building check dams are listed in Box 13. The limitations of check dams are mentioned in Box 14. (Shrestha et al., 2012)

Box 13: Criteria to be considered before building check dams

- Expected rainfall
- Available resources and construction materials
- Soil properties
- Debris (falling stones and earth)

Box 14: Limitations of check dams

- Require maintenance and sediment removal practices
- Difficult to implement on steep slopes (distance between dams must be shorter)

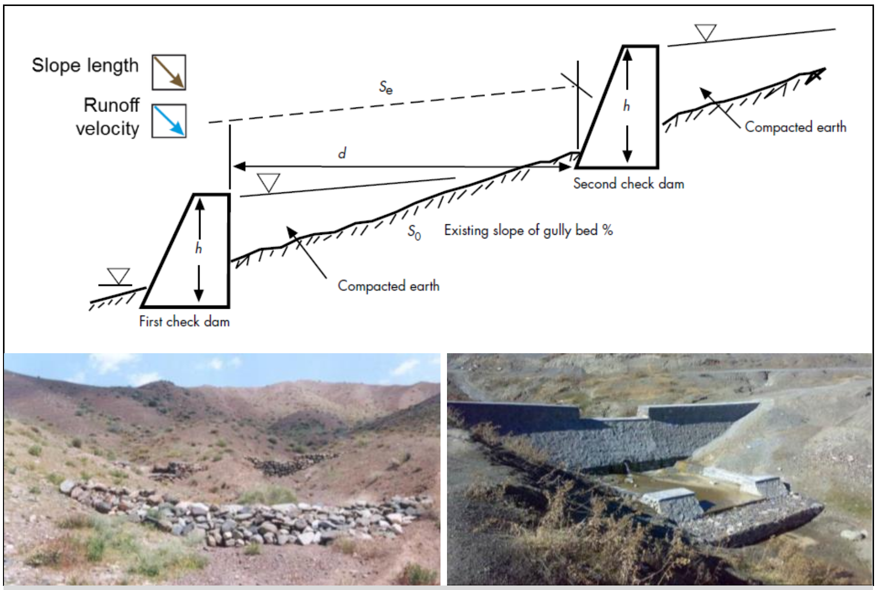

Figure 10: Design of check dams
(Shrestha et al., 2012, Helvetas Swiss Intercooperation)

Cut-off drains, drainage ditches and waterways

Drainage ditches and waterways are ridges of soil or channels with a supporting ridge on the lower side. They are built across the slope to intercept runoff and then channel it to a suitable outlet location. The simplest way to drain water safely is to use an open ditch or a system of open ditches. Some of the criteria to be considered before building drainage ditches are listed in Box 15. (Shrestha et al., 2012)

Box 15: Criteria to be considered before building drainage ditches

- Expected runoff
- Availability of resources and construction materials
- Availability of safe water drainage systems in the valley (otherwise flash flood danger!)

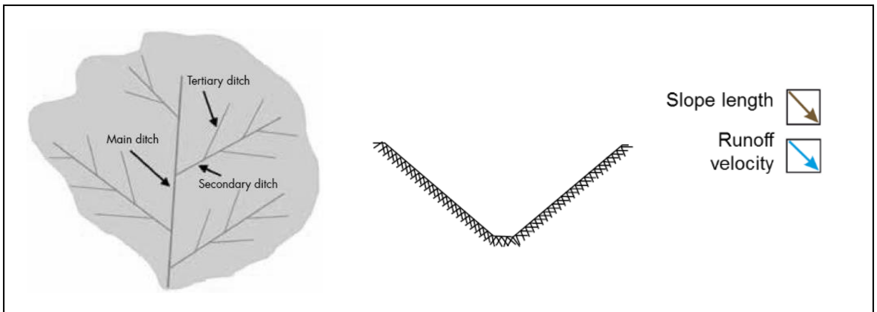

Figure 10: Drainage systems (left) and drainage ditch (right) (Shrestha et al., 2012)

Karez

Karez is a traditional Afghan water management system, which is used to recharge groundwater and bring water to the fertile lowlands. It consists of vertical shafts and an underground channel running between an aquifer (underground water source) on the mountain of higher elevation to a garden on an arid valley plain. *Karez*'s limitations are mentioned in Box 16. (UCDAVIS, 2012)

Box 16: Limitations of *karez*:

- Requires special skills
- Establishment costs are high if the catchment is rocky

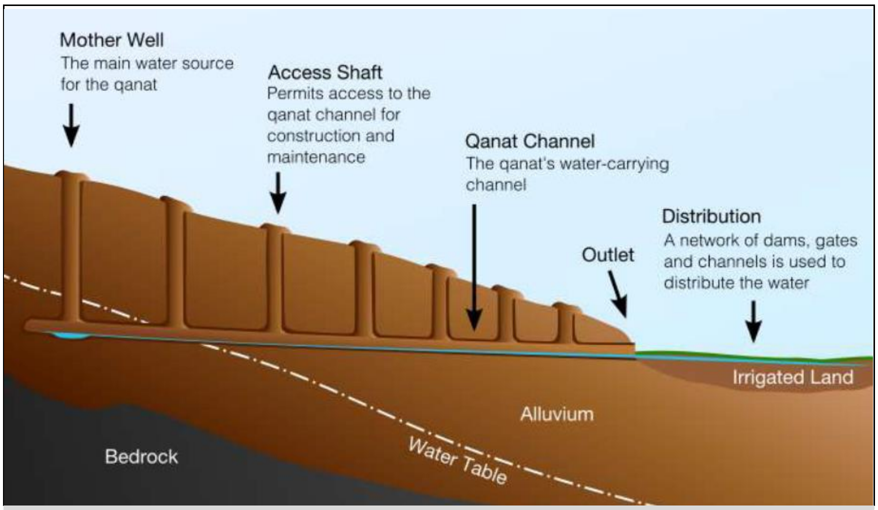

Figure 10: Karez water management systems (UCDAVIS, 2012)

Water reservoirs and *kanda*

Water reservoirs are constructed for the purpose of collecting and storing water of run-off water during excess rain to reduce erosion and for later use. The criteria to be considered before building water reservoirs are listed in Box 17.

Box 17: Criteria to be considered before building water reservoirs

- Steepness of the slope
- Needs and intended use
- Soil
- Availability of resources and construction materials

Kanda

Kanda, a traditional Afghan underground water tank, is an indigenous technology for collecting rain and snow melt. The technology comprises an underground tank (~ 6m length, 6m width, 3m high) carved out of rock (limestone), channels to convey the runoff into the underground tank and a rocky catchment from which runoff is collected. The limitations of *kandas* are mentioned in Box 18. (WOCAT sheet)

Box 18: Limitations of *kandas*:

- Requires special skills
- Establishment costs are high if the catchment is rocky

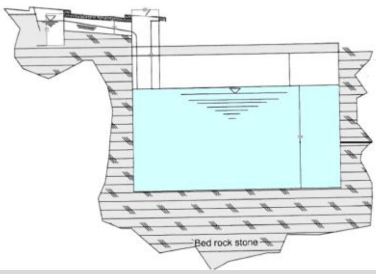

Figure 10: Technical drawing of a kanda (left) and runoff collection hole (right) (HELVETAS Swiss Intercooperation Afghanistan, 2015b)

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Vegetative & Agronomic SWC Measures

The principle of agronomic and vegetative soil and water conservation (SWC) measures is to **maintain a high vegetative cover** through the planting and/or reseeding of trees, shrubs and grasses. This serves two purposes - **protection** and **production**. Vegetative and agronomic SWC measures create effects both above and below the soil surface (see Figure 1), and these help to protect the entire watershed. Plants, plant residues (mulch) and stones increase surface roughness, which helps to **reduce the runoff velocity of water** and **collect eroded particles**. Plants and mulch also **reduce the effect of rain splash** and **decrease surface temperature**, which helps to reduce evaporation losses. As well as improving ground cover, the roots enhance soil structure and with it **aeration, infiltration and biological activity in the soil** (Haile, Herweg, & Stillhardt, 2006). Box 2 gives a detailed overview of agronomic and vegetative measures.

Besides protection, vegetative and agronomic SWC measures can also enhance production and income generation (see Box 1). They may need to be implemented jointly with structural and/or management measures (Concept Notes Structural SWC Measures / Community Based Watershed Management). Moreover, they need to be linked to grazing management measures (Concept Note Grazing Management), the management of firewood resources, and the promotion of alternative energy resources (Concept Note Alternative Energy Resources), since control of overgrazing and uprooting of shrubs plays a crucial role in implementing successfully agronomic and vegetative SWC measures in a given watershed (see Box 9/10).

Box 1: Production and income generation

Vegetative and agronomic measures not only serve as protection, but also for the **production** of subsistence or income-generating crops (cash crops).

Cash crops: Vegetative measures in the highlands can be implemented in combination with cash crops that generate income for local communities. The cultivation of cash crops depends very much on potential market opportunities.

Possible cash crops used are:

- Hing (asafoetida)
- White cumin and black cumin
- Almond
- Pistachio

Concept Note Cash and Fodder Crops

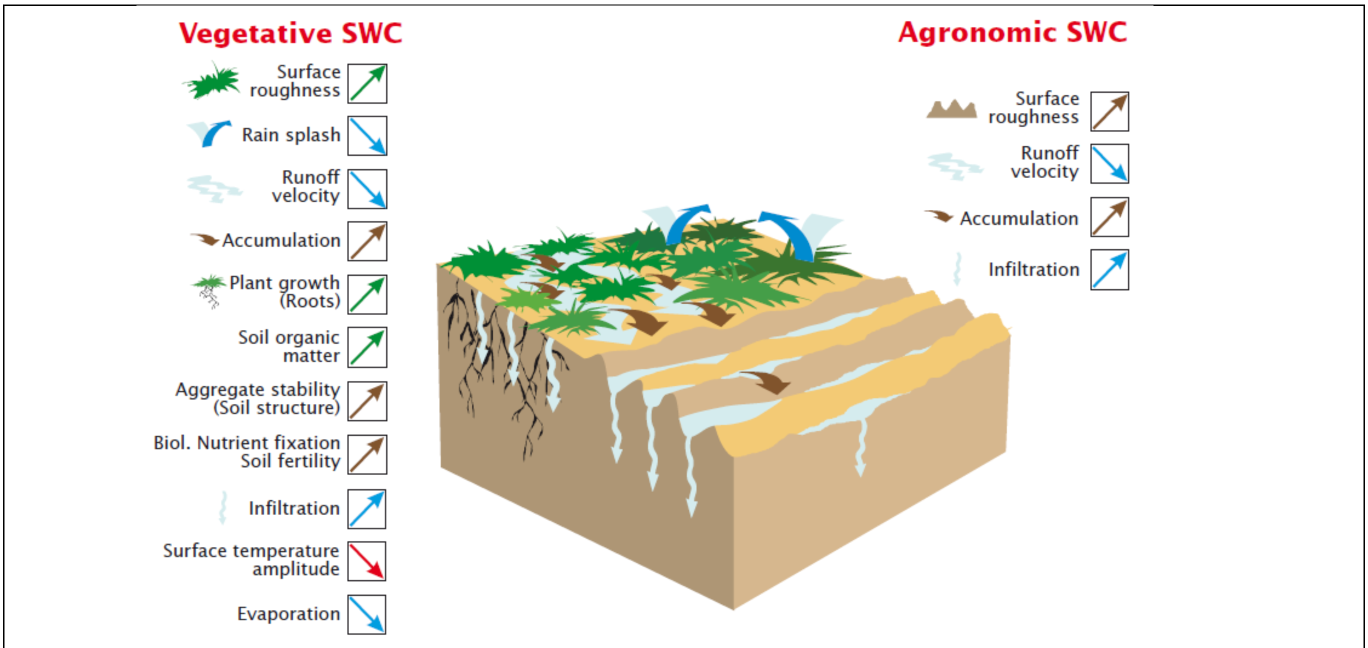

Figure 1: Effects of vegetative and agronomic measures on land (increase: ↗ decrease: ↘). (Drawing: Karl Herweg (Haile, Herweg, & Stillhardt, 2006))

Box 2: Overview on vegetative/agronomic SWC measures

Vegetative SWC measures include planting grasses, shrubs or trees as grass strips, hedgerows, live fences, hedges or shelterbelts. They are of long duration, often lead to a change in the slope profile and are dispersed or zoned on the contour or at right angles to the prevailing wind direction;

- **Grasses and perennial herbaceous plants**: aligned (e.g. **grass strips**) or dispersed (e.g. **improved rangeland**)
- **Tree and shrub cover**: aligned (in annual crops or grazing land: e.g. **hedgerows**, **live fences**, **hedges**, **shelter belts**) or dispersed (in annual crops or grazing land: e.g. in **agroforestry**),

Agronomic SWC measures are usually associated with annual crops, repeated routinely each season or in a rotational sequence, of short duration, not permanent and do not lead to changes in slope profile;

- **Vegetation/soil cover**: better soil cover with crop residues and live mulches, crop rotation and intercropping (e.g. with **conservation agriculture** or **agroforestry**)
- **Organic matter/soil fertility**: intercropping, applying manure, compost and residues (**organic fertilisers**)
- **Soil surface treatment**: minimal soil disturbance (e.g. with **conservation agriculture**)

Haile, Herweg, & Stillhardt, 2006

Grass strips, hedgerows, live fences and hedges

Hedgerows, hedges and live fences involve the planting of trees, shrubs or grasses in rows along the contour. They create a living barrier and reduce slope length, controlling runoff velocity and allowing sediment to accumulate. This process helps to reduce the slope gradient and terrace land. They are the least costly and labour-intensive form of cross-slope barriers. The criteria for choosing whether to use a grass strip, hedgerow, live fence and hedge species are listed in Box 3.

The spacing of the strips depends on the steepness of the slope. The strips are spaced far apart on gently sloping land but may be as little as 10-15 m apart on steep land. An A-frame is used to identify points on the same level along a hillside (Concept Note Structural SWC Measures). Hedgerows, hedges and live fences also provide fodder for livestock and can be used as cash crops (see Box 4 for the criteria for selecting possible species). Also, the space between strips (the alleys) can be used for agricultural crops, grass, fuelwood and timber, fruit trees and other cash crops.

Depending on the species, trees, shrubs and grasses can be planted as nursery seedlings, living branches or seeds with planting techniques such as eyebrow-pit planting, pit planting or trench planting (Concept Note Structural SWC Measures).

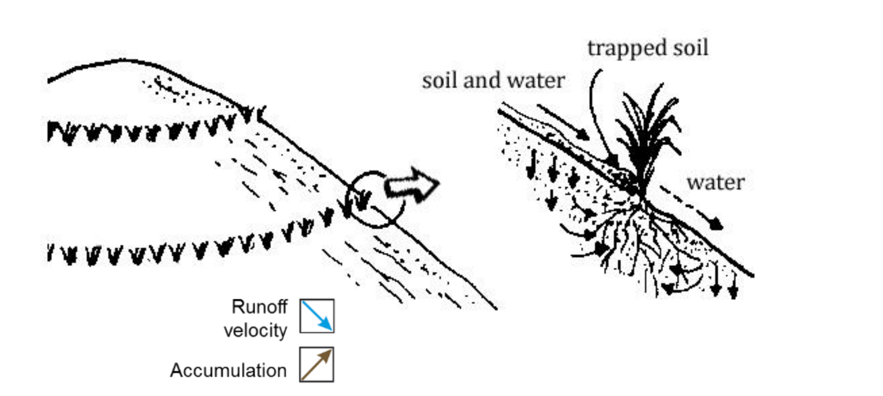

Figure 2: Live fences along contour trenches (IIRR, 1992)

Box 3: Criteria for grass strip, hedgerow, live fence and hedge species selection:

- Suited to local climate
- Fast-growing, deep-rooted, nitrogen-fixing – plant species
- Producing good biomass (fodder/green manure)
- Wind resistance and firmness
- Suitable height
- Deep root system
- Use and/or economic value

Box 4: Selection of possible grass strip, hedgerow, live fence and hedge species for Afghanistan:

- **Fodder crops:**
  Sanfoin, agropyron, alfalfa
- **Cash crops:**
  Hing (asafoetida), white cumin and black cumin, almonds, pistachio

Concept Note Cash and Fodder Crops

Shelter belts

A shelter belt is a strip or a belt of vegetation consisting of a mixture of trees and shrubs planted at appropriate intervals and maintained to protect soil and plant resources from the wind (FAO, 1989). The criteria for selecting shelter belt species are listed in Box 5. The limitations of shelter belts are mentioned in Box 6.

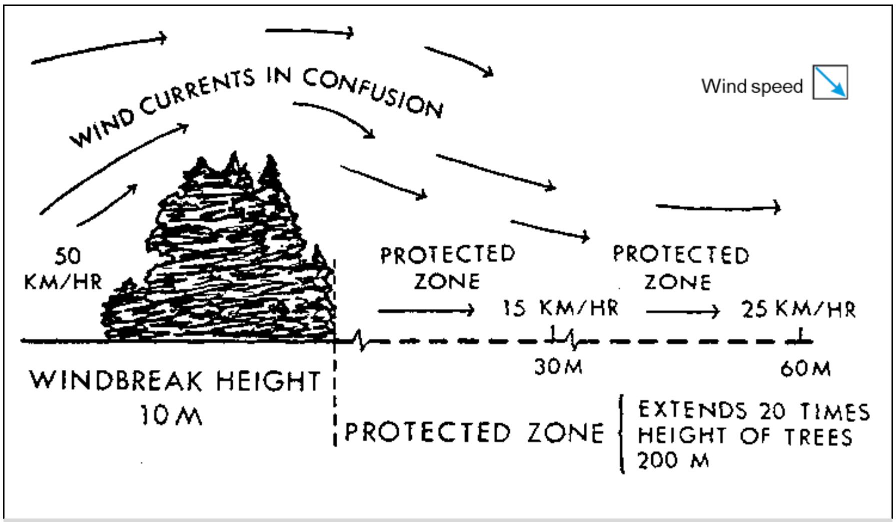

Figure 3: A shelter belt and its protected zone (FAO, 1989)

Box 5: Criteria for shelter belt species selection:

- Wind resistance and firmness
- Rapid growth
- Suitable height
- Deep root system
- Dense crown
- Economic value

Box 6: Limitations of shelter belts:

- Difficult to establish on steep slopes
- Availability of suitable species

Improvement of grazing land/rangeland vegetation

The vegetation cover on grazing land and rangeland can be kept high through effective management (Concept Note Grazing Management) and vegetative measures such as:

- Planting or sowing of suitable grasses, palatable species or fodder species (see Box 7 with a selection of possible species),
- Removing unwanted vegetation,
- Introducing trees and creating an agroforestry/agro-silvo-pastoralism land-use system (see Chapter on Agroforestry).

Figure 4: Slope with grazing land/rangeland vegetation

Box 7: Selection of possible grazing land/rangeland vegetation for Afghanistan:

- Sanfoin
- Agropyron
- Alfalfa

Concept Note Cash and Fodder Crops

Box 9: Overgrazing

Overgrazing has led to the disappearance of many valuable fodder grasses on Afghanistan's rangelands.

Permanent control of grazing is required if **vegetative measures** such as plantings of trees, shrubs and grasses are to succeed.

Possible approaches to reducing overgrazing are :

- **Controlling the time** of grazing and browsing,
- **Controlling the intensity** of grazing and browsing.

Controlling the time and intensity of grazing and browsing enables an area to produce far more feed than under uncontrolled overgrazing. Under controlled grazing, the plants increase in size and productivity rather than constantly losing their stored reserves.

Concept Note Grazing Management

Box 10: Uprooting of shrubs/ deforestation

Rural communities in Afghanistan meet most of their energy needs from traditional biomass sources such as firewood. The fast-growing population, poverty and environmental degradation have led to a steady increase in the uprooting of mountain shrubs or *buta* for fuelwood, degrading the fragile mountain ecosystems.

Vegetative measures such as hedgerows and shelter belts are only effective if they develop well and are not uprooted immediately after planting. Adequate **prevention of the uprooting of shrubs and deforestation** therefore plays a crucial role for the successful implementation of vegetative measures within a watershed.

Possible approaches to reducing the deforestation and uprooting of shrubs are:

- **Managing the firewood resources** jointly and sustainably with the relevant communities,
- **Promoting alternative fuel sources** and **reducing the demand** for firewood through more efficient cook stoves.

Concept Note Alternative Energy Resources

Conservation agriculture

Conservation Agriculture (Training Package SALM, Concept Note Sustainable Soil Management and Organic Fertilisers) is an agronomic SWC measure, which aims to increase the surface roughness, decrease runoff and increase water infiltration. It is a measure that conserves, improves and makes more efficient use of soil, water and biological resources for farming and combines profitable agricultural production with environmental measures and sustainability. The three fundamental principles behind the concept of conservation agriculture are:

- Minimum soil disturbance,
- Permanent soil cover (crop residue or live mulch), and
- Crop rotation or intercropping.

Conservation agriculture covers a wide range of agricultural practices based on no-till (also known as zero tillage) or reduced tillage (minimum tillage). These require direct drilling of crop seeds into cover crops or mulch. Weeds are suppressed by mulch and/or cover crops, and need to be further controlled. (Liniger et al., 2011) The limitations of conservation agriculture are listed in Box 11 -13.

Figure 6: Conservation agriculture: (1) minimum soil disturbance, (2) permanent soil cover: crop residue or live mulch, (3) crop rotation and or intercropping (FAO and LCANTF, 2014)

Minimal soil disturbance

Direct planting involves growing crops with minimum soil disturbance after harvesting the previous crop. Direct planting can be used for all annual and perennial crops and vegetables. Conservation agriculture can be done manually or mechanically. (FAO and LCANTF, 2014)

Figure 7: Minimal soil disturbance (Peace Corps, 1986)

Box 11: Limitations of minimal tillage:

- Weeds compete with the main crops
- Requires careful farm management practices to be successful

Permanent soil cover with crop residues and live mulches

Mulch is any organic material (such as decaying leaves, manure, bark, or compost) spread over the soil and around a crop to enrich and insulate the soil. Live mulches are crops intercropped for the purpose of providing soil cover. Crop residues or live cover protect the soil from the direct impact of erosive raindrops, conserve the soil by reducing evaporation and suppress weed growth. (FAO and LCANTF, 2014)

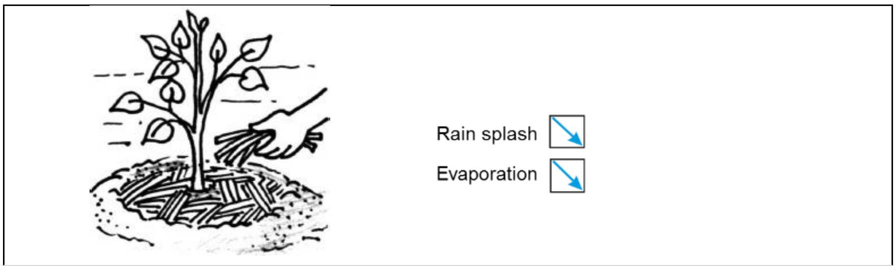

Figure 8: Mulch around a plant (FAO, 2009)

Box 12: Limitations of mulching:

- Mulching is labour intensive
- Too much mulch can be harmful (habitat for animals, pests, rotting of roots, etc.)

Crop rotation and intercropping

Crop rotation and intercropping means that different crops are alternated in the same field. It minimizes the risk of crop failures and increases food security when there is insufficient rainfall as well as combining the production of cattle feed with food for human consumption. (FAO and LCANTF, 2014)

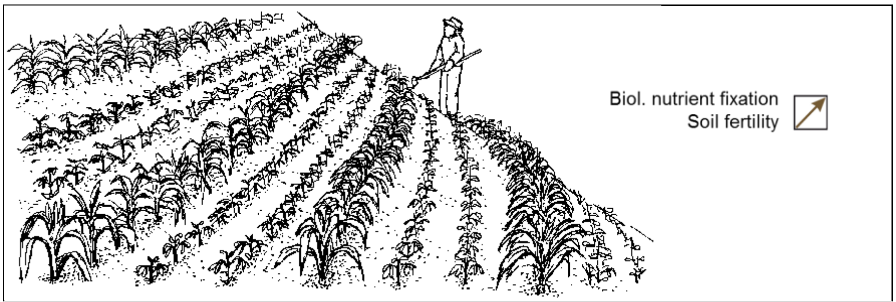

Figure 9: Intercropping (Peace Corps, 1986)

Box 13: Limitations of intercropping:

- It is difficult to harvest crops with different growing rates
- Requires knowledge about what crops can be mixed

Agroforestry/agro-silvo-pastoralism

Agroforestry is a collective name for land-use systems and practices in which **trees are integrated into cropping and livestock systems** in order to achieve multi-functionality. Agroforestry has a variety of benefits and services, but aims to increase productivity and income as well as improving equity, benefit-sharing and sustainable management. Agroforestry systems provide a favourable microclimate and permanent cover, thus protecting the soil from erosion, improving soil structure, increasing infiltration and enhancing the fertility and biological activity of soils. The integration can be either in a spatial mixture (e.g. crops with trees) or in a temporal sequence (e.g. improved fallows, rotation). Agroforestry ranges from very simple and sparse systems to very complex and dense arrangements. (Liniger et al., 2011; WOCAT, 2007)

Box 14: Limitations of agroforestry:

- Possible competition between trees and food crops for space, sunlight, moisture and nutrients, potentially reducing crop yields.

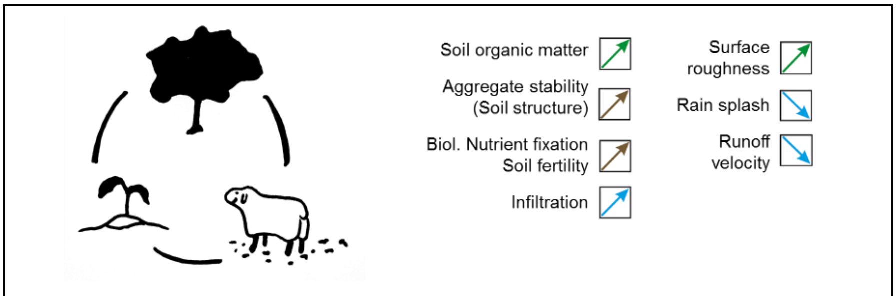

Figure 10: Agroforestry: land-use management system combining trees/shrubs, crops and/or livestock

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This publication has been made possible through financial support from the Swiss Agency for Development and Cooperation SDC. The content, however, is the sole responsibility of HELVETAS Swiss Intercooperation.

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Cash and Fodder Crops

Badam	
English name	Almond
Scientific name	*Amygdalus bucharica*
Description	Almond trees grow to a height of 4-6 m. They need cross-pollination for fruit production.
Use	Cash crop (fruit), fuelwood

Climate and soil			
Main habitat	Mild winters and hot, dry summers in full sun.	Drought tolerance	Moderate
Temperature	Warm and hot	Water needs	Tolerates dry areas, but much better if watered, especially where rainfalls is <500 mm per year.
Frost tolerance	Frost during flowering is a serious problem. Damage occurs at -2°C.	Soil needs	Well-drained loam textured soils. Tolerates poor soils.

Cultivation			
Propagation	Budded	Pests and diseases	Suitable rootstock reduces soil diseases.
Nursery	Required	Harvesting	Shake the tree and sweep (time to 1st harvest: 3-4 years).
Planting	Plant sapling and keep soil moist. Pruning in vase shape and with central leader systems.	Storage of fruits	Store the nuts (with or without shell) as soon as possible in a cool, dry place.

Source and further reading:

UC DAVIS (2015). Afghan Agriculture. Available at: http://afghanag.ucdavis.edu/a_horticulture/nut-trees/almonds/almonds#production

Pista	
English name	Pistachio
Scientific name	*Pistacia vera*
Description	Pistachio trees are broad, bushy and reach heights of 2-10m tall.
Use	Cash crop (fruit), fuel wood

Climate and soil			
Main habitat	Pistachio is a desert plant. Long hot summers are required for the fruit to ripen properly.	Drought tolerance	Moderate to high
Temperature	Thrives in cool to cold winters and long hot summers.	Water needs	Deep, infrequent watering essential for production. Low tolerance to waterlogging.
Frost tolerance	Frost destroys the young fruit and blossom.	Soil needs	Deep loamy soil. Rootstocks are saline tolerant.

Cultivation			
Propagation	Grafting or budding	Pests and diseases	*Botryosphaeria* fungus causes panicle and shoot blight (symptoms include the death of flowers and young shoots) and can damage entire pistachio orchards.
Nursery	Required	Harvesting	Shake and then sweep when hull becomes puffy and loose (in August to September). Time to 1st harvest: 5 to 6 years.
Planting	Plant density: 100-150 trees per hectare.	Storage of fruits	Remove hulls and store in dry container.

Source and further reading:

UC DAVIS (2015). Afghan Agriculture. Available at: http://afghanag.ucdavis.edu/a_horticulture/nut-trees/pistachios/pistachio-fact-sheets/pistachios-overview

Zera	
English name	White and black cumin
Scientific name	*Cuminum cyminum*
Description	Cumin is a thin herbaceous annual plant that grows to a height of 10-30 cm. The plant is slender, with a main stem that divides into up to five secondary branches from the base; each branch may have 2-3 sub-branches.
Use	Cash crop

Climate and soil			
Main habitat	Moderately cool and dry climate	Drought tolerance	Moderate
Temperature	The seeds need 2-5°C for emergence, an optimum of 20–30°C is suggested.	Water needs	Keep moist and moderate water slightly once seeds start to germinate.
Frost tolerance	Very low, especially at flowering and early seed formation stages	Soil needs	Grows best on well-drained sandy loam to loamy soils with a pH of 6.8 to 8.3.

Cultivation			
Seeds	Cumin is grown from seed.	Pests and diseases	Cumin is especially sensitive to *Alternaria* blight and *Fusarium* wilt.
Sowing	Sowing with recommended sowing depth of 1-2 cm	Harvesting	The dried seed of the herb is harvested by hand when plants are around 30 cm tall.
Fertilizer		Storage of seeds	The seeds are dried and stored in an airtight container

Source and further reading:

Encyclopedia of Life Support Systems (2015). Cumin. Available at: http://www.eolss.net/sample-chapters/c10/e1-05a-50-00.pdf

Hing	
English name	Hing/Asafoetida
Scientific name	*Ferula foetida*
Description	Hing or asafoetida is a perennial herb, which grows to about 2 m tall, with a circular mass of 30–40cm leaves. It is a monocarpic plant, so it flowers only once and dies after flowering.
Use	Cash crop

Climate and soil			
Main habitat	Prefers deep fertile soils in sunny locations. Hing does not grow in shade.	Drought tolerance	Moderate
Temperature		Water needs	Soil has to dry out completely between watering.
Frost tolerance		Soil needs	Suitable for sandy, loamy and clay soils and prefers well-drained soils.

Cultivation			
Seeds	The plant produces sprouts and foliage from the taproot.	Pests and diseases	Asafoetida is generally resistant to disease.
Nursery	Required	Harvesting	The resin-like gum comes from the dried sap extracted from the stem and roots. The resin is difficult to grate and is traditionally crushed between stones or with a hammer.
Planting	Transfer the seedling to its permanent location and avoid transferring it again because of long taproots.	Uses of hing	The oil of gum resin, compounded asafoetida, is produced, either for culinary or medical uses.

Source and further reading:

Peter, K.V., Handbook of herbs and spices, Volume 2, Woodhead Publishing, Philadelphia, USA.

Sainfoin	
English name	Sainfoin
Scientific name	*Onobrychis viciifolia*
Description	Sainfoin develops deep, penetrating roots and can draw moisture from a great depth. Sainfoin is a hay crop that can also be grazed. Sainfoin is a leguminous plant and is able to fix nitrogen (N).
Use	Fodder crop (rotational grazing/hay), green manure

Climate and soil			
Main habitat	Thrives in a wide range of temperatures.	Drought tolerance	Moderate
Temperature	Thrives from very hot to very cold.	Water needs	Grows well in areas that receive 300 mm or more of precipitation per year.
Frost tolerance	Good	Soil needs	Thrives in well-draining, alkaline and calcareous soils (> pH 6.2)

Cultivation			
Seeds		Pests and diseases	Does not suffer from any major pests or diseases.
Sowing	Seeds are preferably sown shallow in spring.	Harvesting	Grazed or cut for hay. Sainfoin is best suited to a rotational grazing system. As green manure it is cut and incorporated into the soil.
Fertilizer	Requires no nitrogen fertiliser.	Storage of hay	Storage in a dry place.

Source and further reading:

Legume Plus (2015). Farming with Sainfoin. Available at: http://sainfoin.eu/farming-sainfoin

Agropyron	
English name	Agropyron
Scientific name	*Thinopyrum intermedium*
Description	Agropyron is a perennial grass with an extensive root system and ranges from 30-50 cm in height.
Use	Fodder crop (rotational grazing/hay)

Climate and soil			
Main habitat	Dry and stony mountain slopes	Drought tolerance	High
Temperature		Water needs	Prefers 300-400mm per year. Doesn't tolerate prolonged flooding.
Frost tolerance	Moderate	Soil needs	Prefers well-drained, deep, loamy soils

Cultivation			
Seeds		Pests and diseases	
Sowing	Sow at a depth of 1-1.5cm on medium to fine textured soils.	Grazing	Grazing season is spring, summer and autumn.
Fertilizer	Agropyron has low fertility requirements	Storage of hay	Storage in a dry place.

Source and further reading:

US Department of Agriculture (2015). Crested Wheatgrass. Available at: http://plants.usda.gov/plantguide/pdf/pg_agcr.pdf

Reshqa	
English name	Alfalfa
Scientific name	*Medicago sativa*
Description	Alfalfa, or lucerne, is a perennial flowering plant (20-70 cm high), which has the ability to fix nitrogen.
Use	Fodder crop (hay), green manure

Climate and soil			
Main habitat		Drought tolerance	Can survive periodic droughts.
Temperature		Water needs	600 – 1600 mm annual
Frost tolerance	No	Soil needs	Does best on well-drained soils. All soil textures of sand, loam, and clay are suitable.

Cultivation			
Seeds		Pests and diseases	There are no reports of high pest pressure on Afghan alfalfa.
Sowing	Seeds should be covered with enough soil to provide moist conditions for germination.	Harvesting	Alfalfa can be cut 3-5 times a year.
Fertilizer	Manure. Phosphorus levels are especially critical during establishment.	Storage of hay	Alfalfa for winter feed should be baled. Hay has to be dry before baling.

Source and further reading:

UC DAVIS (2015). Afghan Agriculture. Available at: http://afghanag.ucdavis.edu/c_livestock/reports/Rep_Afghan_Alfalfa_FAF_2009.pdf

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Alternative Energy Resources

Rural communities in Afghanistan meet most of their energy needs from traditional biomass sources such as firewood, cow dung and crop residues. However, the fast-growing population, poverty and environmental degradation have made it increasingly difficult for communities to meet their daily energy needs from these traditional sources (ICIMOD, 2009).

Figure 1: The massive amount of mountain shrub required for fuel: a donkey-load of collected biomass

On the one hand, the constant uprooting of mountain shrubs or *buta* for fuelwood has degraded the fragile mountain ecosystems, leading to recurrent and intense natural disasters such as flash floods. On the other hand, animal dung is an efficient organic fertiliser that is vital for increased soil fertlility and should therefore be recycled back into the soil instead of burned.

Moreover, the lack of alternative energy sources leads to increased workload for women, men and children. For instance, women spend 3-4 hours every day baking bread or *nan*, and children have to miss their studies when they go to collect shrubs for fuel. In addition, cooking and heating from traditional biomass sources such as firewood, cow dung and crop residues have serious implications for human health (see Table 1).

Table 1: Health hazards from using biomass as fuel (Wood Energy News, 1996/1997)

Fuel cycle	Activity	Possible health effects
Production	Preparing dung cakes	Faecal/oral/enteric infections
Collection	Gathering fuel	Trauma, allergic reactions, injuries
Transportation	Carrying biomass	Backache, severe fatigue, damaged reproductive organs
Combustion	Smoke	Acute respiratory infection, eye infections Indoor air pollution, mostly from burning biomass for cooking and heating, kills 1 million people every year (WHO, 2014).

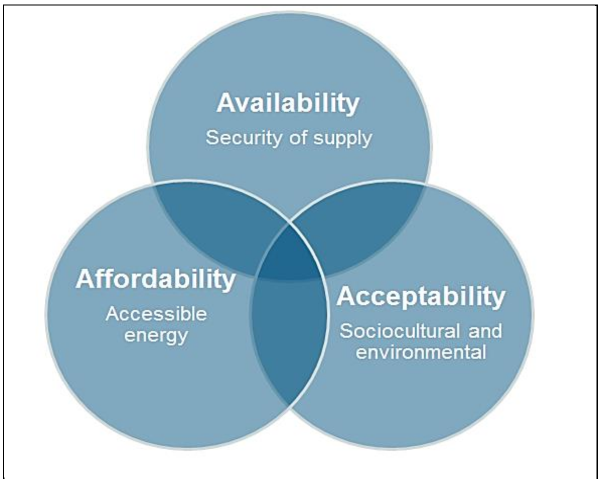

Figure 2: Sustainable energy service requires a holistic approach considering availbility, affordability and acceptability. (ICIMOD, 2009)

Alternative energy sources

The widespread “energy crisis” in rural areas of Afghanistan, combined with serious environmental degradation, makes it promoting alternative energy resources a priority for sustainable development. Properly designed alternative energy technologies can benefit communities in many ways - through savings in fuel and time; by cutting out some of the drudgery associated with biomass collection and cooking; by improving human health; and by reducing greenhouse gas emissions (ICIMOD, 2009). When promoting alternative energy in rural areas, it is nevertheless important to consider three aspects: the availability, acceptability and affordability of alternative energy resources (see Figure 2). Alternative energy sources must be accessible to farmers and other rural people, but also their supply must be secure. Moreover, the technologies need to be accepted by the local population, which is not always a simple task.

There are three approaches to sustainable energy: 1. reduce energy needs, 2. use renewable energy, and 3. use energy more efficiently (Afghanistan Energy, 2009). For instance, the use of **improved cooking stoves** reduces fuelwood consumption. The energy produced by the stoves can be stored if the homes have **thermal insulation**, and cooking time can be reduced by the use of **pressure cookers**. Often a combination of sustainable energy solutions provides best results.

When considering alternative energy resources, it is important to look at the “purpose or end use” of energy - for lighting, water heating, cooking or space heating, etc. Not all alternative energy sources are suitable for all purposes; for instance, water cannot be used to heat space. There are different sources of alternative energy from water, sun, biomass, wood and wind. Figure 3 presents various solutions for the case of rural Afghanistan.

End Use Purpose	Available Technology	Renewable Sources of Energy	Availability	Reliability	Ease in operation	Operational efficiency	Environmental implication	Repair and Maintenance	Durability	Socio cultural acceptability	Capacity or Size of Plant
Lighting	Peltric set	Water	H	H	H	H	N	M	H	H	1 kilowatt (kW)
	Solar PV cell	Sun	M	M	H	H	N	M	H	H	15 watt (W)
	Biogas plants	Biomass	H	H	H	H	N	M	H	M	10 m3 plant
	Improved water mills	Water	H	H	H	M	N	M	H	H	1 kW
	Small scale wind mill	Wind	H	M	M	M	N	M	H	H	
Water heating	Solar water heater	Sun	H	M	H	H	N	M	H	H	20 litre (l) (2 panel)
	Small scale wind mill	Wind	H	M	M	M	N	M	H	H	
	Biogas plants	Biomass	H	H	H	H	N	M	H	M	4 m3 plant
	Briquette	Biomass	H	M	H	H	N	M	H	M	
	Electric cooker	Water	M	H	H	H	N	M	H	M	2 l capacity
	Electric bucket	Water	M	H	H	H	N	M	H	H	20 l300 W
	Back boiler	Wood	H	H	H	M	M	M	M	H	200 L capacity
Space heating	Solar passive heating system	Sun	S	M	H	H	N	M	H	M	
	Small scale wind mill	Wind	H	M	M	M	N	M	H	H	
	Improved cook stove (ICS) domestic/ institutional	Wood	M	M	H	S	M	H	M	H	
	Briquette	Biomass	H	M	H	H	N	M	H	M	
	Back boiler	Wood	H	H	H	M	M	M	M	H	100 L capacity
Cooking	Solar cooker	Sun	S	M	H	H	N	H	H	M	Card board box and parabolic type
	Hay Box cooker	Insulation	H	M	H	H	N	H	H	H	
	Biogas plant	Biomass	H	H	H	H	N	M	H	H	6 m3 plant
	Electric Cooker (Bijuli Dekchi)	Water	M	H	H	H	N	M	H	H	8 l
	Heat storage cooker	Water	M	H	H	H	M	M	H	H	per unit
	Domestic ICS		H	H	H	H	M	H	M	H	per unit
Grain milling	Improved water mill	Water	H	H	H	M	N	M	H	H	with 5 no rice huller
Agri- produce drying	Solar dryer	Sun	S	M	H	H	N	H	H	H	
Water lifting	Hydraulic pump	Water	M	H	H	M	N	M	H	H	
Water pasteurisation	Water pasteurisation	Sun	S	H	H	H	N	M	H	H	Piece

S – somewhat, M – moderate, H – high, N – not/no

Figure 3: Available alternative energy technologies (ICIMOD & CRT, 2007; ICIMOD, 2009)

Figure 4: Dash oven fired by coal in a community bakery in Afghanistan (HELVETAS Swiss Intercooperation Afghanistan)

Many interesting solutions already exist in Afghanistan and its neighbouring countries. For example, in the Kahmard and Saighan districts of Bamyan province, HELVETAS Swiss Intercooperation has been promoting **community bakeries** (Figure 4) which run on coal. Each bakery can be used by 80-100 families every day. Families bring their dough from home and receive baked bread or *nan* by paying about 2 AFN/loaf as a baking fee (SDC, 2010). However, these bakeries can only run successfully if coal is available at an affordable price. For more information watch this video.

Figure 5: A passive solar house with thermal insulation reduces the cost of heating by 90% (GERES Afghanistan)

Passive solar houses (Figure 5) that use insulation and solar energy are another useful technology for the cold regions of Afghanistan. The technology has been successfully tested and promoted by development organisations such as GERES with encouraging results (Hall, 2012). Many families in Bamyan have adopted this technology spontaneously and without external support.

Figure 6: Double-walled chimney bread oven in a house in Tajikistan (Afghanistan Energy)

In Tajikistan, some households are using **chimney bread ovens** (Figure 6), which are very firewood-efficient. The waste heat from the chimney is conducted through a double-walled box. The bread is a maximum of 30 cm in diameter and thicker than the traditional *nan* flatbread. If the house is insulated, the oven provides more heat than a stove or chimney without the oven box (Sjoerd, 2009).

In the sunny climate of Afghanistan, **solar-energy-based technologies** can be a solution. These could be a solar oven for cooking food or heating water, a solar drier for drying fruits/vegetable, or a solar water disinfection (SODIS for short; see www.sodis.ch). Moreover, solar panels can be used to produce light and warm water.

Biogas technology is another viable alternative, especially in areas where there is sufficient animal dung, assured access to water and milder temperatures, all of which support year-round methane production. Biogas can be used for cooking, lighting and generating electricity and has many other benefits, as listed in Box 1.

Box 1: Benefits of biogas plants

- Fuelwood savings
- Reduced workload
- Reduction in greenhouse gases
- Reduced indoor pollution
- Increased agriculture production (biogas plants produce very high-quality organic fertilisers; bio-slurry) or reduced expenditure on chemical fertilisers
- Improved sanitation, less pollution into the groundwater
- Using dung in a biogas plant generates more energy than when using it in direct combustion.

Source: Milbrandt et al., 2011

Figure 7: Flexi-biogas system developed by Biogas International requiring 20-30 kg of dung per day to produce biogas (www.biogas.co.ke)

Figure 8: Beehive briquettes (ICIMOD, 2009)

Briquettes make use of compacted agricultural wastes, including fallen dry leaves, for fuel. Beehive briquettes (a honeycomb beehive-shaped biomass briquette (see Figure 8) are made using a hand mould. Hardwood biomass charcoal briquettes with 20% clay content produce energy which may heat two litres of water in 15 to 20 minutes using one briquette in an insulated metal stove. Depending on the quality of the briquettes, one beehive briquette burns for about an hour and a half, enough time to cook a normal meal for a family of four or five (ICIMOD, 2009). HELVETAS Swiss Intercooperation has been promoting briquetting in selected districts of central Afghanistan and has provided training to many interested women.

Where there is a water source, **water-based technologies** like a Peltri Set to generate electricity or a Cycle Water Pump are interesting alternatives (Table 2).

Substantial energy can be saved by the rural population by combining different options such as thermal insulation, improved stoves and cooking methods. This generates economic, social and environmental benefits.

Table 2: Water-based alternative energy solutions (ICIMOD, 2014)

Technology	Description	
Peltric Set Technology	The device consists of an induction generator that is powered by a small vertical-shaft peltron turbine, and can be used to provide electricity to rural and remote areas.	
Cycle water pump (treadle)	Water is pumped form a water source up to 7.5 metres (25 feet) below the pump to 16.5 metres (50 feet) above the pump, or up to 60 metres (200 feet) in a sloping area, by peddling on an adapted bicycle.	

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Hall, S., 2012: Project evaluation: Energy efficiency in private housing to improve living conditions of populations in Afghan cold regions (Bamyan). GERES, Afghanistan.

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Grazing Management

Box 1: Importance of rangelands

Healthy rangelands function as a water buffer, in particular due to their **vegetative cover**, which increases water infiltration, soil organic matter and nutrient cycling and protects the soil from erosion. This allows rangelands to absorb water and slowly release it thorough the year.

Rangelands are also "the most important carbon sinks", and good management can build resilience to climate change (Wilcke, 2015).

Rangelands are characterised by vegetation consisting of non-domesticated species of **grasses**, **herbs** and **shrubs,** and may be sometimes covered by open woodlands of **low-growing trees**. Their key feature is the high variability and unpredictability of rainfall and temperature patterns. This usually makes them unsuitable for crop production, and they are managed as **natural ecosystems**. The dynamics of rangeland vegetation is highly complex and many recent rangeland ecology models challenge traditional ones (e.g. the "non-equilibrium" model vs. the "equilibrium dynamics" model). These ecosystems are also strongly shaped by human communities and should be considered "**social-ecological systems**" (Hülsebusch et al., 2013)

Box 2: Overgrazing

Overgrazing occurs when a pasture is grazed by too many animals for too long or with too short intervals. Grasses and shrubs need time to recover from previous grazing, regenerate roots and leaves and reproduce (i.e. produce seeds). Overgrazing involves a deterioration in the **quality** and **quantity** of vegetation. (Many sources, see references).

Rangelands form the most important ecosystem in Afghanistan's watersheds and play an important role in **soil and water conservation**, as well as **climate change adaptation** (see Box 1). They are a **common-pool resource** and therefore widely used by the rural population, especially as **pastures** for grazing livestock.
Managing pastures means managing natural vegetation for livestock production. Management **choices by livestock keepers** can positively or negatively affect pastures and their productivity. Good grazing management ensures the long-term productivity of pastureland, whereas poor management's choices can lead to **overgrazing** (see Box 2 and Table 1). Implementing good grazing management practices depends more on **governance aspects** and **local knowledge** than on technical solutions. This concept notes illustrates how to implement sustainable grazing strategies (rotational and high intensity grazing – Box 3 – through a) local governance structures and b) the promotion of indigenous knowledge and local capacity-building regarding rangeland vegetation.

Table 1: Good vs. poor grazing management (Cileshe et al., 2002 ; Rinehart, 2006)

Good grazing management	Poor grazing management
Ecologically sound and **balanced use** of the forage in the pasture	**Excessive** use of the forage in the pasture
Controlled frequency and length of the grazing periods. • Use **mobility as a strategy** • Plan **resting time** for the pasture to recover from grazing ✓ Leave the **leaves and the roots of pasture plants to re-establish** before re-grazing ✓ Only graze a pasture when at least **half of the vegetation is flowering** (in order to graze the maximum possible biomass and secures reseeding of desirable fodder species). (Rahim et al., 2012)	Often **uncontrolled** grazing • **Continuous** grazing × Plants are either continuously or too early re-grazed, they do not have enough resources to regenerate and eventually die
Uniform grazing: weedy species are grazed at the same intensity as palatable species.	**Grazing not uniform**. Stocks only consume preferred plants, subsequent degradation of vegetation.
Mix of species (palatable, weeds etc.) remains **stable** or enhanced through specific techniques (see Box 3, further down).	Palatable species **disappear**, invasion by **weeds**, bush **encroachment**, diminution of rangeland's biodiversity.
Maintenance of pasture's long-term productivity!	**Overgrazing! Erosion.**

Box 3: Example of ecologically sound grazing management

Rotational grazing (see **Annex 1** for a visual description) uses **livestock mobility** as the main management strategy. Mobility is a strategy used by pastoral communities to cope with the high variability of rangeland vegetation and water availability and it is proven to be a **sustainable solution** (Hülsebusch et al., 2013). In Europe and the USA, rotational grazing is established by rotating livestock in a sequence of clear fenced paddocks. One paddock is grazed at a time while the others recover from grazing. The establishment of fenced paddocks in Afghanistan make little sense. However, rotating flocks through roughly established blocks on communal rangelands is an important strategy for preserving these ecosystems (as they are currently overgrazed due to continuous grazing - see Table 2 below).

Managed high-intensity grazing, mob grazing or **bunch grazing** are all strategies for very high-intensity and rapid rotational grazing. A very high number of animals are herded or confined on a small patch for a short time. The objective is to graze intensively and to mix the animal manure into the soil through trampling by livestock. This increases organic matter in the soil and contributes immensely to carbon sequestration. However, this management might not be suited to all ecological conditions and livestock systems (Hülsebusch et al., 2013).

These two strategies can only be implemented if rangeland users organise themselves and communicate, plan and agree on pasture management. In short, the presence of a **local governance structure** is absolutely indispensable. This can be at community level (e.g. community-based) or at watershed level, including various regional and inter-regional authorities and the government (co-management approaches).

Local governance structures

Pastures are used by different stakeholders who often have conflicting objectives and interests. In Afghanistan, pastures are grazed by **sedentary villagers**, **nomads** (Kuchi pastoralism) or **semi-nomads (a** mixture of the two former groups). These groups are highly heterogeneous and have different objectives and believes. In the past, complex customary laws and traditional institutions were regulating the use of pastures, but decades of war, drought and migration have sapped local governance systems, causing an overexploitation of pasture resources (Robinett et al., 2008). Also, rangelands have increasingly been characterized by conflicts over land tenure and are deeply affected by changes in land use (conversion of rangelands into rain-fed agricultural land), which are further exacerbated by population pressure and climate change.

The Land Policy (2007) and Law on Managing Land Affairs (2008) stipulates that the country's **rangelands** are public property or owned by the government, which fosters bottom-up and decentralised approaches, based on existing customary institutions. In the customary law, there are at least three main typologies of rangeland ownership (local, communal and public, as shown in Table 2), and on the basis of these, bottom-up management approaches such as **community based management** and **co-management** approaches for rangelands should be implemented. Any governance institution involved should respect social equity, be gender sensitive and comply with other key principles of good governance (see more details of community-based management and co-management in the Concept Note on Community-Based Watershed Management.

Table 2: Rangeland types and management approaches (MAIL, 2012)

Type of rangelands/pasture	Definition based on current customary law	Possible community based management approach
• **Local rangelands**	**Rangelands near villages**. Might include Kuchi in their winter grazing areas. Boundaries are well known and not disputed.	Community-based rangeland management
• **Communal rangelands**	Rangelands usually in **relative proximity** of villages. Traditionally managed by communities and over which communities have the priority in terms of access and user rights. Grazing is often continuous.	Co-management between communities and a combination of local institutions
• **Public rangelands**	Usually **remote rangelands**. No community and no particular group claims exclusive access and user rights. Traditionally used by many different users (Kuchi, and other non-local customary users). They are theoretically open access.	Co-management among stakeholders.

In *communal and public rangelands*, **co-management strategies** have to be adopted that involve the government, representatives of *Community Development Councils* (CDC) and representatives of the *Independent General directorate of Kuchi* (IGDK) (see the annex of the Concept Note on Integrated Watershed Management for a short description). Particular efforts should be made to **include representatives of nomadic communities**. As a matter of fact, working with sedentary communities only can also be a hidden form of their appropriating the rangeland, thus excluding pastoralists, increasing conflict, inequity and most likely degradation by the different rangeland users.

On the other hand, *local rangelands* can be managed through a community-based approach led by a **community-based organisation** (CBO). Both co-management and a community-based approach to rangelands are based on the planning, implementation and monitoring of a **grazing management plan** (Box 4) supervised by the local decision-making bodies (e.g. rangelands committee, herder's alliances, community development councils, IGDK, etc.)

Box 4: Grazing management plan

A grazing management plan should at the very least include (Rinehart, 2008):

1. **Pasture assessment** (what is the pasture area under the responsibility of the committee? How many different pastures are there in the watershed or near the village? What state is the vegetation in? Who is using them?);
2. **Goals and objective of the management** (e.g. maintaining vegetation cover for soil and water conservation);
3. **Grazing schedule** (shows which pasture is being grazed when and by whom for each period of the year);
4. A **monitoring and evaluation system** (to observe how the goals are being achieved and to monitor rangelands vegetation, new stakeholders, conflicts, etc.

These steps have to be developed with the agreement and participation of all key stakeholders. Please refer to the Concept Note on Participatory Planning for Watershed Management for further information.

Valorisation of indigenous knowledge and local capacity-building

Pasture management also requires an ability to take informed decisions based on the results of pasture assessment and monitoring as well as estimations of the grazing requirement of livestock.

- How much **biomass** is available for grazing in a pasture?
- How many **animals** are grazing and what are their grazing preferences (see **Box 5**)?
- How much biomass is required for these animals to be fed?

Traditionally, herders have great knowledge and experience – so-called indigenous knowledge (IK) – of assessing and monitoring pastures. **Participative strategies** have shown important results in assessing **rangeland pastures** (Box 6), often supplemented by technical knowledge where relevant. As an example, the Herder's Manual for Western Pamir offers an inventory of the major palatable species, weeds and toxic species, which is completely based on participatory assessment of rangelands and completed with recent scientific findings. Building local capacity and sharing knowledge and experience of rangeland vegetation among rural communities is key to sustainable grazing management.

Participatory pasture assessment also has the purpose of creating a **monitoring system** of watershed pastures. These monitoring systems should be mapped and inserted in a **Geographical Information System** (GIS) in order to support local, regional and national decision-making (Concept Note on GIS and Remote Sensing).

Box 5: Grazing behaviour

Animals consume plant species with differing relish. There are **palatable species** and **weeds** (a term for species that are not preferred by animals, with an often invasive behaviour). Management depends on the ability to recognise these species and use this to assess the quality of a pasture.

Additionally, animals have distinct feeding behaviours (sheep and goats are **browsers** and tend to consume shrubs, whereas cattle are **grazers** and prefer grasses) and need **different amounts of biomass per day** (the Herder's Manual for Western Pamir offers details for estimating livestock daily grazing requirements).

Box 6: Indigenous knowledge and participatory pasture assessment

Farmers and herders have in-depth **knowledge** on rangeland vegetation and animals' grazing preferences. Nomadic communities depend almost exclusively on this knowledge. Fairly realistic vegetation assessments can be made using **participative approaches**. This IK must therefore be **promoted** and **shared** among key stakeholders.

- For a **quantitative assessment** of pasture **fresh matter production** with the **transect method**, see the Herder's Manual for Western Pamir; Rahim et al., 2012)
- For a **visual assessment** of pasture **health/degradation** based on a set of indicators, see the LADA, Land Degradation Assessment publication; FAO, 2011).

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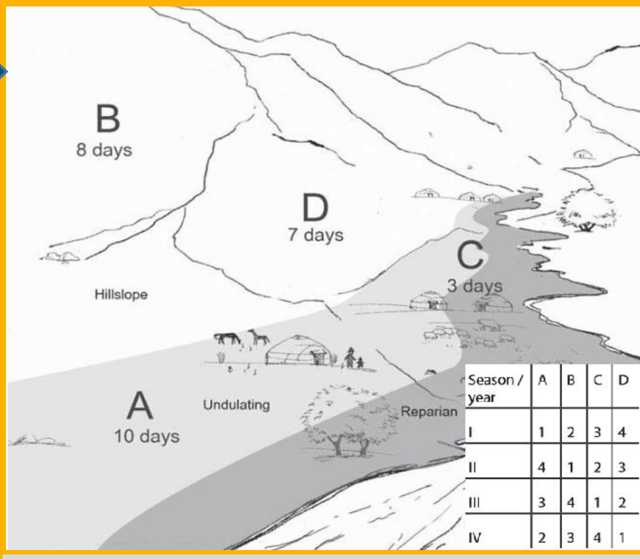
Rahim et al. 2012.

1.
- ➔ Divide the pasture into **units** (blocks) to be grazed in sequence.
- ➔ Based on the **pasture assessment** and the **livestock requirements**, estimate how many **days** you can graze each block.
- ➔ Every year **start with another block**, to allow the vegetation to regenerate.



Season / year	A	B	C	D
I	1	2	3	4
II	4	1	2	3
III	3	4	1	2
IV	2	3	4	1

Figure 2: Example of a rotation grazing system (Rahim et al. 2012).

2. Based on the grazing days, divide each block into **sub-units** (in Figure 1: 10 grazing days are planned for block A, it should therefore be divided into 10 sub-units) and manage livestock to graze one sub-unit a day. This ensures **uniform grazing.**

Pasture management
➔ Good practices!

- ✓ Start to graze a pasture when the vegetation has already started to flower. This insures the **reseeding** of the pasture and allows the plant to **create reserves** and regenerate after grazing.
- ✓ Do not allow the next grazing before the leaves and roots of plants are re-established.
- ✓ Do not allow animals to graze too early in **spring** or too late in **autumn**!
  The vegetation needs to have some time to regenerate or to build up enough reserves at the end of the season to regenerate in the next one!

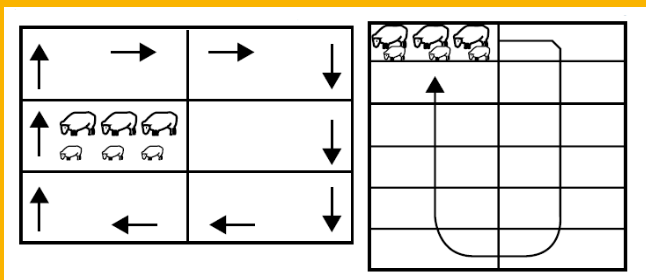


Figure 2: Schematic representation of rotational grazing (Butler et al. 1997)

3. **Control** the stock while it is **rotating** between sub-units. Wherever possible, live fences can be established (while also implementing vegetative measures).

Geographic Information Systems (GIS)

GIS are computer-based tools for mapping and analysing things that exist (e.g. vegetation cover) and events that happen on Earth (e.g. floods). GIS manage information and provide tools for **storing**, **analysing** and **displaying** all types of geographical data.

GIS make it possible to combine data such as land usage, climate and hydrology with political or socio-economic data. **Published maps** and **tables**, **current field observations**, **surveys** and **area/satellite imagery** can be used as data sources (see Figure 1). Following data management and analysis using GIS, the results can then be presented in maps, graphics, statistics and reports.

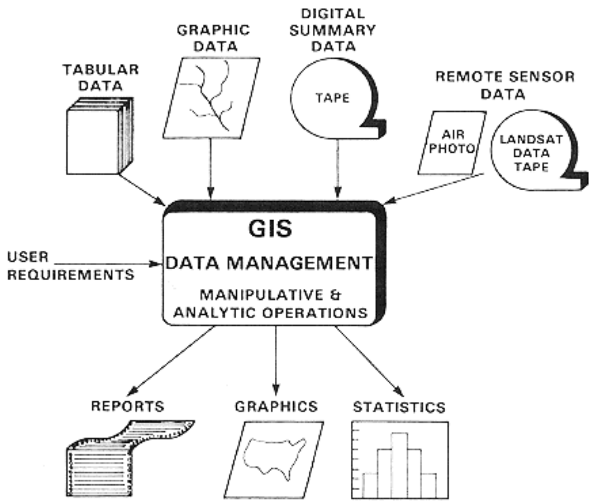


Figure 1: Data management through a GIS with its data sources and results (NASA)

GIS offer a wide range of possibilities for **planning, monitoring, evaluation and decision-making**. When different layers of information are added to the analysis (see Figure 2) and values plotted on a map, things become clearer and give a better picture of the real-world scenario. This helps experts to track erosion and flooding, assess the impacts of a natural disaster, do infrastructure planning and monitor land use. However, GIS do have their limitations (see Box 2). (DeMers, 2009; Shreshta, Bajracharya, & Pradhan, 2001)

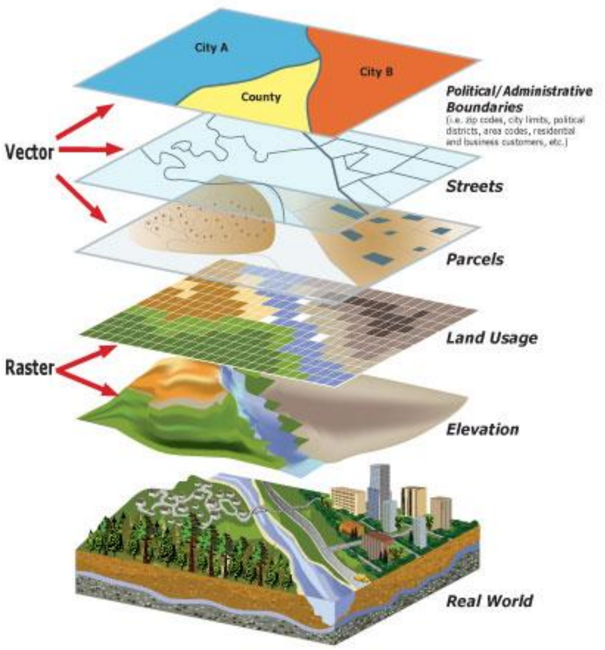


Figure 2: Example of data layers used in GIS (National Weather Service NOAA.gov)

Box 1: Advantages of GIS

- GIS make it possible to **view, understand, question, interpret and visualise data** in many ways, highlighting relationships, patterns, and trends in the form of maps, reports, and statistics.
- GIS help to **plan, evaluate, monitor and make decisions** by looking at data in a way that is quickly understood and easily shared.
- GIS allow efficient management of complex data.

Box 2: Limitations of GIS

- The application is a very time-consuming process.
- Existence, accessibility and quality of data
- Cost of hardware and software
- Requires skilled personnel

Data acquisition

Data used in GIS come in many forms, from many sources, with many scales and levels of accuracy and in different projections. Data can be **already published/available** or **collected/developed by yourself**. They are available in **digital** or **hardcopy** formats (paper, map). The input sources can be:

- Maps,
- GPS – Global Positioning System,
- Satellite imagery (e.g. land use, climate) from remote sensors,
- Aerial photos (e.g. land use) from remote sensors,
- Field data collection (e.g. utility sign inventory, property surveys, land use inventories),
- Tabular data,
- Document scanning (e.g. site photographs) (see Box 5 for some free data sources) (Shreshta, Bajracharya, & Pradhan, 2001).

Remote sensing

Data used in GIS is often delivered through remote sensing. Remote sensing refers to the activities of **recording, observing, perceiving (sensing) objects or events in distant (remote) places** using sensors on airplanes or satellites to produce aerial photography and satellite imagery.

Satellite images are collected as explained in Figure 3. A remote sensor (sensor or camera) – carried on a platform (e.g. airplane or satellite) – detects the **reflected or emitted energy** from an object. Each object has unique reflection or emission characteristics depending on the properties of the object (material and its physical and chemical state, surface roughness as well as the geometric circumstances). These differences make it possible to identify different features and materials on the Earth's surfaces by analysing the radiation they reflect or emit. For example, vegetation reflects energy in a different way than soil. (Canada Centre for Remote Sensing, 2015)

There are several remote-sensing satellite series in operation. It should be considered that images differ in resolution. For example, some take images daily with a spatial resolution of 1km, others every 16 days or once a year but with a spatial resolution of 10m. Among others, the resolution of the images is often a limiting factor in remote sensing (see Box 4).

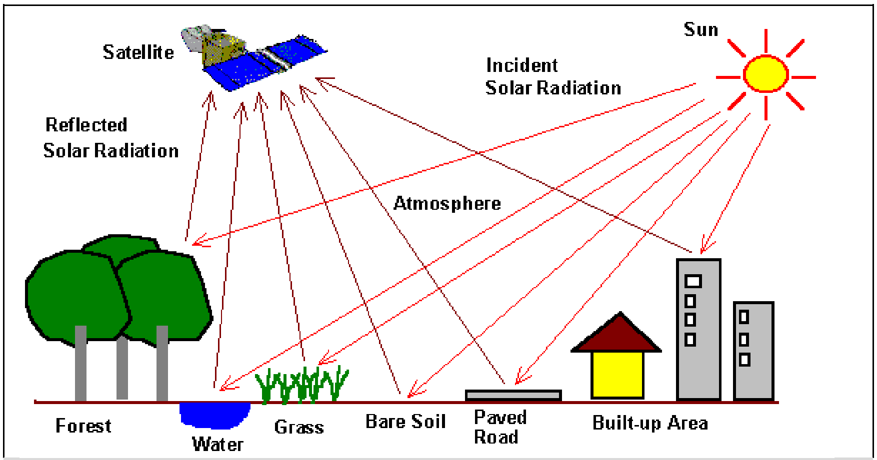


Figure 3: Remote Sensing (CRISP)

Box 5: Where to get the data?

GIS data come for many uses and at a huge variety of prices. Free datas can be get for different topics, for example:

Elevation:

- GDEM: 30m resolution global elevation data derived from ASTER satellite images.

Land Cover:

- MODIS Global Land Cover: 1km and 4km resolution global land cover maps derived from MODIS satellite images.

Hydrology:

- HydroSHEDS: Hydrological data and maps based on the STRM elevation data. Includes river networks, watershed boundaries, drainage directions and flow accumulations for the globe.

Afghanistan:

- Humanitarian Data Exchange: Wide range of datasets including settlements, roads, water, administrative boundaries and logistics layers.

Find more free data:
http://freegisdata.rtwilson.com/

Box 4: Limitations of remote sensing

- The resolution of satellite imagery is often too coarse for detailed mapping and for distinguishing small, contrasting areas.
- Data interpretation can be difficult.
- Phenomena not intended for measurement can interfere with the image (e.g. atmospheric water vapour, sun vs. shadow) and must be accounted for.

Data management

After data are collected and integrated, a GIS provides the facilities to contain and maintain data. As data is the most valuable part of a GIS, the data must be well organised and kept safe. Effective data management also includes security, integrity, storage and retrieval, and maintenance. (Shreshta, Bajracharya, & Pradhan, 2001)

Data analysis

Spatial analysis in GIS is a process for looking at geographic information in data and relationships between data. It allows the visualisation of real-world processes. It provides information about the current situation of a specific area, or the changes and trends in a situation (e.g. changes in vegetation cover or precipitation; see Figure 6). Spatial analysis functions range from very simple requests for information to complicated predictive modelling. (Shreshta, Bajracharya, & Pradhan, 2001)

Rainfall 2012

7	4	5	3
1	1	1	1
1	1	1	2
1	1	1	2

\-

Rainfall 2013

5	1	2	2
1	1	1	1
1	1	1	2
1	2	2	2

=

Change

2	3	3	1
0	0	0	0
0	0	0	0
0	-1	-1	0

Figure 6: Calculation of the change of precipitation at a specific location between two years by overlaying two geographic layers (Rainfall 2012/Rainfall 2013) (adopted from Shreshta, Bajracharya, & Pradhan, 2001)

Data presentation

Processed data from GIS can be visualised and presented in a variety of ways. Traditional methods of tabulating and graphing data can be supplemented by maps and three-dimensional images. These maps and images enable users to perceive the structure of the phenomenon or the area represented (e.g. land-use change, see Figure 7). Depending upon its scale and purpose they contain a different level of detail. Symbols and colours help to illustrate different map contents. (Shreshta, Bajracharya, & Pradhan, 2001)

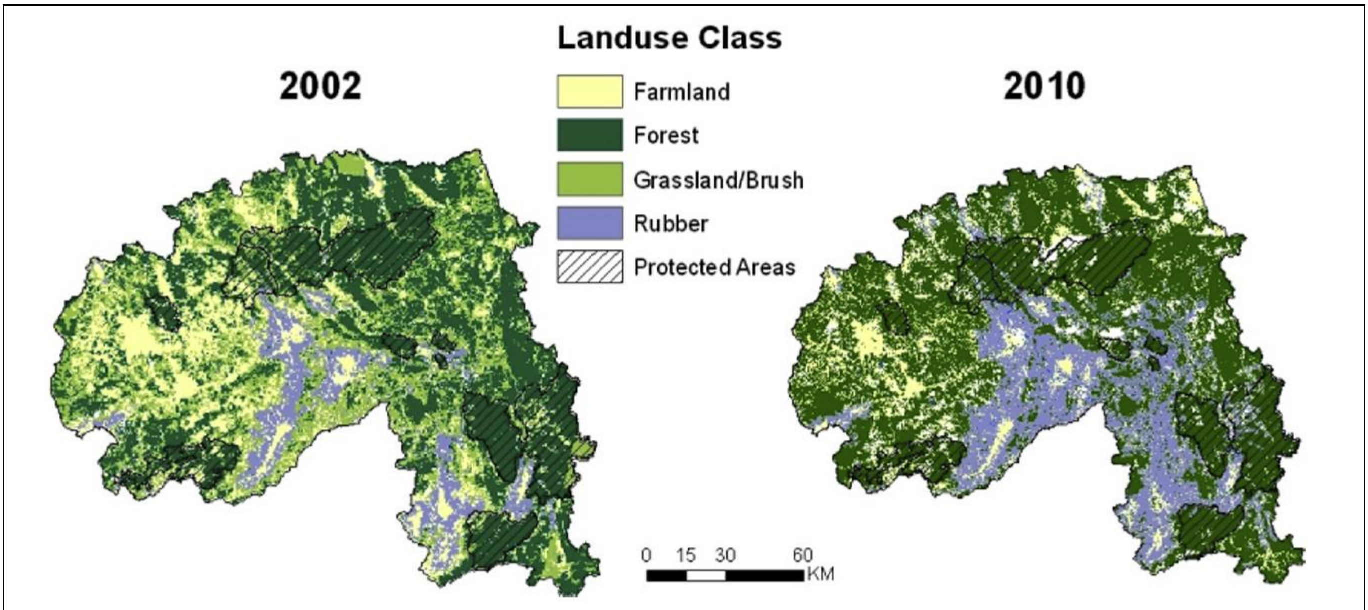


Figure 7: Land use in 2002 and 2010, showing expansion of forest and rubber plantations and a loss of grassland and farmland. (Zomer et al. 2014)

Implementing a GIS

A GIS manages, analyses and displays spatial information. It not only makes it possible to complete everyday tasks more efficiently, but also aids planning, evaluating, monitoring and making decisions.

Implementing a GIS is not an easy task. It begins with gaining an understanding of the basic concepts of the technologies and doing a careful evaluation of the needs and problems. A GIS needs:

- **Hardware**, i.e. computer on which a GIS operates
- **Software** provides the necessary functions and tools. The key software components are:
  - Tools for the input and manipulation of geographic information;
  - Database management system;
  - Tools that support geographic queries, analysis and visualisation;
  - Geographical user interface for easy access to tools.

  (See Box 6, which lists some GIS software.)
- **Data**, e.g. satellite imagery, field data, etc.
- **People** managing the system and developing plans that can be applied to real-world problems. A varied background of expertise is required (see Box 7, which lists some helpful tutorials).
- **Methods and procedures**, i.e. well-designed plans and business rules.

  Policies, as well as institutional frameworks, i.e. the interest and willingness of decision-makers to use GIS technology and functioning organisational set-ups to collect spatial data, analyse it and use the results for planning and implementation. (Shreshta, Bajracharya, & Pradhan, 2001)

Box 6: GIS software

There are many different kinds of GIS software available. Some are commercial and expensive, others are open source and free of charge.

ArcGIS:
GIS software product of the Environmental Systems Research Institute (ESRI), which boasts the largest market share for GIS.
www.esri.com

Open source software:
- GRASS GIS
  https://grass.osgeo.org/
- QGIS
  http://www.qgis.org
- SAGA GIS
  http://www.saga-gis.org
- etc.

Box 7: GIS tutorials

There are many different ways to learn about GIS. Many online tutorials and educational materials provide step-by-step instructions and are a very helpful resource.

- ArcGIS tutorials:
  https://learn.arcgis.com/en/
- QGIS tutorial:
  http://www.qgistutorials.com
- etc.

Further reading and references

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