CATALOGUE OF GOOD PRACTICES FOR CLIMATE RISKS ADAPTATION IN BURKINA FASO

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ACRONYMS AND ABBREVIATIONS

CoP	:	Conference of Parties to the United Nations Framework Convention on Climate Change
DANIDA	:	Danish International Development Agency
IPCC	:	Intergovernmental Panel on Climate Change
IUCN	:	International Union for Conservation of Nature
NAPA	:	National Adaptation Program of Action
SIDA	:	Swedish International Development Cooperation Agency
SP/CONEDD	:	Permanent Secretariat of the National Council for the Environment and Sustainable Development

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PREFACE

As most of other African countries, Burkina Faso is affected by climate changes through an increase in temperatures, intensified floods and droughts, seasonal variations, etc. These extreme weather conditions confirm the reality of climate change and its impacts on all development sectors. Thus, it is urgent that the adaptive capacities of populations and natural systems are increased, to address climate change.

The strengthening of those adaptive capacities must however be based on a sound knowledge of the populations' experiences of climate change and the strategies they developed. To strengthen those adaptive capacities, one must incorporate indigenous knowledge on climate change and the strategies the populations developed into climate change policies. Good adaptation strategies must be based on a deep understanding of climate scenarios, vulnerability of populations and natural systems, appropriate technologies and practices, in order to reduce that vulnerability.

With that in mind, The International Union for Conservation of Nature Programme in Burkina Faso (IUCN-Burkina) with its financial partners (DANIDA and SIDA), supports for capacity building initiatives for civil society and local communities, to build /disseminate good endogenous practices for climate change adaptation.

This catalogue contains a wide range of local/endogenous practices which may contribute to mitigating the effects of climate variability and change. . It results from a participatory process initiated in 2009. A group of consultants made a roughly comprehensive inventory of potential practices in the thirteen (13) regions of Burkina Faso. This best practices report was evaluated by a technical team in relation to their impact on the potential effects (climatic scenarios) of the various climatic parameters. The technical committee's proposals were validated by the participants to the national forum of civil society on Climate Change held in Ouagadougou (Burkina Faso) from November 19-20, 2009. The validated document was presented during aside event organized by the delegation of Burkina Faso at the fifteenth Conference of Parties to the United Nations Framework Convention on Climate Change (CoP15) (Denmark) in December 2009.

The practices listed in this catalogue are selected on the basis of their potential capacity to mitigate the foreseeable negative effects of climate change, particularly recurrent droughts, floods, strong winds/sand storms and high temperatures. Most of these practices have been improved thanks to the concerted action research efforts of governmental agencies, international organizations and civil society.They remain however, perfectible considering the increasing severity and frequent occurrence of the negative effects of climate variability and change. Hence, they must be implemented as much as possible in order to optimize their positive impacts on the well-being of populations and ecosystems health. We hope that this document will lead to a use of good practices for climate change adaptation at the national level and in the sub-region.

The IUCN Regional Director for Central and West Africa

INTRODUCTION

The Intergovernmental Panel on Climate Change (IPCC) reported that climate change, because of its known or expected impacts, is a big challenge for the economic and social development of the poor and vulnerable regions of the world. In the short term, the expected adverse impacts of climate change would result from the increased frequency and intensity of extreme conditions such as droughts, floods, heat waves. In the long term, the expected impacts of climate change would stem from the modification of ecosystem structure and functioning ecosystems caused by climate change (IPCC, 2007). Hence the need for societies to take steps that allow them to adapt, i.e. to adjust the ecological, social, and economic systems to the climate risks observed or anticipated and to their effects and impacts. It is therefore necessary to change procedures, practices and structures in order to limit or eliminate potential damages or to seize opportunities created by climate change.

In Burkina Faso, climate specialists are predicting a rise in average temperatures of 0.8°C by 2025 and 1.7°C by 2050, a decline in rainfall of -3.4 % in 2025 and -7.3 % in 2050. The consequences of these climate changes include (i) significant reduction in water availability, (ii) decline in the biomass potential, (iii) drastic reduction and degradation of pastureland. Aware of climate issues and risks, the country has developed with the assistance of its technical and financial partners a National Adaptation Program of Action (NAPA) on climate variability and change in 2007. Due to the severity and recurrence of climate change negative effects, according to the projections of climate specialists, the successful implementation of the NAPA calls for a multi-stakeholder partnership, but above all a sound knowledge of farmer practices and strategies that could contribute to capacity-building for adaptation to climate change. This knowledge is essential in order to forge links between national strategies to and those at the local level, and mainly to promote adaptation options throughout the national territory.

The International Union for Conservation of Nature Programme in Burkina Faso is involved in the implementation of the NAPA through a climate change programme and helps improve knowledge of adaptation options and practices and build stakeholders' capacities. Two initiatives are being implemented on the one hand to build civil society capacities and on the other hand to increase local communities' adaptive capacities to climate change. Therefore it seems important to identify, document/disseminate and promote good endogenous practices for climate variability and change.

A good practice is defined in these terms: *«an individual or collective practice whose implementation in a given context gives better technical and economical performance of development sectors (agriculture, livestock, forestry, energy, etc.) and/or the social sector (socioeconomic organizations, communities or community groups, etc.) in the context of climate risk»*.

Several technologies are currently used in rural areas of Burkina Faso, some of which may be listed as good practices for climate change adaptation. That They involve several development sectors including agriculture, livestock, forestry and agroforestry, and energy. Fifty-four practices have been described and grouped into seven areas: soil development and management, forestry and agroforestry, water resources management, inputs management and cultivation techniques, pastoral water management, pastoral resources management and livestock systems, energy management. Some practices are implemented in an integrated manner either in the same area or between different areas.
This catalogue lists the best «technological» practices that contribute to strengthen local communities adaptive capacities to climate variability and change.

1. Adaptation practices for soil development and management

1.1. Contour stone bunds

These are mechanical structures constructed with rubble stones (large stones) along the contours of the land affected.

The bunds are used as an adaptation technique to rainfall variability by reducing water erosion and by enhancing infiltration, thus reducing crop water stress during the drought where they are particularly effective in areas with high risk of water erosion.

The construction of bunds demands knowledge of contour lines, technical expertise for the use of water level availability of rubbles, small equipment and hence d'oeuvre labour force for materials collection.

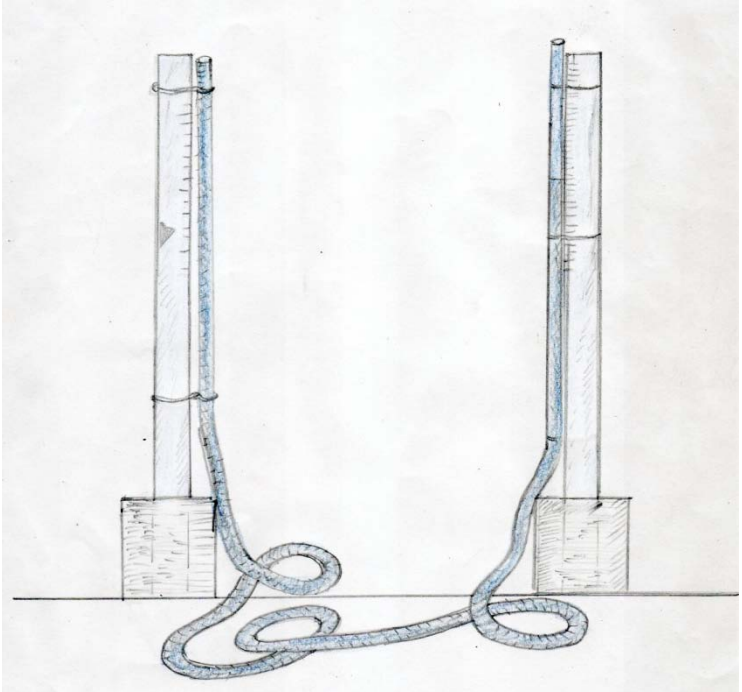


Figure 1: Water level used for surveying contour lines

Photo 1 : Stone Bunds

The contribution of bunds to climate change impact mitigation, particularly to rainfall deficit can be improved by revegetation of bunds, soil scarification, combination with zai and application of organic matter (manure, mulching, and compost). Bunds should also be regularly maintained to ensure their effectiveness.

1.2. The permeable rock dams

It's a mechanical structure made of loose stones or gabions, across a valley floor

This structure rehabilitates the gullies degraded by gully erosion and groundwater recharge.

In terms of contribution to mitigating climate change impacts, this technology improves water infiltration and thus contributes to rainfall variability adaptation

Photo 2 : Permeable rock dam downstream a field

Photo 3 : Permeable rock dam in a gully

Its construction requires knowledge of contour lines and hence technical skills in water level.

Rubble stones, small equipment (cart, wheelbarrow, pick, etc.) and significant labour force are also needed.

1.3. Grass strips

Grass strips are biological barriers consisting of herbaceous plants (*Andropogon gayanus, Andropogon ascinodis, Cymbopogon ascinodis, Vetiveria zizanioide*), planted in the fields along contour lines. These strips can be planted in isolation or in combination with anti-erosion structures upstream of these strips. They help reduce the effects of drought by promoting water infiltration.
its contribution can be improved by associating it with stone bunds, soil scarification and zai.

Photo 4 : Grass strips consisting of *Andropogon sp* in the rainy season

Photo 5 : Grass strips consisting of *Andropogon sp* in the dry season

They also reducesoil erosion and increase fodder and domestic straw availability

Its implementation requires knowledge of contour lines and hence technical skills in water level andlayers of herbaceous plants.

1.4. Zai

In the Moore language (Burkina Faso), Zai means “getting up early and hurrying out to prepare the soil”. It consists of digging pits 24 cm in diameter and 10-15 cm deep, organic manure is placed at the bottom. The pits are usually 40 cm apart and arranged alternatively. There are several types such as traditional Zai, mechanized Zai (through crossed sub soiling) and forest Zai.

Zai contributes to climate change adaptation as it reduces drought effects by improving water infiltration. It also leads to land rehabilitation and to optimal use of inputs; thus crop yields are increased and food security is achieved.

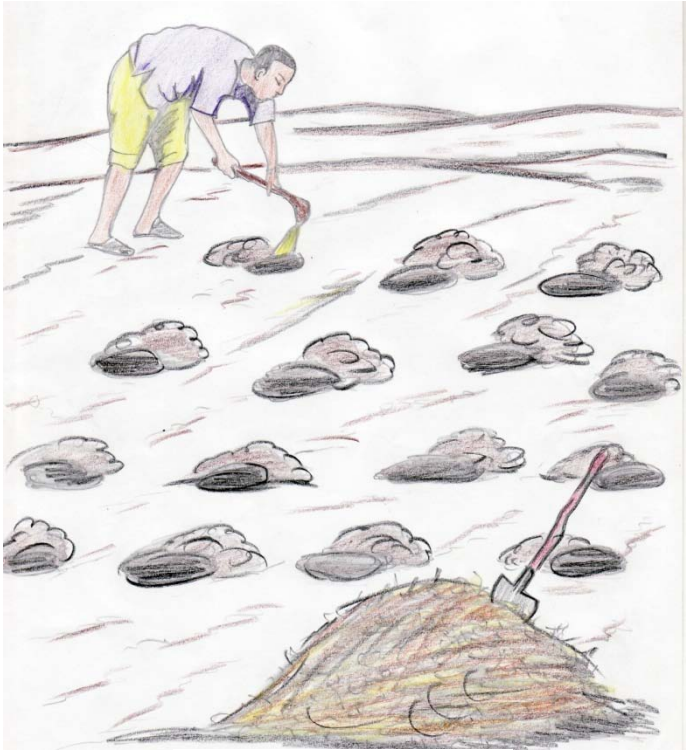


Figure 2: zai holes

Its implementation requires knowledge of water flow direction, organic matters and small equipment (pick, hoe, etc.)

The contribution of zai to drought adaptation can be improved by associating it with stone bunds, site revegetation and mulching.

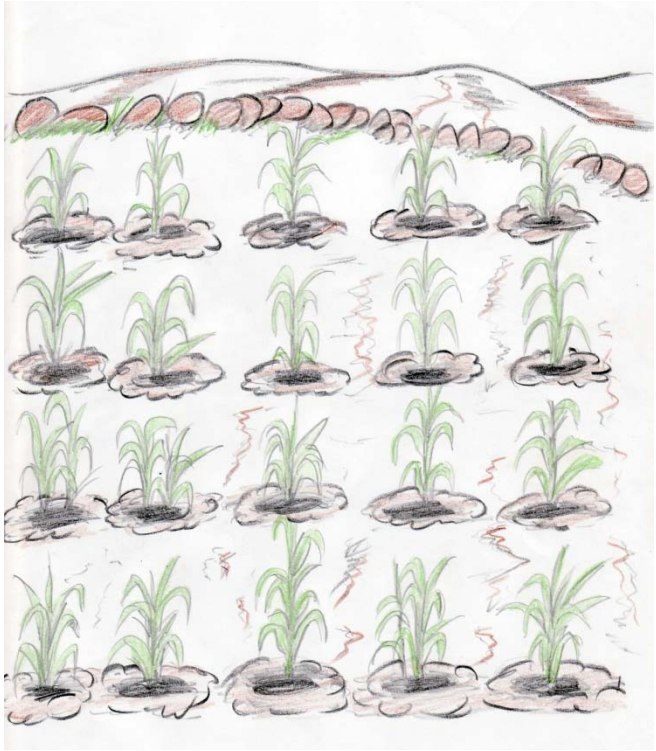


Figure 3: Millet sown in zai holes

1.5. Half-moons

These holes have a radius of 2 m, and are 15-20 cm deep. The spacing is of 8 m between two half-moons. The holes constructed by hand and laid out along the contours.

This technique contributes to climate change adaptation through improved water infiltration and thus reduced effects of rainfall variability.

Photo 6 : Half-moons

Figure 4: Millet sown in half-moons

It also contributes to land rehabilitation, soil stabilization and reduction of water erosion.

Its construction requires skills in contour lines, knowledge of land levelling and small equipment (hoe, pick, etc.) and important labour force.

The contribution of half-moons to climate change adaptation can be improved by combining it with revegetation of the site using herbaceous plants (*Cajanus cajan*, *Andropogon sp*, *cymbopogon sp*.), organic manure and mulching.

1.6. Mulching

Mulching consists in covering the soil with a 2 cm layer of grass (usually *Loudetia togoensis*) equivalent to 3-6 t/ha or branches or even crop residue (stalks of millet or sorghum) to ensure coverage of soil against wind erosion and to stimulate the activity of termites.

This practice helps improve soil moisture retention, water infiltration and thus reduces the effects of drought as a climate hazard. It also helps reduce water erosion and rehabilitate degraded lands.

It requires a lot of plant materials (woody and herbaceous) and is labour-intensive.

Its contribution to rainfall variability adaptation can be improved by combining it with stone bunds, grass strips and by planting woody plants.

Photo 7: Mulching with crop residues

1.7. Sand dunes stabilization

Stabilization of sand dunes is a technique that helps reclaim lands by using hedgerows (*Leptadenia pyrotechnica, Euphorbia balsamifera*) or millet stalks. These hedgerows are oriented in opposite directions to the movement of sand dunes.

It contributes to climate change adaptation through reducing the effects of high rainfall and/or high winds that cause the sand to be transported from the dunes. It also helps stabilize the dunes, rehabilitate lands subject to silting for agropastoral production and regeneration of dunes

Dune stabilization requires technical expertise in hedgerows construction, materials (plants or millet stalks) and small equipment (machete, pick, cart, wheelbarrow, etc.) and is labour-intensive.

Revegetation of hedgerows can be enhanced by planting woody species such as *Prosopis juliflora, Parkinsonia aculeata or Acacia nilotica*.

Photo 9: Dune stabilization with *Euphorbia basalmifera*

1.8. Improved fallow

To improve a fallow, farmers a crop land to rest for a period of time and enrich it with fast growing trees and nitrogen-fixing plants.

This technique helps increase carbon sequestration capacity and reduces soil crusting due to heavy rains, control water erosion through good soil coverage, etc.

Photo 10: Improved fallow

It improves soil fertility and reconstitution of the natural vegetation.

This practice requires sufficient crop lands, knowledge of fallow improvement technique, nitrogen-fixing plants (*Prosopis africana africana Entada, Leuceana leucocephala, Albizia lebbeck, Cajanus cajan, Acacia polyacantha*).

It can be improved through planting or assisted natural regeneration, efforts in fighting against bushfires like building firewalls and anti-erosion structures.

1.9. Exclosure

Exclosure is a practice in which territory or a land plot is protected to keep out men and/or domestic animals (grazing, bushfire, wood harvesting, etc.). This territory or plot can be a fallow.

It contributes to climate change adaptation through reducing the effects of heavy rains (erosion, crusting, etc.), while improving the soil water balance in case of droughts. It contributes also to climate change mitigation through its carbon storage capacity. It helps rehabilitate and protect soils, reduce runoff and erosion, restore natural vegetation.

It requires selecting the land, identifying the species to be regenerated and its expected benefits, knowledge of planting techniques and tree maintenance, small equipment and adoption of simple management rules.

This practice can be improved by associating it with stone bunds, soil scarification, half-moons and complementary reforestation.

Photo 110: Exclosure of a village forest

1.10. Lowlands development

Lowland development is an improved management practice of floodplains for farming (rainfed and off-season)

It contributes to rainfall variability adaptation through the water resources optimizations in lowlands. It helps reduce land degradation, increase land availability and its productivity and fight against water erosion.

It construction requires developable lowlands as well as technical exploitation skills.

Photo 11: Developed lowland

Photo 12: Rice grown in developed lowland

Its contribution to climate change adaptation can be improved through anti-erosion structures upstream the lowland combined with revegetation of the banks with shrubby or herbaceous species (*Euphorbia balsamifera, Jatropha curcas, Vetivera nigricans*, etc.).

2. Adaptation practices in forestry and agroforestry

2.1. Intentional clearing

controled clearing means sparing trees and/or natural strips of vegetation during land clearingfor establishing an agricultural land plot. The technique involves identifying and marking the protected species and those of interest to the producer. Unmarked trees are cut at ground level to a maximum height of 15 cm above the ground. The number of young plants to be spared is 20 to 25 feet per hectare and between 60 to 80 sprouts or shoots.

Photo 13 Controlled clearance

This practice contributes to climate change mitigation through the protection of crops against high winds and soil against water erosion and hot sunshine. It contributes both to carbon sequestration and carbon storage of the soil. Spared species are in addition a seed reserve and a source of income diversification and or food. It requires knowledge of agroforestry techniques (pruning, cutting, etc.).. It can be improved by creating firewalls around the agricultural plot, erosion control structures and practicing assisted natural regeneration on shoots.

2.2. Assisted natural regeneration (ANR)

Assisted natural regeneration consists in causing or stimulating natural regeneration of multi-purpose woody species.

It contributes to carbon sequestration capacity and thereby climate change mitigation. It contributes to sustainable management of natural resources, protection of soils against erosion and effects of heavy rains and high winds. It also increases agricultural production.

It requires expertise in assisted natural regeneration techniques, protection of seedlings against bushfires and straying animals, and maintenance of young plants through loosening, trimming, pruning and staking.

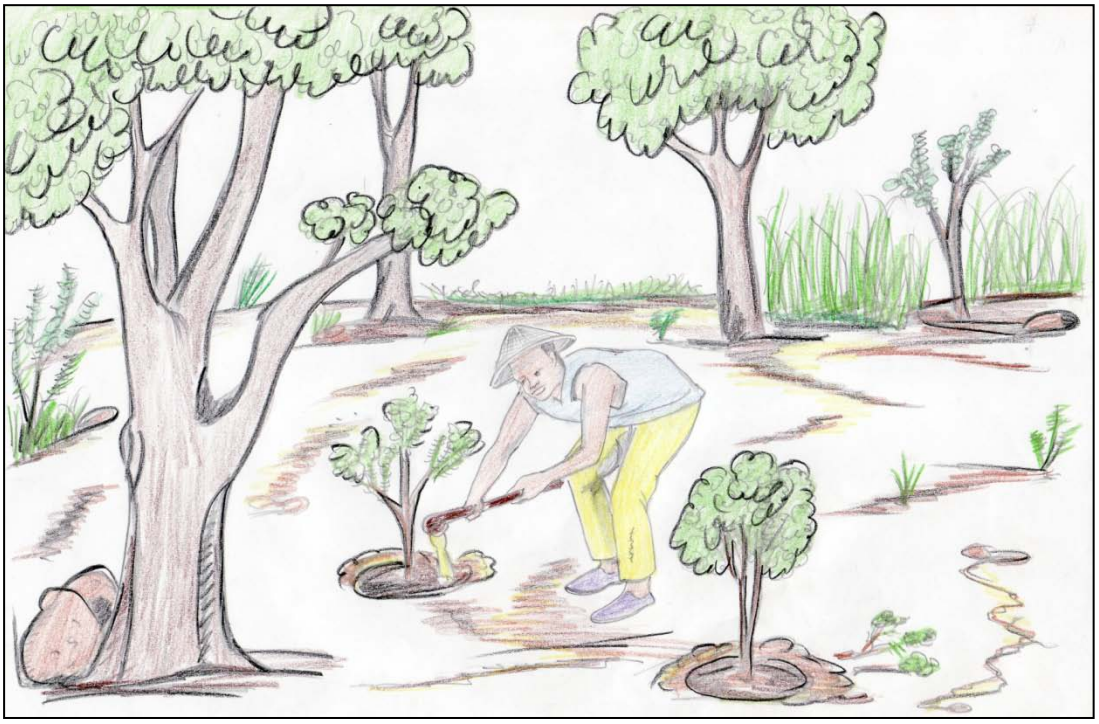


Figure 5: Assisted natural regeneration

2.3. Reforestation/afforestation

This practice consists in planting trees on areas considered to be degraded. Planting to restore a degraded forest is called reforestation. When practised in a virgin area, it is afforestation.

The contribution of this practice to the fight against climate change is both in terms of adaptation and mitigation.

Photo 13 : Production of seedlings

Photo 14 : Tree planting

In terms of climate change mitigation, it contributes to increase vegetation cover which improves carbon storage capacity of the area. Its contribution to adaptation is in terms of soil protection against wind and water erosion, improvement of water infiltration and groundwater recharge. It can protect the banks against the effects of flooding and serves as a refuge for animals during bad weather conditions.

Its requires production of young plants and their planting on selected sites following a good selection of species based on the needs and proper planting techniques.

This practice can be improved through soil scarification, combination with half-moons, forest zai and creation of firewalls around the area.

2.4.Windbreaks

This practice consists in installing linear structures, often alive (quickset hedge), but also dead (dead hedge). These structures consist generally of woody species and sometimes herbaceous species. A windbreak consists of two (2) parts: a windward side (exposed to prevailing winds) and a leeward side.

It helps reduce the effects of high winds on cultivated, grazed, or inhabited areas or water bodies. It also fights against wind and water erosion. It produces wood, fruits and medicines.
It requires skills in windbreak installation techniques, availability of suitable plants, significant labour force and availability of water for maintaining seedlings.

It can be improved by combining different tree species and heights.

Figure 6: Windbreak installed with two rows of woody plants

2.5. Firewalls

It is a practice that consists in putting into place a mechanism to prevent the spread of bushfires and extinguish them when they appear to preserve an area we want to protect. It is associated with other reforestation and forest management practices.

In this case, the practice helps maintain and even increase carbon storage capacity. It is thus a practice that helps reduce greenhouse gas emissions.

It also helps protect crops and houses.

Photo 16 : Opening of a fire-wall

Photo 17: Cleaning a fire-wall by setting fire

It requires small equipment (machete, rake, water can, boots, etc.), means of transportation (cart and bicycle), technical skills for opening the firewalls, and is labour-intensive

This practice can be improved through application of early fires, sensitizations and training in fire management techniques, establishment of fire fighting committees, community involvement.

2.6. Banks stabilization

Banks stabilization consists in establishing tree plantations or structures to protect watercourses against congestion and/or silting.

It helps reduce rainfall effects, especially heavy rains that may result in the transport of solid material to silt up watercourses. It therefore slows down water erosion of riverbanks and contributes to the conservation of water resources and associated fauna necessary for the well-being of populations

It also provides shelter for animals and a safety area for people in case of flooding.

Photo 18: Stabilization of the banks of a watercourse by planting multipurpose trees (fixative, fruit and fuel wood producing)

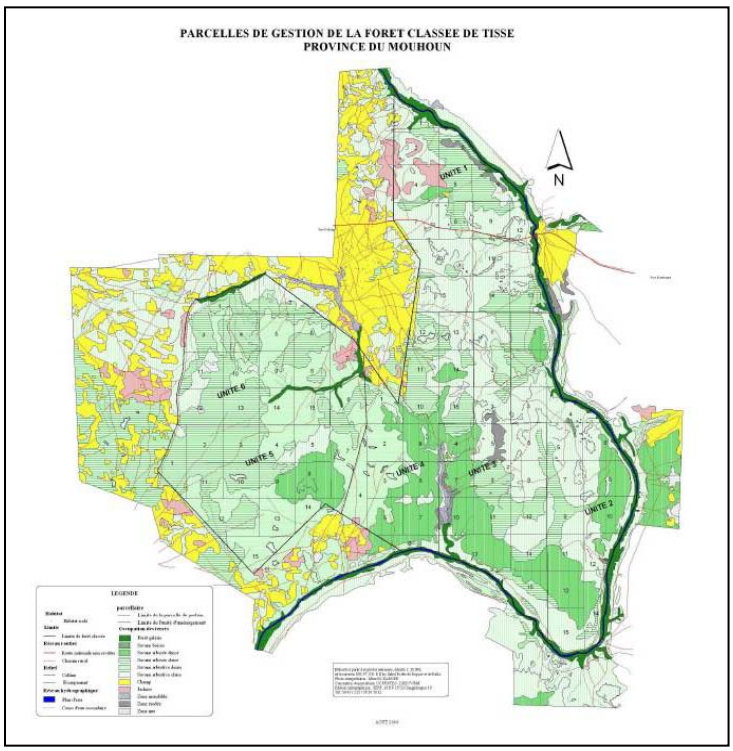
It requires skilled labour, appropriate plant species *(Nauclea latifolia, Raphianus soudaneica, Mitragyna inermis, Ziziphus mauritiana, Acacia seyal, Bauhinia rufescens, Andropogon gayanus, Parkinsonia aculeata, Prosopis juliflora, Bambusa chinensis)*, and/or rubbles, wire fence for the structures.

The combination of tree plantations and structures helps improve the contribution of bank stabilization to reducing the harmful effects of heavy rains.

2.7. Development and management of natural forests

The practice of natural (classified or protected) forest management is a set of development strategies and actions (included in a development and management plan) to meet the populations needs for forest wood products (fuel wood, timber and lumber) and non-timber products (fruits, flower leaves, bark, roots, etc.) It requires assistance from a forester manager.

It helps maintain carbon sequestration capacity by limiting deforestation and promoting actions to offset the exploitation of forest resources. It therefore plays a significant role in increasing resilience capacity of forests during potential droughts or floods while reducing the economic vulnerability of populations.



carte 1: managed forest card

Forest development is carried out on a site with developable forest resources. It requires technical skills in forest management and participatory management as well as stakeholder involvement.

This practice can be improved if populations are sensitized and by combining it with restoration of degraded areas through planting, assisted natural regeneration, direct seeding and construction of erosion control structures in sensitive areas.

2.8. Arboretums and botanical conservatories

Creating an arboretum requires reserving a space in which forest or enclosure species characterizing a given environment or region are planted for environmental education purposes. Creating a botanical conservatory entails creating a scientific public or semi-public body.

Photo 15 : Arboretum consisting of local species

Both practices are intended to contribute to the protection of wild plant heritage and possibly domesticated and cultivated. Their roles in reducing climate change effects lie in their ability to absorb greenhouse gas emissions through increased vegetative cover in the area. They also contribute to adapt of heavy rains and strong winds in riparian areas. They contribute to the preservation of endangered species, preservation in situ of biological diversity and ecosystems.

They require identification of the site and species to be planted and/or protected, legal formalization of the site, knowledge of development of such spaces and a system for operating and maintaining the site.

3. Adaptation practices for water management

3.1. Micro-irrigation holes or "Koglogo"

Micro-irrigation holes refer to the practice of using earthenware jars to make depressions in order to localize irrigation under market gardening. This is a water saving technique. It therefore helps manage small water quantities of water reservoirs or groundwater, due to rainfall reduction. It helps improve agricultural productivity.

Photo 16: **Tomato hole "koglogo"**

Photo 17: Harvest in tomato holes

It requires jars, appropriate market gardening production techniques (transplanting into the hole), and knowledge of installation of holes using jars. This practice can be improved by combining it with integrated nutrient management, use of improved seeds and mulching.

3.2. Piping systems

The practice of piping systems refers to the installation of water pipes which help reduce water loss during its distribution from the source to the crops.

As a water resource management practice, it contributes to reducing the effects of infrequent rainfall. It also contributes to improving food security. The implementation of a piping system depends on the selected system (hosepipes, movable pipes, bubbler, Californian system, drip system).

Photo 18 : Bubbler for a mango-tree

Photo 23 : Installation of a piping system

It demands technical expertise for the installation of the selected system and the choice of type of crop to be produced.

This practice can be improved by combining it with integrated nutrient management, compost production and use of improved seeds.

3.3. Surface water ponding: dams and boulis

The practice of water impoundments involves constructing hydraulic structures for better management of surface water. It refers to the construction of large structures (dam) and small structures (boulis).

It contributes to adapting to climate change in that it reduces the effects of rainfall variability on water availability especially in the dry season.

Photo 19 : Water body of a dam

Photo 20: Water body of a bouli

It also participates in increased availability of water for agricultural (market gardening and arboriculture) and fish production. Thus, these structures contribute to mitigating the water deficit created by repeated droughts, to reducing the vulnerability of breeding and better pastureland use/management.

The implementation of a reservoir demands technical skills, building materials, significant labour force, heavy equipment and maintenance against invasive plants and silting.

Its contribution to adapting to climate change can be improved by involving the population, bank protection, development of a management and development plan, the use of conservation techniques in water use activities, etc.

3.4. Rainwater collection or impluviums

The practice of collecting and storing rainwater or, others terms, impluviums, involves developing a system for collecting and storing rainwater. Two types of impluviums are used in Burkina Faso: the lateritic rubble stone impluvium and the ferrocement impluvium.

It contributes to the management of infrequent rainfall by improving the availability and access to drinking water. The collected water should be managed in a precautionary manner during the lean season.

Photo 21: Ferrocement impluvium

Photo 22: Ferrocement impluvium system for water storage

Its implementation demands technical skills for the installation, knowledge of the origins of water and significant financial resources.

The efficiency of the system can be improved by diversifying water collection points. The quality of the collected water can be improved by installing a water filtering mechanism before entry into the tank.

3.5. Underground water pumping techniques: wells and boreholes

These are hydraulic structures using a set of techniques for pumping groundwater. Depending on the depth of the water table there are pipe shafts (shallow water table, mainly in lowlands), large diameter wells (water table) and boreholes (groundwater). Boreholes may be associated with a solar-powered or manual human-operated system.

These structures help reduce the effects of rainfall variability through the mobilization of the available water in water tables and increase the availability of drinking water, water for irrigation or livestock watering and for wildlife.

The implementation of pipe shafts demands PVC discharge or pressure pipes of 100 to 160 mm and technical skills. The implementation of wells requires digging equipment, ducts and masonry, tandis while that of boreholes is more complex and requires heavy equipment

Photo 23: Borehole

for drilling or pumping (solar or manual pump) depending on financial capacity.

These structures may be associated with piping systems to optimize the use of water in irrigation cases.

Photo 29 : Large-diameter well

Photo 30: Pipe shaft

3.6. Fish holes

The practice fish holes involve creating depressions (holes) in a floodplain of a river or a pond to isolate fish during periods of recession. Traditionally practiced by the Bozo fishermen, it has been improved and widely popularized in Burkina Faso by the Japanese cooperation.

It helps ensure fish production under conditions of low availability of water thus reducing the effects of drought on fishery resources.

Photo 31: Fish hole

Its implementation demands technical and organizational capacities of actors, the identification of a pond or river, digging a pool, the derivation of the pond to the pool, the application of fertilizers in the pool, monitoring the site, etc.

3.7. Overdeepening of natural ponds

This practice involves digging a natural pond (natural body of water less than 3 m deep) to increase its depth of water storage for the dry season.

The overdeepening of ponds helps increase the adaptability of wetland ecosystems, people and animals to rainfall variability in the Sahel.

Photo 32: Dried pond

Figure 7: Overdeepening of a pond by the population

The overdeepening must be associated with the development of the bank to protect the water point against silting. This protection consists of stone bunds associated with subsoiling and reafforestation. Gully treatments are carried out where erosion is present. When the soil of the pond to be overdeepened is permeable, 20 to 30 cm of clay is spread on the bottom and sometimes on the edges of ponds to make them watertight.

3.8. Protection of water points against silting

The practice of the protection of water points against silting involves a set of (mechanical, farming and agroforestry) techniques along the banks designed to help slow down water velocity in order to decrease or stop the silting of the watercourse.
This practice helps reduce the silting of watercourses and increase water availability.

Figure 8: Protecting the banks of a watercourse by planting woody plants

It demands for its implementation major mechanical, farming and biological work along the banks. This is the installation of stone bunds, permeable rock dams, the practice of subsoiling and revegetation of mechanical infrastructure.

4. Adaptation practices relating to inputs and cultivation techniques

4.1. Improved seeds

The use of improved seeds involves adapting the cycle of seeds to the conditions of ecological zones. In Burkina Faso, crops that are most concerned are maize, sorghum, millet, sesame, cassava, cotton, etc.

This practice helps adapt to the continued reduction in the number of rain days and the quantity of water.

Its implementation involves varietal research on-station and in the natural environment before obtaining the seed variety.

Photo 33: Improved sorghum

Photo 34: Improved millet

Then, the dissemination of these seeds requires training of producers, financial resources to ensure the multiplication of certified seeds, support for agricultural extension and observation by the producers of crop management experienced by scientific research.

4.2. Flat ploughing and contour ploughing

The practice of flat ploughing and contour ploughing involves breaking the soil crust to improve its structure, water infiltration and reduce erosion by reducing water flow velocity.

It therefore helps manage the amount of water on the plot and thus adapt to the rainfall parameter of climate change.

Photo 35: Flat ploughing

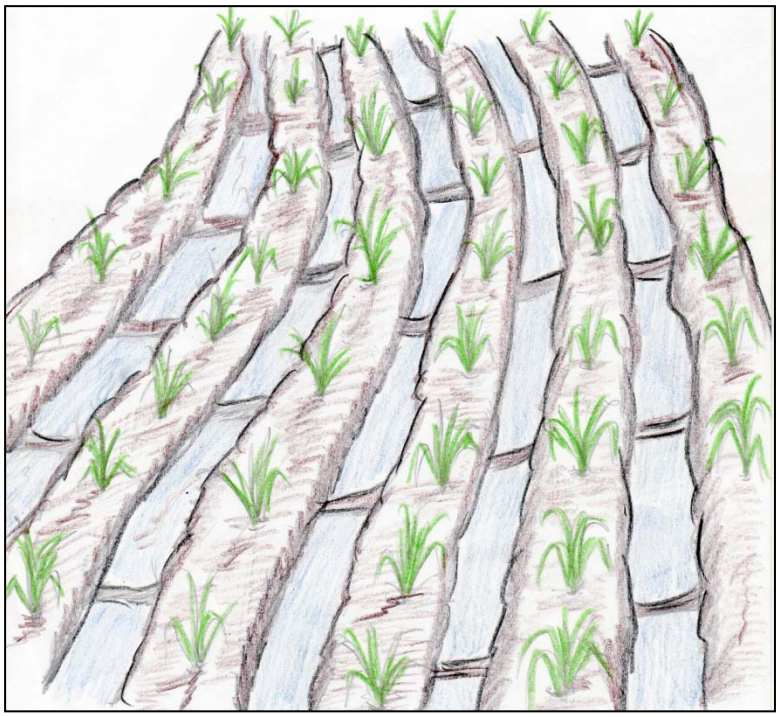


Figure 9: contour ploughing

Its implementation demands availability of suitable agricultural equipment.

Its contribution to adapting to climate change effects can be improved by associating mulching, the use of improved seeds

4.3. Scarification

The practice of scarification involves tilling the soil by scraping the surface layer with a toothed implement, either manually or with animal traction, to loosen the top 10 cm of the soil.

The scarification improves water infiltration into the soil and can be adapted to the rainfall. The conditions of its implementation include the choice of toothed tools for tillage, technical competence to loosen the top 10 centimetres of the soil.

photo 36: scarification technique

This practice associated with mulching, the use of improved seeds helps improve its contribution to adapting to the effects reduced rainfall.

4.4. Subsoiling

The practice of subsoiling involves breaking the surface layer of a tight soil. It is used for the recovery of frozen soils with low infiltration.

It improves water infiltration into the soil and reduces the erosion caused by water.

The conditions of its implementation include digging a furrow of 30-50 cm in depth with a width of 30 cm and a height of 50-100 cm for the rejected earth.

Photo 24: The subsoiling technique

Photo 25: Subsoiling combined with reafforestation with woody plants

Stone or biological bunds such as the reafforestation of woody plants and/or the seedling of grasses may be associated.

4.5. Composting

The practice of composting involves fermenting organic matter from plants and animals for a certain period to reduce their carbon/nitrogen ratio and to clean the organic matter before application to the field.

The application of compost increases the water retention capacity of the soil in addition to improving its physico-chemical properties.

Photo 26: Pit composting

Photo 40: Heap composting

As a result, compost helps reduce the effects of rainfall variability. The conditions of its implementation include selecting the technique (pit, compaction, and combination of pit and compaction), the availability of the organic matter to be composted, expertise in the compost preparation.

Its contribution to adapting to climate change can be improved by combining it with the practice of zai, micro-irrigation, stone bunds and permeable rock dams.

4.6. Intercropping

The practice of intercropping cereals - legumes or cereals - cereals involves sowing in the same plot several crops. This results in increased yields, water and soil conservation, maintained and improved soil fertility under rainfed crops.

The criterion for adapting to climate change effects mainly concerns soil and water conservation in that intercropping reduces water erosion and results in improved water management in the plot.

The conditions of its implementation imply a sound knowledge of farming techniques and the selection of crops to be associated. Its contribution to adapting to climate change effects can be improved by combining it with contour ploughing and improved seeds.

Figure 10: Intercropping of cereals and legumes

4.7. Alley cropping

This is a farming practice which involves exploiting seasonal food crops in corridors formed by hedgerows. The hedges are regularly cut and incorporated into the soil to improve its fertility.

It protects the soil against wind and water erosion and therefore reduces the effects of winds and torrential rains.

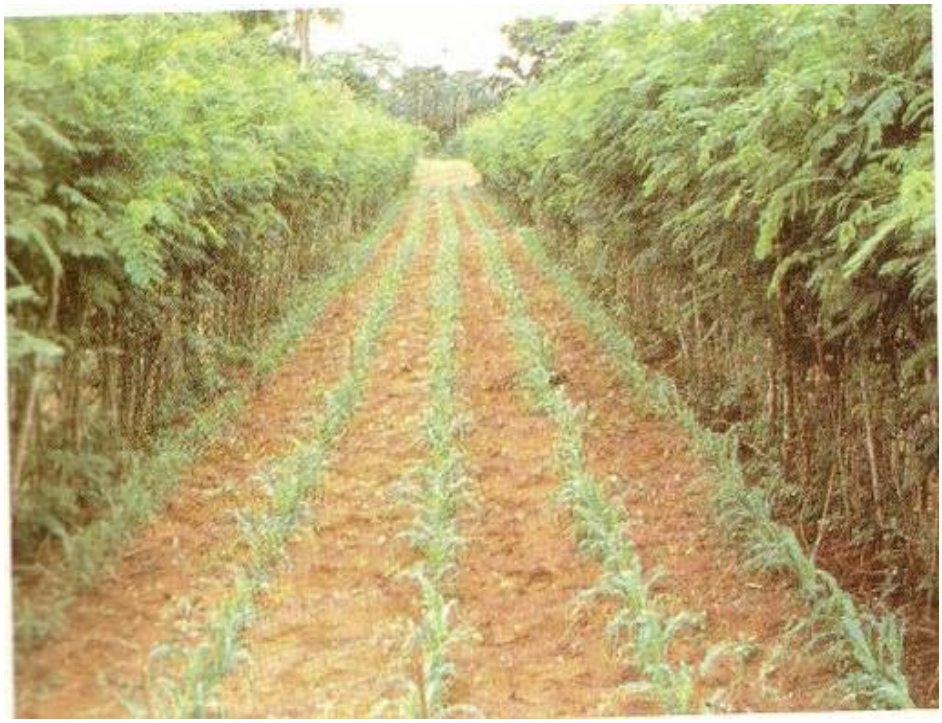


Photo 27: Alley cropping

It also contributes to the improvement and soil conservation.

Its implementation demands technical skills and availability of plants to form the corridors.

4.8. Off-season crops and vegetable gardens

The practice of off-season cropping involves practicing farming in the dry season by exploiting surface or underground resources.

This practice makes it possible to adapt to disastrous agricultural conditions in the rainy season, such as the loss or the inadequacy of agricultural production in case of flooding or drought.

Photo 28: Cabbage production

Photo 29: Production of pepper and onion

The conditions of its implementation are the presence of water points (dams, ponds or boulis), the digging of drainage wells, wells or boreholes, and labour force.

The contribution of this practice to the reduction of climate change effects can be improved by strengthening the technical skills of producers, facilitating access to credit, using improved seeds and carrying out the development of suitable sites.

5. Animal resource practices

5.1. Fodder cutting and conservation

The practice of fodder cutting and conservation involves collecting and storing natural pasture plants (herbaceous and woody plants) for use in the dry season.

It helps increase the availability of food resources for livestock during the dry season and therefore adapt to the decline of grazing on the hoof.

The conditions for its implementation are making a proper collection of the species to be cut, the vegetative stages, heights and periods of their use, mastering fodder conservation and storage techniques and appropriately planning the use of the stock.

Figure 11: Fodder cutting

Photo 30: Stored haystack

This practice can be improved by combining it with the establishment of fodder banks.

5.2 Fodder crops

The practice of fodder crops involves sowing on agricultural plots fodder species in order to provide (fresh, wilted and stored) fodder to cattle.

These fodder crops may have a dual purpose, feed and production of food such as cowpea, sorghum, fodder, maize. The fodder crops may also be grown on the natural site of the fodder, such as cultivation of bourgou (*Echinochloa stagnina*).

Photo 45: Dual purpose cowpea field

Its contribution to adaptation is in terms of provision of food supplement for livestock feed by the stockpiling of fodder available during the dry season. Harvested cowpea is also a source of food for humans.

The conditions for the implementation of fodder crops include a good command of the technical management of the species considered and the climatic and soil conditions suitable for appropriately externalizing its potential.

5.3 The practice of livestock mobility and transhumance

The practice of livestock mobility and transhumance are practices of pastoralism. The first refers to the movement of cattle from one point to another in search of pasture resources (water, pasture, salt licks). The second refers to a seasonal or cyclical movement of herds in search of water, pasture and/or salt licks.

Photo 31: Transhumant cattle

This allows adapting to the effects of drought and rainfall variability by optimizing regional opportunities in terms of availability of pasture and water.

The conditions of the implementation of this practice are well controlled by shepherds and require sensitization and training on their rights and duties, compliance with regulations governing mobility and transhumance, the flow of information on the availability of fodder and water, securing hosting areas and transhumance routes.

6. Adaptation practices for the energy sector

6.1. Valorisation of solar energy

This practice consists in harnessing and concentrating solar radiation at a sufficient level for many domestic purposes: water heaters, dryers, refrigerators, wax melters, etc. It helps reduce greenhouse gas emissions and contributes to climate change mitigation. It also reduces fuel wood consumption as well as fossil fuel with positive effects on the conservation of forest resources.

Photo 32: Solar drier

Figure 12: Solar cookers

it requires technical skills and financial resources at the outset.

6.2 Transformation of solar energy

Photovoltaic cells (solar panels) transform solar energy into electricity for multiple purposes.

This practice generates clean energy (no fossil fuels) that is renewable and thus preserves from dependence on the use of fossil fuels and firewood.

It makes time for other income generating activities (when used for pumping water ...) and reduces greenhouse gas emissions and deforestation

Photo 33: Solar panels

It requires solar panels (power production system), an energy control and storage system (battery, regulator), appliances that use the solar energy generated (utilization system) and a sunny space for installing a power production system.

6.3. Improved stoves

improved cookstoves are used to reduce energy losses and increase energy efficiency. It helps reduce wood consumption and therefore the effects on forest resources. In return, reducing the pressure on forest resources helps increase the carbon storage capacity of forests, thereby mitigating the effects of climate change.

Photo 49 Improved adobe stove

It requires construction materials

(metallic, adobe, ceramics, cement, etc)and technical construction skills.

Photo 50: Improved metallic stove

The practice contributes to the fight against desertification and the effects of climate change through energy conservation

It requires materials (metallic, adobe, ceramics, cement, etc.) and assistance from relevant technical services.

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Photo 51: Adobe stove for local beer (dolo) brewing

CONCLUSION

Climate change is recognized today as a serious threat undermining development efforts. It concerns all countries and affects all sectors.

Therefore, mitigation (reduction) and adaptation measures are currently recommended worldwide. Poor (non-industrialized) countries with low contribution to greenhouse gas emissions responsible for global warming, are encouraged to adopt National Adaptation Programs of Action (NAPA).

This document shows that in order to adapt, there are various techniques in virtually all major areas of vulnerability of Sahel countries such as agriculture, water, animal resources and e environment.

However it is important to note that the practices identified are immediate responses to the constraints faced by the population. So there is a need to build real and sustainable strategies to address climate change through adaptation and anticipation actions.

There is also a need, in adaptation efforts, to consider some cross-cutting aspects such as capacity building, diversification of income sources and production for populations (micro-credit, development of non timber forest products, off-season crops, small scale breeding, etc.) and solidarity from all.

Finally a major effort should be made to mobilize financial partners on this issue and new financial techniques and methods must be developed to help investors and institutions who finance projects take into account climate change.

To resume, the climate is changing, let us change our behaviour for a better adaptation.

ANNEX : Table of additional information sources with indicative implementation costs

Adaptation practices and technologies	Additional information	Implementation cost
1. Stone bunds	1. Zougmoré, R., Zida, Z., 2000. Lutte antiérosive et amélioration de la productivité du sol par l'aménagement de cordons pierreux. Fiche Technique no1. Institut de l'Environnement et de Recherche Agricole, 2 p.	115,000 CFAF / ha without labour cost. (source : PNGT2
2. Permeable rock dams	1. PNGT2, Référentiel technique pour les actions de gestion intégrée des écosystèmes 2. Van Driel W. F., Vlaar, J.CJ., 1991. Impact des digues filtrantes sur le bilan hydrique et sur les rendements agricoles dans la région de Rissiam, Burkina Faso. *Soil Water Balance in the Sudano-Sahelian Zone, IAHS, 199: 299-309*	180,000 CFAF / ha without unskilled labour (source : adapted from PDRD).
3. Grass strips	1. Zougmoré *et al.*, 2003 ; Zougmoré *et al.*, 2004; INERA, 2004 ; MEE	35,000 CFAF / ha (Zougmoré *et al.*, 2004)
4. Zaï	1. ZOUGMORE Robert, ZIDA Zacharie, KAMBOU Frédéric - Récupération agronomique des terres encroûtées par la technique du zaï – *Fiche technique n°02/2005/CNRST/INERA/GRN-SP/Projet Jachère et fiche technique INERA n°10*	30,000 FCFA / ha (source : adapted from PDRD)
5. Half moons	1. Zougmoré, R., Zida, Z., 2000. Récupération agronomique des terres encroûtées par la technique de demi-lune. Fiche technique no5. Institut de l'Environnement et de Recherche Agricole, 2 p	50,000 CFAF / ha (source : CILSS)
6. Mulching	1. http://www.csf-desertification.org/.../10-hien-v-et-al-2004-projet-83-recherche-sur-des-technologies-de-lutte 2. http://www.fao.org/docrep/t1765f/t1765f0o.htm	Variable depending on the availability of raw materials and labour
Dunes stabilization	Manuel de fixation des dunes : http://www.fao.org/docrep/t0492f/t0492f00.htm	Variable depending on the type of materials used (55,000 à 285,000 cfa f/ha)
7. Improved fallow	1. NIKIEMA Paligwendé, BAYALA Jules, LAMIEN Niéyidouba - Jachère forestière améliorée à *Acacia polyacantha* et *Mucuna cochinchinensis* – *Fiche technique n°20/2005/CNRST/INERA/GRN-SP/Projet Jachère* 2. Des jachères améliorées pour les agriculteurs africains http://www.farmradio.org/francais/radio-scripts/76-3script_fr.asp 3. Z. Segda, V. Hien, F. Lompo et M. Becker : Gestion améliorée de la jachère par l'utilisation de légumineuses de couverture http://www.idrc.ca/en/ev-31929-201-1-DO_TOPIC.html	

Adaptation practices and technologies	Additional information	Implementation cost
8. Exclosure	1. Christian Floret, Victor Hien et Roger Pontanier : Le projet «La jachère en Afrique tropicale » http://horizon.documentation.ird.fr/exl-doc/pleins_textes/divers10-02/010039331.pdf 2. Diatta M; Albergel J; Perez P; Faye E.; Séne M. et Grouzis M : Efficacité de la mise en défens testée dans l'aménagement d'un petit bassin versant de Thysse-Kaymor (Sénégal) ftp://ftp.fao.org/docrep/nonfao/lead/x6208f/x6208f00.pdf 3. Ministère de l'Environnement et de l'Eau (MEE), 2001. Manuel de foresterie villageoise, 67p. 4. La mise en défens des parcours en zones arides : 5. Avantages écologiques et obstacles socio-économiques. http://www.ressources.ciheam.org/om/pdf/c62/04600210.pdf 6. L'efficacité de la mise en défens testée http://www.sist.sn/gsdl/collect/bre1/index/assoc/HASHc559.dir/20-232-244.pdf 7. Concept: aire mise en défens http://www.environnement.gouv.sn/IMG/pdf/concept-defens.pdf	N/A
9. Lowland development	1. PNGT2 ; 2007 : Référentiel technique pour les actions de gestion intégrée des écosystèmes195p. 2. PLCE/BN ; 2009. Protocole de mise en œuvre des activités de protection des berges des mares et cours d'eau, 9 p.	10, 000, 000 CFAF/ha (CPF, 2009).
10. Intentional clearing	1. Ministère de l'Environnement et de l'Eau (MEE), 2001. Manuel de foresterie villageoise, 67p. 2. Comment gérer un « espace fini » ? Nouveaux enjeux fonciers en zone de colonisation agricole dans l'Ouest du Burkina Faso. http://www.hal.inria.fr/docs/00/13/69/98/PDF/T228Tallet.pdf	N/A
11. Assisted Natural Regeneration (ANR)	1. Sandra Paris, Jean Sibiri Ouédraogo, Alain Olivier et Jean Bonneville : Systèmes fonciers et dynamiques des parcs arborés au Burkina Faso : le cas de trois villages du Plateau Central http://www.plg.ulaval.ca/projet-agf-sahel/Paris_S.pdf 2. Ministère de l'Environnement et de l'Eau (MEE), 2001. Manuel de foresterie villageoise, 67p. 3. Etude de la régénération naturelle assistée dans la région de Zender au Niger. http://www.frameweb.org/adl/fr-CA/2802/file/4/FRAME.pdf 4. Analyse de la régénération naturelle assistée dans la région de Maradi au Niger. http://www.plg.ulaval.ca/projet-agf-sahel/Marou-Zarafi_A.pdf	45,000 CFAF/ ha (PNGT2)
12. Reforestation	1. Ministère de l'Environnement et de l'Eau (MEE), 2001. Manuel de foresterie villageoise, 67p. 2. CNSF. http://www.cnsf.gov.bf 3. http://www.afdb.org/fileadmin/uploads/afdb/documents/Evaluation-Reports/05280421-FR-	285 CFAF/ planted seedling (PNGT2).

Adaptation practices and technologies	Additional information	Implementation cost
	SENEGAL-LUTTE-CONTRE-LES-FEUX-DE-BROUSSE-ET-REBOISEMENT.PDF 4. Botoni, E., Reij, C., 2001. La transformation silencieuse de l'environnement et des systèmes de production au Sahel : Impacts des investissements publics et privés dans la gestion des ressources naturelles. CILSS, Centre for International Coopération, Université Libre d'Amsterdam, 61 p.	
13. Windbreaks	1. Ministère de l'Environnement et de l'Eau (MEE), 2001. Manuel de foresterie villageoise, 67p.	N/A
14. Alley cropping	1. Kieft, H., 1993. Potentiel d'une agriculture à "peu d'intrants externes" In : Van Reuler H. and Prins W.H (eds.) 2. Rôle de la fertilisation pour assurer une production durable des cultures vivrières en Afrique Sub-saharienne, VKP, Leidschendam, pp. 141-156. 3. Ministère de l'Environnement et de l'Eau (MEE), 2001. Manuel de foresterie villageoise, 67p. 4. FAO, Guide sur la gestion et la conservation des sols et des éléments nutritifs. ftp://ftp.fao.org/agl/agll/docs/misc27f.pdf	N/A
15. Fight against bush fires	1. Ministère de l'Environnement et de l'Eau (MEE), 2001. Manuel de foresterie villageoise, 67p. 2. MECV, 2006 - Guide méthodologique pour la gestion des feux en milieu rural au Burkina Faso / Projet « Gestion des feux en milieu rural », 66 pages + annexes 3. http://www.afdb.org/fileadmin/uploads/afdb/documents/Evaluation-Reports/05280421-FR-SENEGAL-LUTTE-CONTRE-LES-FEUX-DE-BROUSSE-ET-REBOISEMENT.PDF 4. http://www.fire.uni-freiburg.de/Globalnetworks/Africa/Senegal-feux-1999.pdf	Variable depending on situations
16. Banks stabilization	1. Ministère de l'Environnement et de l'Eau (MEE), 2001. Manuel de foresterie villageoise, 67p. 2. Manuel de fixation des dunes de la FAO. http://www.fao.org/docrep/t0492f/t0492f00.htm ou http://www.fao.org/docrep/X5315F/x5315f00.htm	Variable depending on situations
17. Forest development	1. Guide Méthodologique d'aménagement des forêts au Burkina *:* http://www.environnement.gov.bf/SiteEnvironnement/documents/index.html	N/A
18. Arboretums and botanical conservatories	1. http://fr.wikipedia.org/wiki/Arboretum 2. Cordier, S., 2000. Sibang, l'histoire d'un arboretum en Afrique. La lettre de l'OCIM, 72:19-27	N/A
19. Micro-irrigation holes or "Koglogo "	1. L'adaptation aux changements climatiques et l'atténuation de ses effets en Afrique subsaharienne aux moyens des pratiques de gestion durable des terres. Guide d'orientation – version 1.0 ; 2. http://www.Knowledgebase.terrafrica.org/fileadmin/user_upload/terrafrica/docs/adaptation_changement_climatique_et_pratiques_GDT%20guide_orientation_v1.0.pdf	60, 000 CFAF /ha

Adaptation practices and technologies	Additional information	Implementation cost
	3. Durabilité des pratiques culturales dans le nord du bassin versant ; Http://cpwfbfp.pbworks.com/f/BFP+volta_hauchart+(2007).pdf 4. CEAS, 2008. Les cuvettes à tomates. Centre Ecologique Albert Schweitzer, Spore, CTA, 137 : 7. 5. Ouédraogo, E., 2004. Une méthode traditionnelle de petite irrigation au Burkina Faso : les cuvettes à tomates « Koglogo ». *Acacia*, 28: 15-16	
20. Surface irrigation water conservation systems	1. CEAS, 2009. Rapports des activités de recherche appliquée. Département Agroécologie, Centre Ecologique Albert Schweitzer, Burkina Faso, 23 p. 2. EIER/ETSHER, 1999. Rapport de recherche sur les systèmes d'économie d'eau. Projet FAO, 87p. 3. Durabilité des pratiques culturales dans le norddu bassin versant. Http://cpwfbfp.pbworks.com/f/BFP+volta_hauchart+(2007).pdf 4. Mémento de l'irrigation Collection "Manuels Techniques http://www.isf-iai.be/fileadmin/user_upload/manuels_memento_irrigation.pdf	N/A
21. Piping micro-irrigation systems	1. CEAS, 2009. Rapports des activités de recherche appliquée. Département Agroécologie, Centre Ecologique Albert Schweitzer, Burkina Faso, 23 p. 2. ICRISAT, 1998. Le jardin potager Africain, Manuel à l'usage des formateurs et des paysans. ICRISAT, IPALAC, NETAFIM, 106 p. 3. Une nouvelle publication de la FAO pour diffuser les techniques d'irrigation à petite échelle aux agriculteurs de l'Afrique subsaharienne. http://fao.org/nouvelle/1997/970704-f.htm 6. The african market garden: advanced horticulture for the poor. http://www.lespuisatiers.com 7. Benin micro-irrigation project. http://lespuisatiers.com 8. Innovation technico-agricole pour la lutte contre la pauvreté ; Sénégal et Afrique de l'Ouest. http://www.lespuisatiers.com/IMG/pdf/TIPA_senegal_chiffres.pdf 9. la gestion des sols dans les savanes semi-arides. http://www.lespuisatiers.com/IMG/pdf/gestion_des_sols.pdf 10. Benin micro-irrigation project. http://lespuisatiers.com	700, 000 CFAF / ha
22. The construction of water reservoirs: dams and	1. Gestion des petits barrages et interaction eau – écosystème : une évaluation communautaire participative	Boulis : 7, 000, 000 à 10, 000, 000 CFAF ;

Adaptation practices and technologies	Additional information	Implementation cost
boulis	http://vulgarisation.net/agdumed2009/ait_%20lhaj_gestion_petits_barrages.pdf 2. Ouvrages hydrauliques. http://foad-2ie-edu.org 3. Manuel des analyses socioéconomiques et de gestion des points d'eau http://reseaudev.net/IMG/pdf/manuel_socioeconomique_volume_3_web.pdf 4. Durabilité des pratiques culturales dans le nord du bassin versant de la volta. http://cpwfbfp.pbworks.com/f/BFP+volta_hauchart+(2007) 5. Introduction à la gestion conservatoire de l'eau, de la biomasse et de la fertilité des sols. http://fao.org/docrep/t1765f/t1765f00.htm	Dam = high but variable cost depending on the size of the infrastructure (Source : CPF Survey, 2009).
23. Construction of impluviums	1. La collecte des eaux de pluie. http://www.anancy.net/documents/file_fr/collecte%20des%20eaux%20de%20pluie.pdf 2. Citernes de stockage des eaux de pluies (impluviums). http://oieau.fr/ReFEA/fiches/CaptureEauPluie/1impluviums.pdf 3. Le captage des eaux de pluies d'un toit, une alternative pour l'alimentation en eau potable des communautés démunies http://www.er.uqam.ca/nobel/oci/moged/ouaga/capatagepluie.pdf	N/A
24. Water mobilization through pipe shafts	1. CEAS, 2006. Catalogue des produits développés par le Centre Ecologique Albert Schweitzer - Burkina Faso. Centre Ecologique Albert Schweitzer, Burkina Faso, 29 p. 2. Ouédraogo, E., Ouattara, L., 1998. Évaluation du projet de recherche sur les forages maraîchers au Burkina Faso. CEAS, 47 p. 3. Innovation et transfert technologique dans la culture du coton en Thessalie : les systèmes d'irrigation. http://ressources.ciheam.org/om/pdf/co2-2/CIO10989.pdf 4. Une nouvelle publication de la FAO pour diffuser les techniques d'irrigation à petite échelle aux agriculteurs de l'Afrique subsaharienne. http://fao.org/nouvelle/1997/970704-f.htm 5. The african market garden: advanced horticulture for the poor. http://www.lespuisatiers.com 6. Benin micro-irrigation project. http://lespuisatiers.com 7. Innovation technico-agricole pour la lutte contre la pauvreté ; Sénégal et Afrique de l'Ouest. http://www.lespuisatiers.com/IMG/pdf/TIPA_senegal_chiffres.pdf 8. la gestion des sols dans les savanes semi-arides. http://www.lespuisatiers.com/IMG/pdf/gestion_des_sols.pdf	200, 000 CFA F per well with 100 mm PVC drain pipe; 350, 000 CFA F with 160mm PVC pressure

Adaptation practices and technologies	Additional information	Implementation cost
25. Induced rains	1. Bado J.M. 2005. Pluies artificielles pour lutter contre la sécheresse au Burkina. REFLETS SUD, Tv5. http://www.afrik.com/article8167.html 2. Traoré A. 2008. Présentation du programme Saaga à la première journée de la société de la science du sol du Burkina Faso. *Coordination nationale, Programme Saaga, Secrétariat Général, Ministère de l'Agriculture, de l'Hydraulique et des Ressources Halieutiques, Burkina Faso ; 15 p.* 3. Note d'information sur le programme des pluies provoquées au Sénégal « BAWAAN ». http://www.notes-senegal.net/download/note_ifo_ppp.pdf	N/A
26. Fish holes	1. Murai, T., Dia, M., Toupou, S., Haneda, S., 2009. Pisciculture communautaire en haute Guinée. Agence Japonaise de Coopération Internationale, JICA, 35 p. 2. Amélioration de la production halieutique des trous traditionnels à poissons (whedos) du delta de l'Ouémé (Sud Bénin) par la promotion de l'élevage des poissons-chats (*Clarias gariepinus*) et *Heterobranchus longifilus*. http://hdl.handle.net/2078.2/22686	2 ,300 CFA F / m^3 i.e. 1, 500, 000/ 1000 m^2 (material, supervision and labour).
27. Improved seeds	1. Fiche technique n°2 : technique de production de semences améliorées certifiées. http://www.afriqueverte.org/r2_techniques_de_productions_de_semences_ameliorées	Foundation seed = 1, 500 to 2,000 CFA F ; Certified seed :500 to 1, 000 CFA F).
28. Flat or contour ploughing	1. Restauration de la productivité des sols tropicaux. http://www.infotheque.info/fichiers/JSIR-AUF_hanoï07/articles/AJSIR_3-1_roose.pdf 2. Dégradation des terres et développement en Afrique de l'Ouest. http://anafide.org/doc/HTE%2086/86-7.pdf 3. Durabilité des pratiques culturales dans le nord du bassin versant de la volta. http://cpwfbfp.pbworks.com/f/BFP+volta_hauchart+(2007) 4. Travail du sol et propriétés physique du sol en zone semi aride Ouest Africain. http://anafide.org/doc/HTE%2086/86-7.pdf 5. Durabilité des pratiques culturales dans le nord du bassin versant de la volta. http://cpwfbfp.pbworks.com/f/BFP+volta_hauchart+(2007) 6. Introduction à la gestion conservatoire de l'eau, de la biomasse et de la fertilité des sols. http://fao.org/docrep/t1765f/t1765f00.htm	20, 000 to 30, 000 CFA F /ha

Adaptation practices and technologies	Additional information	Implementation cost
29. Scarification	1. Effets du scarifiage sur les propriétés du sol, la croissance des semis et la compétition : revue des connaissances actuelles et perspectives de recherches au QUEBEC. www.afs-journal.org 2. Dégradation des terres et développement en Afrique de l'Ouest. http://anafide.org/doc/HTE%2086/86-7.pdf 3. Durabilité des pratiques culturales dans le nord du bassin versant de la volta. http://cpwfbfp.pbworks.com/f/BFP+volta_hauchart+(2007) 4. Introduction à la gestion conservatoire de l'eau, de la biomasse et de la fertilité des sols. http://fao.org/docrep/t1765f/t1765f00.htm 5. FAO, Guide sur la gestion et la conservation des sols et des éléments nutritifs. ftp://ftp.fao.org/agl/agll/docs/misc27f.pdf	20, 000 CFA F /ha
30. Reclamation of lands degraded by the subsoiling technique	1. Le sous solage, le travail du sol et le chaulage ; http://www.agrireseau.qc.ca/legumeschamp/documents/soussolage.PDF 2. Action de l'amélioration du profil cultural sur la production des céréales et de la betterave à sucre au Tadla; http://anafide.org/doc/HTE%2086/86-6.pdf 3. La compaction des sols: les causes et les solutions. http://www.agrireseau.qc.ca/agroenvironnement/documents/tsague_La%20compaction%20des%20sols.pdf 4. Introduction à la gestion conservatoire de l'eau, de la biomasse et de la fertilité des sols. http://fao.org/docrep/t1765f/t1765f00.htm	Simple subsoiling : 60,000 F / ha
31. Composting	1. Ouédraogo, E., Mando, A., Zombré, N.P., 2001. Use of compost to improve soil properties and crop productivity under low input agricultural system in West Africa. Agriculture, Ecosystems & Environment, 84 (3): 259-266. 2. Ouédraogo E., 2004. Le compostage pour l'amélioration de la fertilité des sols et de la production agricole au Sahel. CEAS, Imprimerie A.D, Ouagadougou, 1ère édition, 31 pages. *3.* Zougmoré, R., Mando, A., Ringersma, J., Stroosnijder, L., 2003. Effect of combined water and nutrient management on runoff and sorghum yield in semiarid Burkina Faso. *Soil Use and Management, 19: 257-264.* 4. Agir au quotidien sur l'environnement, le compostage domestique. http://espace-documentaire.cg38.fr/uploads/documents/1F/web_chemin_34809_1206975272.pdf 5. Durabilité des pratiques culturales dans le nord du bassin versant de la volta. http://cpwfbfp.pbworks.com/f/BFP+volta_hauchart+(2007)	Implementation cost : 30, 000 CFA F (source : CILSS, 2008).

Adaptation practices and technologies	Additional information	Implementation cost
	6. Introduction à la gestion conservatoire de l'eau, de la biomasse et de la fertilité des sols. http://fao.org/docrep/t1765f/t1765f00.htm	
32. Intercropping	1. INERA, 2004. Rapport final du Projet 83. Recherche sur des technologies de lutte contre la désertification au sahel et étude de leur impact agro écologique. 91p. 2. Les pratiques culturales et leurs effets sur les ennemis des cultures. http://onide.endogene.org/docs/doc1.pdf. 3. Pratiques paysannes d'association des cultures dans les systèmes cotonniers des savanes centrafricaines. http://hal.inria.fr/docs/00/13/10/34/PDF/T118kafara.pdf 4. Durabilité des pratiques culturales dans le nord du bassin versant de la volta. http://cpwfbfp.pbworks.com/f/BFP+volta_hauchart+(2007)	300,000 CFA F /ha) Inputs + productive labour throughout production
33. Off-season crops and vegetable gardens	1. Durabilité des pratiques culturales dans le nord du bassin versant de la volta. http://cpwfbfp.pbworks.com/f/BFP+volta_hauchart+(2007) 2. Une nouvelle publication de la FAO pour diffuser les techniques d'irrigation à petite échelle aux agriculteurs de l'Afrique subsaharienne. http://fao.org/nouvelle/1997/970704-f.htm 3. The african market garden : advanced horticulture for the poor. 4. Benin micro-irrigation project. http://lespuisatiers.com 5. Innovation technico-agricole pour la lutte contre la pauvreté ; Sénégal et Afrique de l'Ouest. http://www.lespuisatiers.com/IMG/pdf/TIPA_senegal_chiffres.pdf 6. la gestion des sols dans les savanes semi-arides. http://www.lespuisatiers.com/IMG/pdf/gestion_des_sols.pdf	N/A
5. Protection of water points against silting	1. Guide des techniques de lutte contre l'ensablement *www.fao.org/docrep/X5315F/x5315f00.htm*	8,300 CFA F / m
6. Implementation of high-discharge boreholes equipped with solar pumps	1. www.cipcsp.com/.../pompage-solaire.html 2. www.cilss.bf/prs/article.php3?id_article=3	53, 000, 000 (fifty three million) CFA F/ high flow rate borehole equipped with a solar-pump.
7. The construction of	1. Technique des petits barrages en Afrique sahélienne et équatoriale/ Par Jean-Maurice	240, 000, 000 CFA F on average

Adaptation practices and technologies	Additional information	Implementation cost
pastoral dams	Durand,Paul Royet,Patrice Mériaux http://books.google.fr/books	per dam; but with variable costs
8. The implementation of pastoral wells		7, 000, 000 CFAF per unit + watering places
9. The overdeepening of natural ponds	1. Voir rapport d'enquête PDELG, 2009	45,000, 000 CFAF / natural pond
10. Delimitation of pastoral areas or specially developed pastoral spaces	1. voir loi d'orientation relative au pastoralisme au Burkina Faso (MRA)	Varying cost depending on pastoral areas to be delimited
11. Delimitation and marking of cattle and transhumance tracks	1. Loi d'orientation relative au pastoralisme au Burkina Faso	
12. Open stables for fattening and organic manure production		9 m^3 compost pit stabilized at 15 000 CFA F with the filling, watering and mixing, up to 12,000 CFAF. The transportation cost for a cartload is 500 FCFA on average over 3 to 4 km. On average 30 cartloads are necessary to drain the pit
13. Fodder cutting and storage	1. Techniques de fauche et de conservation du fourrage nature 2. www.ifipafrique.org 3. INERA / Burkina Faso	10 to 60 CFA F/ kg of dry fodder produced
14. Fodder crops	1. CIRAD- cultures fourragères tropicales www.fao.org/ag/againfo/.../10Forcro.htm	300,000 CFA F / ha
15. Bourgou cultivation	2. INERA (KIEMA A,)	400,000 CFA F / ha
16. The traditional practice of cattle mobility and transhumance	3. *http://www.iied.org/pubs/pdfs/G02236.pdf* 4. www.csf-desertification.org/.../137-collectif-2010-modernite-mobilite-lavenir-de-lelevage-dans-les-zones-arides-dafrique 5. www.scidev.net/.../la-gestion-des-p-turages-doit-tenir-compte-des-besoins-des-communaut-s-locales.html	
17. The solar water heater	1. http://ceas-ong.net/nos-produits/	Classical 100-litre solar water

Adaptation practices and technologies	Additional information	Implementation cost
		heater : 535,000 CFA F, 100-litre Cité Picasso: 375,000 CFA F; 56-litre collecting tank: 100,000 CFA F
18. Solar food drying	1. http://ceas-ong.net/nos-produits/	Costs : familiy solar tunnel drier: 160, 000 CFAF ; community solar tunnel drier: 300, 000 CFAF, solar Banco dryer: 600, 000 CFAF, large-scale « shell » dryer: 185, 000 CFAF.
19. The practice of using photovoltaic solar energy	1. http://www.economiesolidaire.com/2010/08/06/cellule-photovoltaique/ 2. http://www.mediaterre.org/afrique-ouest/actu,20090710161443.html 3. http://ceas-ong.net/nos-produits/	
20. Improved stoves	1. http://www.grad-france.org/Docs/PI/livret62.pdf 2. http://guinee.ouest-atlantis.com/foyer-ameliore-boke.html 3. http://www.fondationensemble.org/fichestech/FT_Sos_Sahel_F.pdf	700 CFAF. / Unit
21. The solar wax melter	1. http://ceas-ong.net/nos-produits/47-le-fondoir-a-cire.html	20, 000 CFAF / solar wax melter