

1.1.14. Community agro-forestry, an alternative to deforestation on the outskirts of the Tai National Park in Côte d'Ivoire

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Plant production by the CABB cooperative

Located in the southwest of Côte d'Ivoire between the three administrative regions of Nawa, Cavally and San Pedro, the Tai National Park (PNT) is administered by the South-West Zone Directorate of the Office Ivoirien des Parcs et Réserves (OIPR).

A detailed analysis of the area showed that, out of an area of 83,000 ha in the peripheral zone of PNT, only 1% of the total area could be identified as forest area. This peripheral zone is occupied by vast expanses of agricultural plantations, thus accentuating its ecological isolation due to the degradation of the adjoining forests. There are more than 176,000 cocoa farmers who provide more than 40% of the national production. This situation has led to a change in the landscape, with a subsequent change in the rainfall regime, the disappearance of non-timber forest products in the rural environment, a decrease in agricultural yields, etc. During patrols in

the park, surveillance officers regularly apprehended women in search of foodstuffs that are highly prized by local communities and that are no longer found in the rural environment, which is a source of perpetual conflict between park managers and these communities.

As a sustainable solution to this state of affairs, the project for the development of sustainable agro-systems in the riparian zone of the PNT has put forward the idea of encouraging the domestication of forest fruit trees to reduce the pressure on the park's resources.

In order to comply with UTZ certification criteria, which place particular emphasis on the preservation of natural resources, the Benianye de Buyo agricultural cooperative society (CABB) has undertaken to promote good practices in its members' plantations located on the periphery of the PNT. The CABB has been especially active in raising awareness among its members and communities through meetings and the local radio station in Buyo, as well as in the production and transportation of seedlings. The women members of the Assiessian and Siguite Mogosson associations in Tchétaly and the women producers who are members of the CABB were the first actors in the identification of seedlings in the PNT and participated in all project activities. Out of a total of 213 project beneficiaries,

women represent a proportion of 52.5%. The CABB implemented this action in collaboration with the NGO Conservation Tai, which supervised the production and distribution of seedlings, as well as the Office Ivoirien des Parcs et Réserves (OIPR) through its South-West Zone Directorate, which provided the seeds and contributed to the financing of the production and distribution of seedlings to communities.

The action was supported by the administrative and customary authorities of the project area who took an active part in the sensitization and follow-up.

Their involvement ensures ownership of the results at the institutional level.

For example, the Chief of Kouzié Canton made a 1 ha site available to the project to serve as a pilot agro-forestry demonstration site.

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The main achievements are the training of 25 relay producers on sustainable agriculture practices and the establishment of buffer zones called sustainable agro-systems zones; these occupy a total area of 9 ha, i.e., a strip of 10 m by 7 km on the edge of the Tai National Park (TNP). In addition, more than 1,200 producers have been supported by the project and are implementing practices such as agro-forestry and composting on nearly 1,000 ha. They have received approximately 116,818 seedlings, including *Irvingiagabonensis*, *Treculia africana* and *Garcinia cola*. 15 nursery workers have been trained in useful forest plant production techniques and 25 heliculture farms under cocoa trees have been set up for 50 women to raise snails, improve their income and minimize the use of pesticides in the plantations.

The promotion of sustainable practices through the domestication of these fruit trees has put an end to fraudulent harvesting, which considerably reduces the pressure on TNP resources and conflicts between TNP managers and local communities. Ultimately, the introduction of the trees into cocoa plantations will ensure the sustainability of cocoa production in the riparian zone of the Tai National Park and contribute to mitigating the effects of climate change in this part of the national territory.

1.2. Alternatives to cope with the Massive use of Firewood and Excessive Deforestation

1.2.1. Cashew nut shells as alternative fuels: zero wood, zero waste in the COOPAKE processing unit in Burkina Faso

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Cashew nut shells

Since 2017, the Agricultural Cooperative of Kéné Dougou (COOPAKE) has been using pyrolysis for cashew nut embrittlement and kernel drying in its cashew nut processing unit. This innovation is part of a larger project, the Kénébio project, financed by the EQUITE program.

The Agricultural Cooperative of Kéné Dougou has developed a process for using waste from the processing of agricultural products. This process reduces the massive exploitation of wood, and can help the cooperative achieve its objectives. It can provide greater access to local and international markets, and even help the cooperative to position itself on the fair trade market, where prices are more remunerative.

The experience of using cashew nut shells as an alternative fuel is a response to the growing demand of populations for firewood-based energy.

A pyrolysis oven for zero waste and zero firewood in the processing of cashew products



Pyrolysis is a technique that allows the use of waste from certain agricultural products as fuel in the processing of these products. This thermochemical process offers a good alternative to the

intensive use of firewood and allows to fight effectively against deforestation.

The pyrolysis oven of the cashew nut processing unit of COOPAKE allows the use of the cashew nut shells. Injected into the environment of the reactor heated to nearly 1,000°C and in the absence of oxygen, these shells enter into combustion. They release some of their chemical compounds to produce pyrolysis gas and bio-coal. The gas provides the thermal energy necessary for the operation of the processing unit and the bio-charcoal. After burning the



nut shell to remove the oil from the nut, this bio-coal is used for nut processing and other uses, including domestic uses.

This H2CP (High Calorific Cashew Pyrolysis) technology was developed by

the NGO NITIDAE, formerly RONGEAD, for the energetic valorization of cashew nuts. It produces the steam necessary for the embrittlement of the nuts and the drying of the almonds. The oven is a simple and cheap equipment (around 12 million CFA francs) that can be manufactured locally without using imported technologies. It is supplied by local equipment manufacturers who can train boiler room technicians in its operation and maintenance. The equipment manufacturers themselves provide long-term maintenance.

In terms of results, this technological innovation has reduced the drudgery of the workers in the processing unit. In the past, the smoke produced by the wood affected the eyes and health of the workers in the unit. The use of the pyrolysis oven has also improved the quality of the almonds produced and the processing unit has been able to obtain Fairtrade International and SPP (Symbol of Peasant Producers) certification.



The almonds produced meet certain internationally recognized social and sustainable standards and can be sold

at better prices on international markets. This has led to some improvement in the income and living standards of the 150 employees of the processing unit and their families. This population is estimated at about 750 people, plus more than 800 people belonging to the families of the 94 members of Agricultural Cooperative COOPAKE.

The bio-coal produced is made available to households in the region for domestic use, which contributes to a cleaner living environment for the people of the Orodara region by promoting the absence of waste and pollution. The pressure on forest reserves is also greatly reduced.

To consolidate the achievements of this experience of using cashew nut waste as an alternative fuel to wood and butane gas, COOPAKE wants to focus on improving this equipment to make it even more efficient. This technology, used for drying mangoes, would contribute to limit



or even eliminate the use of butane gas.

COOPAKE also wants to present the bio-coal in the form of briquettes to facilitate its domestic use. The association of this charcoal with other wastes could also make it possible to produce organic manure to replace part of the chemical fertilizers whose use is widespread. This activity would contribute to reducing the rapid degradation of soil and biodiversity



in the province of Kénédougou and in the High Basins of Burkina in general.

This experience can be duplicated in all similar areas provided that they produce cashew nuts, as their shells are the source on which the experiment is based. This technology can also be used to meet the energy needs of other types of businesses.

1.2.2. Shea cake briquettes as an alternative to firewood for women in the town of Réo in Burkina Faso

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Briquettes of shea cakes

This experiment focuses on «energy optimization through the valorization of shea cakes in the form of charcoal briquettes». Indeed, the processing of shea cakes into butter is a good source of income for the women of the city of Réo and other regions of Burkina Faso. However, this processing produces a significant amount of waste, notably oil cakes, which can be used as fuel and substituted for wood in the various operations required for this processing. Several shea butter production centers are already using oil cake pellets for this purpose. However, this method has a major disadvantage; because of piling up, the cakes used in powder form do not produce a good flame. In addition, the manufacture of the pellets is a tedious operation, especially for producing large quantities of oilcake.

One of the main activities of the Ce DwaneNyee Association (CDN), which has become the Union of Women's

Groups Ce DwaneNyee (UGF/CDN), is the production and marketing of organic and fair trade certified shea butter. This activity is based on the collection of shea nuts in the classified forests and parks of Tiogo, Kalyo and Baporo, which cover an area of 5,940 ha in the central-western region of Burkina Faso.

In terms of results, the 6,914 women members of the 65 groups/cooperatives that make up the UWG/CDN produce and market nearly 250 to 300 tons of shea butter per year. They need 4 to 5 kg of wood to produce 1 kg of shea butter. They thus use nearly 1,500,000 kg of firewood per year to carry out their activity. The production of shea butter also produces 65% of oil cakes, solid waste and liquid waste.

Currently, the women of the UWG/CDN produce briquettes that are used in the boilers and pyrolysis roasters of their processing unit, but also for improved stoves in the families.

The production of briquettes involves the following steps:

1. Collection of waste (the liquid paste) from the processing of the fines into shea butter;
2. Decanting (to separate the liquid part from the solid part);
3. Drying of the solid part;
4. Preparation of the material to be densified;

5. Mixing this material with water;
6. Drying and pressing of the densified material in a press to produce briquettes (fuels);
7. Drying the briquettes;
8. Use of the briquettes in boilers, improved stoves and roasters.

From a methodological point of view, the technology for converting these wastes into fuel briquettes is mastered locally. The consumption of firewood has been reduced by 80% compared to the initial situation mentioned above, and the objective is to reach 0% of wood for the production of shea butter. It should be noted that the Union manages to produce more than 720,000 kg of briquettes per year.

The 6,914 women of the UWG/CDN have become aware of the need to protect their environment and no longer use firewood in their households but rather the briquettes they produce for the processing of shea fines. This activity has enabled them to employ six women and three young people who are responsible for producing the briquettes. Other cooperatives are being established to produce and market these fuel briquettes. More than 2,500 women have been trained in the use of these briquettes.

Local artisans have been trained in the manufacture and repair of press equipment for the manufacture of briquettes made from shea cakes.

The women's commitment to the «Zero Wood» slogan in the processing of fines into shea butter and in cooking activities has had a structuring effect on territorial ecology and on the reduction of the drudgery of women's work, who used to spend a lot of time looking for firewood. Now they have time for other activities that are useful for their families and their cooperative. Another important factor is the ease of having all the necessary materials for making briquettes available locally.



1.2.3. Making ecological charcoal briquettes and improved stoves from waste to combat deforestation and address the challenge of climate change

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Ecological coal briquettes

The Coalition des Jeunes en Action (CJA) has been supporting a group of women and youth in Gitega since 2016 in the use of biodegradable and non-biodegradable waste to make ecological coal briquettes and improved stoves.

Indeed, charcoal is the main source of domestic energy in Burundi. As highlighted in the Bois et Forêt des Tropiques Report N° 328 published in 2016, «charcoal is consumed at 77% by the urban population».

The second alarming finding is the accumulation of household waste, biodegradable agricultural residues and also, metal residues in the major cities of Burundi, especially in Gitega which is located about 110 km east of Bujumbura. The Coalition of the Youth in Action has undertaken applied research on household waste and agricultural residues which has led to the design

of an ecological and healthy charcoal prototype to be offered to the population. In addition to the production of charcoal briquettes, the CJA's actions focused on the following aspects:

1. Raising community awareness on the effects of deforestation linked to the massive use of wood for charcoal production and the risks of the disappearance of Burundi's forests;
2. Training of the pilot team for the development of biodegradable waste and metal residues;
3. Capacity building of organizations in charge of waste collection and sorting;
4. Supply of agricultural residues such as corn cobs, rice bran, coffee poles, sawdust, etc., to farmers;
5. Drying and carbonization of waste materials;
6. Manufacturing and drying of coal briquettes;
7. Marketing of these briquettes.

One of the first results of this experience is the awareness of the various actors who have been able to see its positive effects on community life, that of vulnerable women and youth. These

women and young people, who are responsible for finding wood for heating and cooking, find cleaner coal more easily and nearby. This environmentally friendly alternative to charcoal is an innovative and sustainable solution to biodegradable solid waste management. It also has other advantages: it burns more slowly and therefore longer, which allows households to save on the resources spent on wood and charcoal; it does not produce smoke and odors harmful to the health of users; it does not blacken pots and is suitable for all types of stoves, improved or traditional. The women and young people who participate in the experience can earn money by producing or marketing coal briquettes and the ecological stoves associated with the use of this coal. Through their testimonies, the consumers have become themselves the commercial agents of these products.

Institutions that have understood the relevance of the experience are looking to replicate it in other cities in Burundi threatened by waste accumulation,

deforestation, and increased unemployment among girls and young men. The recognition of this relevance has been reflected in the three awards obtained by the CJA.

The experience can be replicated at low cost to provide a valuable alternative to the use of wood or charcoal. It can also contribute to a more rational use of certain wastes to produce ecological products that protect the environment and the health of the population.



Manufacturing of energy conserving furnaces/ stoves and local employment

1.24. Bio-digesters and improved cooking stoves to help rural communities mitigate climate change effects and develop livelihoods

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Resistant seedling produced using organic fertilizer from biogas plant.

Due to the fluctuating cost and the environmental effects of conventional sources of energy, especially crude oil, and the negative effects of greenhouse gas emissions on the environment, there is an emergent interest in the use of renewable energy. ... (International Journal of Energy Economics and Policy Vol 9 · Issue 2 · 2019)

It is in this framework that, from 2017



With deforestation finding wood for cooking is a big challenge in many Rwandan areas

to 2019, Inades-Formation Rwanda has initiated the experience which consists in the construction of bio-digesters for the production and use of biogas as fuel for cooking, to promote efficient and low-carbon energy consumption at household level. Inades-Formation Rwanda (IF Rwanda) promoted those facilities in the communities of Bugesera, Rwamagana, Huye and Ngoma districts in Ruhuha, Mugesera, Huye and Gishali sectors in the Eastern Province of Rwanda. It was inspired from Rwanda green growth strategy 2018 and it was adapted to household level to help reduce the cutting of trees, CO₂ emission and eyes and respiratory diseases caused by wood fuel smoke.

The promoted system, i.e., bio-digesters, uses cow dunks and human waste from toilets. Urines are separated from solid waste and all dejections are oriented in the system to generate gas.

This experience of promoting bio-digesters to help rural communities mitigate climate change effects and develop livelihoods, aimed to solve the following issues:

- increasing deforestation due to the massive use of wood fuel and the risk of desertification in the Eastern areas of Rwanda;
- high and increasing CO₂ emissions with

the use of firewood, charcoals and the rest of crops as wood fuel;

- eyes and respiratory diseases caused by wood fuel smoke,
- climate change effects on agriculture.

The experience which includes the construction of bio-digesters for the production and use of biogas and improved cooking stoves aimed reduce deforestation, respiratory diseases

this has greatly reduced the number of trees cut to produce charcoal and firewood.

The health of the beneficiaries has been improved and there is less cases of eyes and respiratory diseases caused by wood fuel smoke. Women and the other members of the families equipped with improved stoves greatly appreciate using less time in healthiest conditions

Biogas is an output of anaerobic digestion (AD), where various microorganisms, break down organic matter through different metabolic processes. Tremendous and novel development in biogas production has led to the creation of advanced bio energy facilities. As such, the biogas facilities are the basis of an economy concept aimed at nutrients recycling,

reduction of greenhouse gas emissions and bio refinery purposes. The AD is a microbial degradation of organic waste in the absence of oxygen. Organic matter conversion to CO₂ and CH₄ gases occurs next to a sequence of biochemical reactions during an anaerobic process (Bailey and Ollis, 1986).

caused by wood fuel smoke and promote the production of organic fertilizers of good quality.

From the beginning of the experience in 2017, bio-digesters were constructed in 60 households in the districts of Bugesera, Rwamagana, Huye and Ngoma. 17 of those households are women headed. The capacities of those beneficiaries have been strengthened and they are now able to cope with climate change effects. The experience also created employment for youth and women during and after the construction process. These farmers have got knowledge on production and use of clean energy through the construction and use of bio digesters and of organic fertilizers in their farming activities. They now use a clean energy for cooking, and

to cook. They can save money and time to use for other activities. The action has also introduced changes in the lives of families, now men and youth can cook as it is easier to use improved stoves.

The experience contributed to improve the sanitation in the households equipped with digesters because the system uses cow dunks and human waste from toilets. Urines are separated from solid waste and all dejections are oriented in the system to generate gas. In these conditions bad smelling and flies are eliminated.

The experience contributed to the achievement of one of the objectives of the National Strategy for Transformation (NST1, 2017-2024) that aimed the transition of Rwanda towards a green



A student coming from school using biogas to cook the food

economy, with a reduction from 79.9% to 42% of households depending on firewood for cooking, by 2024. These are also in link with the objectives of Sustainable Development Goals, particularly 7 and 13 which respectively wants to ensure access to affordable, reliable, sustainable, and modern energy for all and urgent climate actions to help people mitigate climate change and its impacts on their live.

1.2.5. Empowering rural communities to cope with climate change effects through promotion of improved cooking stoves

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Improved cooking stoves

The project takes place in local communities in Bugesera, Ngoma and Rwamagana districts in Rwanda's Eastern Province and aims to help farmers in these communities cope with the challenges of climate change through the production and use of biogas and improved cookstoves. It fits into Rwanda's strategic green growth priorities (2018 Rwanda Green Growth Strategy) at the household level. Most households in the target area use firewood for cooking, which contributes to deforestation, generates harmful gas emissions, and has a negative impact on public health and economic development. The area is semi-arid, characterized by low rainfall and low forest cover. These factors negatively affect the living conditions of the local population, especially local farmers.

This experience involved the local authorities at the Sector and Unit level, the beneficiary farmers, ALBOAN as

financial partner, DelAgua as supplier and Inades Formation Rwanda as implementing partner.

In close collaboration with the local authorities at the Sector and Unit levels, the beneficiaries were trained in the use of the improved cookstoves that were distributed to them. The local authorities also created an enabling environment for the first trainees to train their neighbors in the use of the improved stoves. The beneficiary farmers helped to share a good experience in the use of these stoves.

In terms of results, according to testimonies from the field, the improved stoves have reduced tree cutting, CO₂ emissions, and respiratory and eye diseases caused by firewood smoke. This pilot experience has benefited 200 households. 46% of them are headed by men (92 households) and 54% by women (108 households). The women contributed a lot to demonstrations on the use of improved stoves and provided testimonies on how the use of these stoves has improved their living conditions. 200 improved stoves were distributed to 200 households in the project area.

The use of improved stoves has reduced the number of trees cut for charcoal and firewood production. The stoves distributed save up to 60% of firewood. Cooking time has been reduced. The

distributed stoves have resulted in the participation of men in the kitchen as they also feel comfortable cooking. The money spent on buying firewood is saved and used for other purposes. These achievements are also in line with SDGs 7 and 13, which focus on affordable energy and climate solutions, respectively

The experience has brought about changes on several dimensions: environment, relations between men and women, economic dynamics around the manufacture and sale of new models of stoves, eradication of diseases related to excess smoke. The involvement of local government officials has been of great importance in facilitating adherence to the change in practices.



1.2.6. Improved wood and coal stoves to limit deforestation and improve the health of rural women in Togo

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According to a survey by the International Energy Agency (IEA) conducted in 2012, 95% of the Togolese population uses biomass energy, particularly wood, for cooking. Only 27% of this population has access to electricity. In addition, 15,000 ha of forests are destroyed each year in Togo, compared to only 1,000 ha replanted (data from the National Environmental Action Plan - PNAE, 2001). This overexploitation of forest resources is favored by traditional agricultural production methods and amplified by strong demographic growth. It compromises the crucial role of forests in the process of mitigating and reducing the effects of climate change.

The almost exclusive use of biomass-energy, and mainly wood as energy for cooking and other household needs, has a particular impact on women, who are committed to these tasks. They are

exposed to health problems related to the inhalation of smoke from traditional fireplaces, which also contribute to environmental pollution. To remedy the overexploitation of forest resources, the Togolese government, in its energy policy document developed in 2011, emphasized the use of improved stoves to reduce the use of wood energy for cooking.

The experience consisted in the popularization of good practices based on the use of two types of stoves that save wood energy: improved charcoal stoves and improved wood stoves.

Local authorities facilitated the dissemination of these stoves; 71 village chiefs and their notables, 84 members of village development committees (CVDs), and 128 presidents of women's groups participated in the dissemination

Manufacturing process of the improved charcoal fireplace locally called "Asubibi":



We take clay that we buy or that we find locally in a village, to which we add a little cement. Then, we mix them to make the ceramic heart that we make in a furnace. We also make the metal container of the fireplace with sheet metal. After assembly, we put everything in the oven for the final firing before painting the fireplace.

Manufacturing process of the improved wood-burning fireplace locally called “AdokpoToxoe”:



Clay, straw, rice husks and a little sugar are kneaded to make small bricks with which the fireplaces are made after 14 days of drying..

of information on these innovations by organizing mass or community awareness-raising sessions.

Women and youth have also acted as marketing agents by popularizing the improved charcoal stoves to their distributors, who are mostly women traders. People with disabilities also took part in the promotion of these stoves. 19,141 improved charcoal stoves were thus placed with 12,439 households between January 2017 and September 2019.

The experience resulted in 176 people being trained in the proper installation of the improved charcoal stoves. In addition, 256 people, 60% of whom were women, 35% men and 5% youth, were involved in

the project as distributors of solar lamps, improved charcoal stoves or promoters of improved wood stoves.

The experiment also focused on young people, especially pupils and students. Thus, 2,860 of these young people have learned the basics of sustainable energy solutions and the marketing of improved stoves. Among these young people are 808 students from 10 schools in the prefectures of Amou, Oti and Kozah, in the regions of Kara, Plateaux and Savanes. Now that the population has been sensitized, it remains to promote economic activities for the commercialization of these households. Community savings and credit systems and a “prepaid” mechanism will be encouraged.

1.2.7. Improved stoves to reduce deforestation around refugee camps in Burundi

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A traditional stove

The experience was developed in Burundi, in the refugee camps located in the areas of Musasa and Kinama in the North of the country and Bwagiriza and Kavumu in the East. In 2013, there were nearly 35,000 people in these camps, or about 7,000 households. To meet their heating energy needs, each month these refugees consumed nearly 4,000 steres of wood. Nearly 53 hectares of forest disappeared each month, or about 636 hectares of Burundi's forest reserves each year. In the camps, the refugees used mostly traditional three-stone stoves that consume large quantities of wood. This led to large-scale cutting of forest reserves and increased costs for transporting this wood to the camps. Statistics show that the quota of m³ of wood allocated to each refugee family was insufficient to cover their needs.

In order to cope with the ever-increasing number of refugees and the rapidly diminishing forest reserves around the camps and transit sites, a solution had to be found to facilitate the refugees' access to environmentally friendly energy.

The Council for Education and Development (COPED), with the support of UNHCR, proposed alternatives to reduce the consumption of firewood.

The choice of the model of fireplaces to be promoted was discussed between the experts and the beneficiaries. Certain



Landscape around Kavumu Camp, with in the distance, the shelters of Congolese refugees in Burundi

criteria were targeted: energy savings, consideration of the height between the hearth and the cooking pot, low smoke emission, size of the openings, shape, thickness and durability of the hearth, faster and more homogeneous cooking.

A large number of cooking tests were carried out to analyze the performance of the various fireplaces proposed. The models that were selected have reduced wood consumption in the Kavumu camp by nearly 60%.

The protection provided by the brick masonry system also contributes to a



Improved fireplace recessed in fired brick masonry to improve its durability in workability

significant reduction in heat loss and to the greater stability and durability of the fireplace. To make it stronger, more stable and therefore more durable, COPED proposed to have it embedded. This improvement has another advantage, the fireplace stores more heat for cooking.

The raw material is available on all the hills of Burundi. For less than US\$8, or about 4,265 CFA francs, a clay fireplace insert can be built. In addition to the environmental response, the manufacture and sale of these types

of fireplaces is a source of income-generating activities for youth and women. This makes it possible to perpetuate the dynamics without requiring external assistance.

The reduction in the consumption of wood energy has led to a decrease in the number of people taking wood from the National Park and excursions into the forest. Other effects include: the reduction of traditional quarrels between these refugees and members of the host community and also with the services in charge of environmental protection; the improvement of cohabitation between refugees and residents; the reduction of conflicts related to the theft of firewood within the camps.

The Congolese refugee camps were a gateway to an experience that will be generalized to all the hills of Burundi. COPED plans to use its expertise to replace wood with fuel briquettes to have an even greater positive impact on protecting Burundi's forest resources.

Among the factors that have greatly contributed to behavior change is the sensitization of refugees in Kavumu camp to the challenges of climate change. There were also the environmental clubs that were set up by COPED in this camp. These clubs have been very active in information and awareness meetings on this topic.

1.3. Practices to Preserve and Promote Local Genetic Heritage Through the Adoption of Climate Change Resistant Seeds/Crops and Local Breeds

1.3.1. Grafting local mangoes varieties and fruit nursery to promote local mango value chain as a mechanism to climate change resilience in favor of women farmers in Kitui in Kenya

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Mango juice

The experience was developed in Kitui County. Kitui County is hot and dry and falls under arid and semi-arid dry lands of Kenya with rainfall distribution which is erratic and unreliable. Climate change effects have been observed over the years which include unpredictable rainfall patterns, diminishing household incomes, soil erosion and degradation among others. The experience was to promote production and value chain processing based on mangos varieties tolerant to climate variability. The experience was more benefit to women who were organized in cooperatives. The beneficiaries developed capacity in matter of improving livelihoods by adopting climate resilience mango varieties.

With initial support from FARM Africa, the mango value chain for women farmers in Kitui was initiated as a strategy to

increase communities' income and enhance climate resilience. The project targeted 800 women famers from Kitui central, Kitui east and part of Kitui rural sub counties and for now the project is working with 1677 farmers.

In collaboration with Kenya agricultural research institute (KARI), Kitui Development Centre (KDC) provided the technical information on mango production and source for the different cultivars. They also trained the youth on mango grafting and fruit tree nursery establishment and management.

The objective was to increase mango production through utilizing appropriate production technologies, knowledge and skills in mango value chain. The production technology promoted consisted in mango grafting technic for improving local varieties, fruit nursery management. For the project sustainability, a mango processing plant (Kitui enterprise Promotion Company) was established. The farmers were organized into small farmer groups and later formed NZAMKA cooperative but as for now we are working with a total of 6 cooperatives. The farmer's sells mangos as raw materials while the company processes the mangoes into several

products: puree, juice, mango flakes and fortified flour.

At farm level, women's-specific role is to plant and manage mangos orchards. The youth have no patience hence requires quick money. Their specific roles include nurseries establishment and management. They are the ones in charge to graft the trees, harvest, and transport the mangos to the processing plant. At the factory the women are trained on good manufacturing practices and employed as casuals at the processing plant. Later on, they are engaged in continuous job training. The youth operate the machines during processing and also participate in the marketing of the finished products.



At the beginning of the project in 2012, there were 20,000 indigenous and 50,504 mango trees of improved variety yielding 2,474 tons per year in Kitui central sub county. (Ref: ADB/IDM survey Eastern Kenya).

The mango grafting technology and fruit tree nursery establishment increased capacity of varieties in matter of tolerance to climate variability. This is contributed by the increased training on good agricultural practices and increased uptake by the processing plant hence leading to the improved household incomes.

The project targeted 80% women farmers while the 20% is on men and youth in the project area. Overall, this involve adopting practices that enable the identified vulnerable target group to protect their existing food security systems, diversify their sources of income, and change improved livelihood.

The project has increased farmers income through sale of local produced mangoes. The household average income increased from ksh 2700 to ksh 15000 per a farmer per year depending on the yields. The project has created positive environmental impact through runoff water harvesting, Soil and water conservation and re-afforestation which increases water retention, soil fertility and therefore increased farm productivity.



Youth earn their living from the sale of grafted mango seedlings and of other crops.

1.3.2. Awakening untapped potential of arid and semi-arid lands the future for climate change adaptation and mitigation by farmers in Kenya

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Henhouses made from local materials

In 2013, Sustainable Agriculture Community Development Programme (SACDEP)-Kenya launched an ecological sustainable agriculture initiative in the Kilimambogo-Mithini, Makuyu and Gikindu regions of Kenya. These arid and semi-arid regions are characterized by high temperatures and fragile soils due to lack of land cover and heavy deforestation to provide people with biomass fuels. Lack of soil cover and unsustainable agronomic practices result in moisture deficits that make the soil unsuitable for most crops. As a result, small-scale farmers are forced to look for alternative ways to generate the income needed to survive in the harsh climate. Many young and vigorous men and women are therefore forced to migrate to the cities in search of gainful employment. Older men are not spared either, and many also leave their wives behind to care for malnourished children in the villages. Others indulge

in excessive drinking to try to forget the hardships of life.

The experience involved training these communities and popularizing crops and livestock adapted to the drylands, including l'cajun peas, sorghum, cassava, and indigenous chickens. The project also promoted the associated economy, based on agro-ecological practices, including the use of local materials, local chicken breeding and local plant protection products.

A credit-savings system has been set up to help farmers mobilize funds to purchase chickens, seeds and other agricultural inputs. Indigenous farmers and chicken breeders who were more



Demonstration fields of good practices on cassava experienced were used as leaders and trainers.

To meet the cost of chicken feed,

farmers learned to make feed from locally available products. Farmers were



Local pest and disease control practices

informed about available markets and trained in group selling techniques to cope with the challenges of middlemen and take advantage of economies of scale.

The project benefited 680 households (300 women, 280 youth under 35, and 100 men). Economic activities managed by the 300 young people, including blacksmithing, purchase and sale of agricultural products and inputs, were developed in the project intervention area.

1.3.3. Community seeds Banks for the conservation of agro-biodiversity through capacity building and documentation of local varieties

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A local seeds varieties: Bank

In Kenya, as elsewhere in Africa, farmers are experiencing a new era of industrial agriculture that is leading to the erosion of local crop genetic varieties and monoculture: seed prices are very high and chemicals are used excessively. Food insecurity and reduced food sovereignty are endemic. The situation is amplified by climate change.

The experience proposed by Seed Savers Network (SSN) Kenya was to support farmers in action research to find alternative solutions to these problems. Through the promotion of climate change resistant varieties, the intervention aimed to find appropriate solutions to the problems caused by frequent droughts and unpredictable weather conditions. These problems include hunger and malnutrition among small-scale producers, lack of supply of planting materials such as vegetatively propagated crops, cassava, arrowroot and sweet potato. The project also

addressed genetic erosion of local varieties, reliance on poorly adapted hybrids, high seed prices, and excessive use of chemicals.

Seed Savers Network (SSN-Kenya) began training farmers' groups in Gilgil in 2009 and then in Nakuru, Kakamega, Baringo, Nyandarua and Kiambu. The approach involved creating community seed banks to help these farming communities develop community-based



ways of conserving local biodiversity and a culture of agricultural seed saving.

The work consisted in:

1. Mobilizing farmers to recover indigenous knowledge on seed saving and biodiversity conservation;
2. Identifying senior farmers who still use traditional knowledge and local varieties;
3. Identifying women who serve as leaders in agro-biodiversity conservation;

4. Setting up and training farmers' groups in the most appropriate seed selection methods to continuously improve existing varieties;

5. Organizing farmer champion groups motivated to share their knowledge and experience with other farmer groups.

A pool of farmers trained in positive and negative seed selection methods was established. A total of 40 seed banks have been established whose members organize seed fairs to exchange, share and sell their seeds. In these banks, there are 15 varieties of local maize, more than 40 varieties of beans, 17 varieties of potatoes, more than 10 varieties of sorghum, 8 varieties of millet, 20 varieties of vegetables, 30 different legumes such as dolicho beans, peas, beans, groundnuts and cowpeas. There are also 3 varieties of cherry tomatoes, 37 varieties of local fruits, 13 varieties of local herbs, 5 of wheat, 3 of nuts and 7 of local agro-forestry trees.

Other farmers in other regions are connected to the groups from a database containing information on the seed producer for a given variety. Smallholder farmers' access to a variety of seeds has improved. The adoption of ecological agriculture principles has contributed to the preservation of biodiversity for greater resilience to climate change. This has improved the resistance of local crops to prevailing weather conditions.

Three important factors contributed to the success of the experiment: working with groups that were already well organized; working with women interested in food and nutrition security; and the goodwill of the government. However, continued advocacy is needed given Kenya's seed laws, which are linked to those of the International Union for the Protection of New Varieties of Plants (UPOV91); these support the commercial seed system and criminalize the farmer-managed seed system.

1.3.4. Farmers innovators in matter of production and conservation of local maize seeds in semi-arid area in Tanzania

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Local seeds

From 1998 to 2007, Inades-Formation Tanzania implemented a project entitled “Promoting Farmer Innovation (PFI)” and the follow-up of this project from 2007 to 2016. Within the framework of the Convention to Combat Desertification and under the aegis of the United Nations, this UNDP project was carried out in three East African countries, Kenya, Uganda and Tanzania. The main idea was to identify farmers’ innovations that helped them adapt to the effects of climate change. Indeed, it was found that in the semi-arid central region of Tanzania, crop yields were very low. Farmers were sensitized to growing imported, supposedly improved seeds. However, for some time now, these seeds have not been successful in the face of climate change. They are more susceptible to pest attacks and diseases. They do not have the local characteristics usually attached to the culture and tradition of the inhabitants of the region, such as palatability, taste, potential for brewing beverages, color, size and quality sought for rituals. In

addition, these seeds were not reusable after one season and required more inputs.

The experience, which took place in the Kondoa District of the Dodoma Region in central Tanzania, involved identifying innovative seed farmers. Testimonies were collected and used to scale up traditional practices. The project team visited villages in Dodoma to identify successful farmers and to learn what they were doing and how they were successfully adapting to climate change. For the project, innovative farmers are people who take initiatives to try and test various things from their own thinking or from other sources to improve agricultural productivity, environment and seed conservation.

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Stakeholders agreed on a common understanding of what innovations are and who could be called an innovative farmer. Each stakeholder suggested names. Then, Inades-Formation Tanzania established and led a coordination team that visited all the proposed farmers and their experiences to decide whether they were an innovation or not. Out of 200 nominees, 40 were selected, including Suzana Silvest.

Observation, literature review, questions and answers, are the action research methodology used to find out if the experience was new and could be called an innovation. Inades-Formation Tanzania, a district and village agricultural extension officer, village leaders and PELUM Tanzania were the four main actors in the project.

PELUM Tanzania often organizes fairs

and competitions on good agricultural and culinary practices. The implementation of the experiment concluded that the innovative seed farmers had the know-how to:

- Select large, good maize cobs at the mature stage in the center of a plot;
- Let the cobs dry completely;
- Harvest them and place them on a pole stand built over the wood stove to let them continue drying under the smoke;
- Shell the completely dried ears and put them in a bag coated top and bottom with wood ash, sew these bags well;
- Place the bags on a wood to prevent them from touching the ground and for good ventilation;
- When the new season arrives, simply take the seeds and sow them on prepared soil.



This experience has given the farmers confidence in their ability to produce from the seeds they have saved. **Suzana Silvesta**, a widow, one of the local seed promoters, confirmed that «using better sustainable agricultural practices, including the best performing local seeds, solves the main challenges

of climate change in semi-arid areas and helps farmers to get out of poverty through increased production; these practices also help them to invest in other related businesses.» Suzana says, «For maize, her production has increased from 2 or 4 to 15 or 20 bags per acre; she now has the capacity to provide 3 nutritious meals per day for her family; she has been able to build a very good house of cement bricks covered with corrugated iron sheets. She is nationally recognized as a resource person for local knowledge.

The challenge now is formal recognition of peasant knowledge by public authorities. This is an advocacy challenge.

1.4. Experiences in Promoting Renewable Energy Technologies for Irrigation

1.4.1. Affordable solar pumps for small-scale irrigation, a revolutionary technology to help farmers increase their resilience capacity to climate change issues in Cameroon

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An extremely simple and portable solar water pump

The promotion of affordable solar water pumps for small-scale irrigation is part of the project entitled «Neem and market gardening for climate change mitigation and socio-economic needs in Ngoketunjia Division». It was proposed by the forest and agro-forestry promoters of the NGO FAP (Forest and Agro-forestry Promoters) to the GEF (Global Environment Facility). Irrigation farming, especially during the dry season (November to March), brings in a lot of money for gardeners. But small-scale farmers, especially women, do not benefit enough because they are forced to work as helpers and workers with these gardeners. They cannot afford a motor pump to bring water to their small farms. The solar water pump experiment has attempted to solve this problem.

The solar water pump experience is the result of various efforts to make it easier

for small farmers, especially women, to bring water from streams, wells and canals to their fields.

Watering cans of 15 to 20 liters, which were initially used to collect water from streams to water crops, required farmers to go several times from the stream to their plots. Running between the stream and the farm exhausted them, especially the women who are often heads of households. The water supplied to the crops was insufficient, resulting in low crop yields. Farmers were forced to cultivate only a small portion of the land because of the difficulty of using watering cans.

The NGO FAP Cameroon mobilized smallholder farmers into groups and trained them in agricultural irrigation practices using solar water pumps. This choice aimed to increase agricultural production and also to reduce the energy used for hand watering. It also aimed to avoid the refueling and maintenance costs associated with the use of diesel-powered pumps and to reduce the water, soil and air pollution caused by these pumps.

FAP Cameroon used focus groups to facilitate exchanges between farmers on

the various methods used for irrigation. They shared their successes and failures from which other farmers learned. They were also trained through practical workshops in the use of solar water pump irrigation systems. Farmers organized in groups of 10 members learned how to manage a solar water pump system. Each day, depending on the size of their farm, three to five farmers were able to use a solar pump.

Local government technical staff in the Northwest and Western regions provided support to FAP and the farmers to learn irrigation farming using the solar water pump. A total of 357 farmers participated in the various experiences that led to the implementation of the innovative solar water pump system for irrigation.



Watering using a solar pump

They received training on water pumping techniques, pump use and handling. Sono Inter System Commerce General in the Northwest region and Destin Solar Technologies based in the Western region were the suppliers of the solar pump system; they provide the pumps, solar panels and other accessories. They provide training on system maintenance.

As regards the results achieved, in 2016, a revolutionary and affordable

solar pumping system was tested. The number of beneficiaries increased from 60 farmers to 110 in 2017, and to 260 in early 2019, including 218 women, 26 youth and 16 men. In May 2019, they were 357 farmer-heads of households who improved their knowledge on irrigation farming and on the use and maintenance of solar water pumps. This created more jobs for women and youth through increased vegetable cultivation and marketing. The increased cultivation of vegetable crops, especially vegetables, has also created jobs for community members who purchase these products at the community level for resale in major cities within and outside of Cameroon. The initiative has also increased the storage and supply of solar pump system service providers.

The government's agricultural technical services have begun to introduce the initiative to their smallholder farmers as an alternative to manual watering and diesel-powered pumps. The experience shows that solar powered irrigation can be applied in the farming environment. However, it is important to support group-based fundraising mechanisms and to advocate for policy incentives.



Members of a trained women group

1.4.2. Promoting sustainable agriculture in a changing climate through integrated ecological methods in Bugesera District, Eastern Province, Rwanda

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A solar panel

The Bugesera district is located in the densely populated lowlands of the eastern region of Rwanda. This region is strongly affected by long periods of drought that tend to become cyclical and persistent. The extent and intensity of land degradation has also weakened its resilience. Drought, combined with overgrazing and poor farming practices, has led to the of pasture and arable land to the point that much of it has been abandoned.

Like other communities in Rwanda, the life of the Bugesera community is closely linked to agriculture; women and girls are more affected than other social groups because in most cases they are responsible for agricultural activities and take care of families by fetching water over long distances for domestic activities.

For example, cassava, the main food and income generating crop, is now a scarce commodity, and bean production has also been affected by low soil moisture.

To help solve this problem of degradation of farmland and the environment in general, in Mareba, Rweru, Ngeruka, Ruhuha, Kamabuye, Nyarugenge, Rilima and Juru, eight of the fifteen sectors of Bugesera District, RECOR (Rwanda Environmental Conservation Organisation) has implemented a project to promote sustainable agriculture in a changing climate through integrated ecological methods. This project involved various actors for its management, implementation and monitoring. These included various donors, beneficiary communities, local authorities and implementing partners.

This experience aimed to build community resilience through the promotion of several sustainable livelihoods based on



green growth techniques such as the integration of agro-forestry practices by increasing the planting of fruit trees, the use of green and low carbon technologies including solar powered irrigation systems.

To implement this experience, the following activities were conducted:

- Capacity building of communities, awareness raising on climate change to enable them to adapt and mitigate the effects on their lives, integration of agro-forestry practices in community lands;
- The installation of eight solar-powered irrigation systems on demonstration sites of one hectare each;
- The construction of eight ecological water storage systems for irrigation;
- The planting of over 170,000 fruit trees in combined cropping systems;
- The production of biodegradable compost.

The experience has achieved the following key results:

- 3,000 community members, decision makers, technicians and farmers, had their capacities strengthened in climate change adaptation and mitigation techniques;
- 172,000 local drought-resistant fruit trees were planted using intercropping systems: grafted avocado and mango trees, guava trees, papaya trees and orange trees;
- 8 irrigation systems powered by green energy (solar energy) are operational to irrigate 8 ha which serve as demonstration sites in the eight sectors;



PVC pipe installation for water transport

- 2,000 ha are to be farmed with agro-forestry practices and properly managed with intercropping and fruit trees. Decomposed biomass from mulch and tree leaves increases and improves soil moisture and fertility as well as the movement of microorganisms;
- 16 tons of biodegradable compost were produced as organic fertilizer for use in transplanting fruit trees.

In addition, the project beneficiaries have developed good knowledge and skills for climate change adaptation and mitigation of its effects on their lives. These beneficiaries have changed their perception of farming systems and are adopting, for example, agro-forestry practices that they had never used before. By intercropping grafted fruit trees and crops, applying organic compost that they make themselves, they have increased their productivity.

Land use and soil management have been improved in the project areas and beyond. The forest landscape has also been restored and is contributing to climate change mitigation and carbon sequestration. The community is now aware of the benefits of the experience

and is committed to protecting the fruit trees on the farms for the fruit production market value chain.

In addition, the experience has encouraged the use of green technologies for irrigation farming, through the use of solar powered water pumps and an ecological water storage tank.



Water Storage Ecological Tank

1.4.3. Solar powered irrigation system to horticulture farmers in Londoto and MsituWaTembo villages in Tanzania

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Solar powered irrigation system

Agriculture in Tanzania consumes over 90 percent of the water with most of it applied using inefficient gravity open canal. This is despite the fact that Tanzania and the Pangani River Basin, in particular, is considered as a “water-stressed” region. Simanjiro district along the Pangani river Basin is a productive agricultural zone, with large-scale farmers and a huge number of smallholder agriculturalists producing food for export internationally as well as regionally in addition to the local market.

The smallholder farmers are over-reliant on traditional furrow irrigation. Increasing the use of water-efficient irrigation could liberate significant quantities of water for productive economic activity and enable more water to be made available for social purposes.

Msituwatambo and Londoto are the villages found in Simanjiro district with a high potential for the production of onion and tomato. Practically, the villages are completely dependent on the Pangani River Basin for irrigation and farmers are over-reliant on fuel pumps for lifting water. However, the use of fuel pumps increases the cost of production and contributes to climate change. As an alternative, the Tanzania Horticulture Association (TAHA) and some of its partners have introduced an experience of using solar-powered irrigation systems (SPIS). TAHA and Rikolto facilitated creating an enabling environment, developing management capacities of smallholder farmer organizations, and linking those that are market-ready to financial institutions with irrigation business plans to succeed.

It also creates the pipeline of business plans for financing. Rikolto and TAHA also sensitized and trained farmers on the cost-benefit of using solar-powered irrigation system (SPIS) loan accessibility, the payback period of the system per acre, quality of the systems, and good agricultural practices. Private Agriculture Sector Support (PASS) provides technical service in assessing viable projects; guarantees in line with perquisites of sources of funding, build

the capacity in project evaluation and preparation of fundable projects as part of seed funding to project initiation.

Simusolar Company limited trained farmers groups. The training includes but not limited to effective and efficient use of the solar pumps and accompanying application system (drip kit), develop or put together the appropriate technological package and costing for 1,2 and 3 acres farms that have been identified as the average farmed by most horticultural farmers. It includes also the development of the relevant materials for technology including for the analysis of profitability and environmental impacts.

The targeted total number of the direct beneficiaries is 467 of which women are 154 representing 33% and youth are 98, representing 21%. The irrigation finance project is designed to ensure that women and young people are integrated into horticulture businesses' commercial value chains. They participate in the establishment and management of demos, production, keeping records, and marketing of the produces. Also, the program developed women's and youth skills to facilitate access to market information, inputs, and agronomic services.

One of the results of the experience is the establishment of six horticulture demonstration plots through solar-powered irrigation systems to ensure useful information is impacted to farmers, collected and organized to enable improvements to be made on technology and financial products. Another result is the mobilization and building potential

capacity of 158 farmers from five farmer's organizations to enable service delivery to their members.

Agricultural production has increased from 2 to 3 or 4 cycles per year: the increasing of farmers' productivity ensures food and nutritional security for farmers. The products are of better quality and safe food thanks to good agricultural management. Farmers' incomes are improved thanks to the increase in the number of annual production cycles, the reduction of operating costs, and the good structuring of markets.



The experience reduced also carbon emissions produced by fuel engines. The experiment makes it possible to have sustainable water for irrigation, and some members of the community use this water for social and domestic purpose which moderates stresses and reduce the distance to collect water for 33% of women who are direct beneficiaries.

The experience included empowerment of decision-making for women as they are owners of systems and participate in the production and marketing of products. Communities still improving economically and environmental resilience and this

led to social cohesion in both villages of Londoto and Msituwatembo.

Solar-powered irrigation system (SPIS) loan accessibility has proven to be a technically viable and competitive option with attractive return on investment.

But SPIS loan accessibility requires an organisation of farmers in cooperatives and saving education.



Horticultural production has increased

1.4.4. Faced with climate change, a chain of solidarity to facilitate access to solar pumps to boost market garden production in Chad

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One of the first beneficiaries in his eggplant field

Agriculture and livestock are the main economic activities in Chad and occupy more than 80% of the population. Livestock breeders are mainly transhumant, moving from the desert north to the south, which has a Sudanese climate during the dry seasons. They return to the north during the rainy seasons. Climate change is resulting in the extension of the desert to the south, making the central Sahelian zone more arid. Some pastoralists are even beginning to settle in the south, putting increasing pressure on the natural resources of this area, where farmers are faced with the problem of livestock devastating their fields.

The reduction in rainfall and its poor distribution in time and space are also major problems that lead to a reduction in agricultural yields. Households are thus exposed to the risk of food shortages and even famine.

Faced with this situation, a large number of households in the village of Koro-Kaga, where the experience is taking place, are turning to market gardening to make up for the food deficit caused by droughts and the devastation of fields by livestock. In order to have access to the water necessary for market gardening, some farmers have dug boreholes equipped with immersion pumps powered by generators, while others use these motorized pumps that they must fuel from Moundou, the nearest town, which increases the cost of their production and reduces their profit margin.

It is in this context that ATASANPE has initiated the project to use solar pumps to help the market gardeners of the village Koro-Kaga gathered in the market gardeners' group «TeenKor», to produce at a lower cost in a sustainable way and to draw more substantial income from their work. To do this, ATASANPE used a participatory approach that allowed for the strong involvement of all beneficiaries in the reflection, negotiation and implementation of the experience. The association negotiated the supply of solar pumps on credit from a supplier in Moundou, with a two-year payment period.

This project benefited 32 members of the TeenKor group, including 19 women, 8 young people, and 2 older people.

Women and young people are in the majority in the group with 59.37% of women and 25% of young people.

As a result, the market gardeners now have sufficient water for their market garden production, as well as permanent and affordable drinking water for the entire village, which has the possibility of obtaining water from the project site.

As a result, the market gardeners now have sufficient water for their market garden production, as well as permanent and affordable drinking water for the entire village, which has the possibility of obtaining water from the project site.

The first phase of the experience has brought about a notable change in the lives of the first three beneficiaries

of the solar pumps. They are using the knowledge they acquired during the training to face the challenges of climate change. Conflicts around water pools have decreased significantly and will be even less important when each beneficiary will be able to install his plot outside the area of the pools, which is often a source of conflict in the village.



Training on the construction of boards for crops

1.5. Community-based Climate Information Systems in Farming Areas to Better Prevent Disasters and Manage the Effects of Climate Change

1.5.1. A climate information system (CIS) to control the agricultural calendar in Burundi

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A farmer receives useful messages for her work

The province of Bubanza in which the experience of sharing climate information for a better control of the agricultural calendar is taking place is located for a large part in the natural region of Mumirwa. This region is characterized by a mountainous terrain with steep slopes, separated by deep gorges that are subject to runoff and seepage, causing huge landslides in some places. In recent years, rainfall has become irregular, with alternating periods of heavy rain and prolonged drought.

A survey conducted in the community of Bubanza shows that farmers and 40% of technical service agents did not know

how to obtain information on climate and climate risks. Because of the lack of weather information, some farmers planted late because they feared insufficient rainfall, while others planted early at the first raindrop. This exposed the plants to excessive rainfall or water deficit. Farmers also had a problem choosing crops that were adapted to the temperature and rainfall of the season. The consequences of this situation were low agricultural production and high household food insecurity.

The experience developed consisted in providing farmers with seasonal climatic information, which helps them to choose the right crops and to better program the sowing, in order to reduce the poor results linked to the discrepancies between the agricultural calendar and the rhythm of rainfall. The dissemination of this information is done through telephone messages sent to them, complemented by a more participatory reading of the seasonal forecasts in consensus interpretation and decision-making workshops on the behaviors to adopt for the season.

The information disseminated is sourced from the Geographical Institute of Burundi (IGEBU) and the Freemeteo.fr website, which are responsible for

disseminating daily weather forecasts. The local hill authorities and the services of the Provincial Office of the Environment, Agriculture and Livestock (BPEAE) played a role in mobilizing the community. ADISCO monitored daily and weekly weather forecasts for the Bubanza province.

To support the dissemination of these forecasts, ADISCO held workshops to share the weather forecasts. It also put its technicians at the service of farmers to help them adapt their agricultural campaign to the seasonal and daily forecasts and more specifically, to adopt resilience practices such as the promotion of short-cycle crops, for example vegetables; the choice of optimal dates for their planting; the promotion of drought- and wind-resistant crops such as fruits and tubers; the planting of forest and agro-forestry trees to protect the fields against erosion, etc.

The governance and climate change resilience watch committees (GCCRWC) receive the information on their telephones and disseminate it once a week through the self-help and solidarity groups and cooperatives to which they are attached.

The implementation of the experience has enabled 120 members of 18 climate

committees, 50% of whom are women, to be trained in the use of the information received on weather forecasts. 138 people belonging to these committees and to the technical services of the communes had previously been trained on the role of the climate committees in the functioning of the SIC (Climate Information System).

As a result of the use of this climate information, farmers are increasingly choosing crops that are resilient to the effects of climate change: 8,000 fruit tree seedlings have been planted, as well as cassava, colocase (taro), yam and sweet potato; 19 collective fields have been planted with cabbage, onions and tomatoes; 152 households have home gardens.



Home gardens with vegetables produced in the dry season thanks to small-scale irrigation

1.5.2. Information and Communication Technology (ICT) becomes a crucial farmer-led research tool on agroecology in some parts of Tanzania

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The use of mobile phone technology has increasingly been advocated to assist small-scale farmers. Development of networks and use of low-cost ICTs, enhances timely access to accurate and reliable information and by itself calls for more investment of the country's limited resources for ICT development.

Mobile communication technologies have become the main tools of ICT for agriculture initiatives and a study in Tanzania argue that the key benefits that mobile phones can deliver to small-scale farmers includes accessing timely information, making markets more efficient and transparency.

Moreover, it has been used to provide advance warning of weather and other risks to climate change issues and accessing services, such as mobile banking or insurances to majority of these smallholder farmers.

Therefore in 2011 Eugenio Tisselli and Angelika Hilbeck from Swiss Federal Institute of Technology (ETH) in collaboration with Chambezi Agricultural Station in Bagamoyo decided to promote their initiatives by bringing agroecological smallholder farmers to the information and communication era using smart phones. It started gradually as voices of the farmers in Swahili as SautiyaWakulima (2011-ongoing), where

a group of farmers in Bagamoyo, Tanzania, shared smart phones to document the effects of climate change, and their agricultural practices for adaptation, using pictures and voice recordings thus creating a shared online repository, and share them on the Internet for a wider discussion.

It focuses on developing and validating a series of ICT platforms that will aid in the process of evaluating the effectiveness of selected agroecological treatments to encourage farmer-led research on agroecology and climate change adaption. After this initial work, then Macho Sauti Project came into being as an innovative collaboration between scientific research institutions and civil society in the development context.

The ICT platform used in Macho Sauti consists of open-source mobile and web applications. This implementation methodology includes human moderation of contents posted by farmers, as well as face-to-face interaction through regular trainings and workshops. Macho Sauti is an Information and Communication Technology (ICT) platform which allows small holders farmers to raise issues, discuss and forge solutions with peer farmers, experts, researchers, and extension officers, using a Smartphone application and website. It is designed for the collaborative creation of multimedia

documents. Farmers are encouraged to use Smartphone technology to report various problematic issues happening at their farms; for example, diseases and share their farming experiences with other farmers, students, and scientists.

Its implementation and optimization are coordinated by SWISSAID Tanzania, by reaching out and training farmers from partner associations. The implementation methodology includes human moderation of contents posted by farmers, as well as face-to-face interaction through regular meetings.

This exchange of knowledge between small-scale farmers and between farmers and researchers encourages the uptake of novel agroecological practices and farmer-driven innovation, and greatly increase the effectiveness

of learning. Face-to-face interactions between stakeholders complement the virtual exchange and the knowledge gained feeds into training manuals and will be synthesized in a compendium of most relevant posts.

For this, 112 smart phones have been distributed to seven farmer's organizations; 224 farmer coordinators who have also been trained to use it. Every coordinator passes on his/her knowledge to a group of up to 15 farmers. Macho is being used as a tool to bring farmers more closely of agroecology through sharing experiences, challenges, and solutions. Up to now the project has reached a total of 1113 small scale farmers in Mtwara region sharing 73 smart phones in small groups of 15-20 farmers, leave Bagamoyo alone.

LOCAL GOVERNANCE SYSTEMS IN RESPONSE TO CLIMATE CHANGE CHALLENGES

2.1. Local Governance Systems for a Collaborative Management of Natural Resources and Agro Ecological Transition

2.1.1. Boussou communities are committed to the sustainable management of the Baoudoumboin inter-village forest in Burkina Faso

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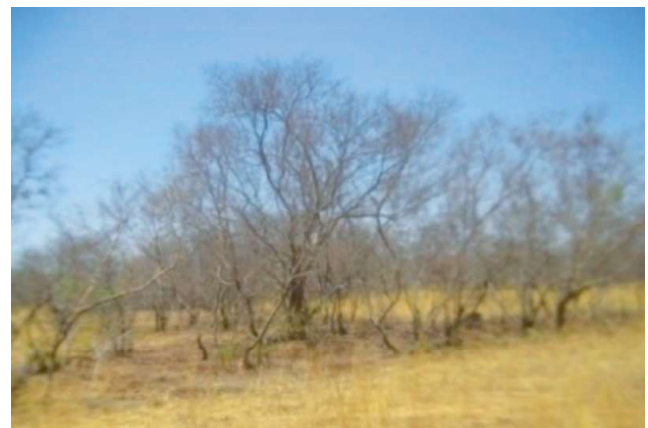


Signage clearly indicates the boundaries of the areas to be respected

In Burkina Faso, the rural sector employs more than 85% of the national population and generates 2/3 of the national wealth. Land, water resources, pastoral, forestry, fishing and mining resources are the main sources of survival for the population and the country's socio-economic development. However, population growth (3.1%), coupled with the deterioration of the country's economic situation, is putting strong pressure on natural resources, resulting in the degradation of vegetation cover and soil, climate change and the loss of biological diversity.

The forest relic of Baoudoumboin in which the project is carried out is located in the commune of Boussou, Zondoma Province in northern Burkina Faso. It covers an area of approximately 400 ha and eight villages share the natural resources of this relic.

Originally dense and teeming with a wide variety of plant and animal species, this forest has undergone a phenomenon of



degradation that has accelerated over the last three decades due to the increase in the population, which derives most of its subsistence resources from this relic, mainly firewood (the main source of energy) and service wood, non-timber forest products, game, grassy pasture

for animals, etc. Further degradation or disappearance of this forest relic would lead to an ecological and economic disaster for the populations.

Faced with this situation, the local communities of Baoudoumbouin, under the leadership of the Wend La Panga Association of hunters in the province of Zondoma, decided in 2010 to create and delimit a conservation area in this inter-village forest, with a view to preserving and managing its natural resources in a sustainable manner. The major challenge of this experience was to reconcile the need for these poor local populations to continue to meet their socio-economic needs with the necessity of preserving and sustainably developing the biodiversity and productive capital of this forest.

The process followed several steps that led to the development of consensus rules to reconcile the often divergent interests of users.

A participatory diagnosis conducted by Inades-Formation Burkina, in order to clearly define the problems and propose sustainable management solutions, resulted in an action plan that included several types of actions setting up a Forest Management Group (FMG) in each village along the river, training communities on topics such as forest management, techniques for the production of seedlings of local species, techniques for grafting local species, materialization of forest boundaries with signs, development of non-timber forest products such as beekeeping, which brings in income for women, environmental education of young

people in the Boussou municipality through the establishment of a Green Club on eco-citizenship.

Inades-Formation Burkina and the Wend La Panga Association led this process in collaboration with the customary authorities who took an active part in the awareness raising and mobilization of the populations around the project, the village communities and the representatives of the Village Development Committees (VDC), the National School of Water and Forests (ENEF). The Ministry of the Environment, Green Economy and Climate Change financed a solar borehole in the protected area and the purchase of fencing to enclose it. The action of Inades-Formation Burkina was supported by Broederlijk Delen.

Approximately 261 women out of a total of 417 people, including 12 customary leaders of the villages bordering the forest, took part in all stages of the process. Among them, fifteen women from the village of Baoudoumbouin organized themselves and benefited from the support of Inades-Formation in order to develop the forest's resources through beekeeping. They operate more than 40 modern beehives. Others exploit non-timber forest products such as fruits, flowers and seeds for processing into by-products such as «sombala», a condiment made from néré seeds, shea butter, etc., which are consumed or sold on local markets.

The young people, especially the students, of whom more than 150 have been sensitized, have organized themselves in the «Green Club» of the Boussou departmental high school.

They are involved in forest surveillance, reforestation and the opening of firebreaks.

The main result of this experience, which accompanied the initiative of the local communities of the Baoudoumboin forest, is the definition of consensus-based local rules for the management of this forest, in order to prohibit bad practices that endanger its natural resources and lead to its degradation.

These rules take into account the use rights of the populations to satisfy their socio-economic needs but also the imperative need to preserve the resources in a sustainable way. The participation of the populations in the development of their own management rules allows them to better respect them, since they are not perceived as having been imposed by the State services.

The other important result of the experience is the delineation of a zone in which these rules are applied. The trees indicating the limits of this zone were painted white and today, nine panels fixed at the edge of the zone clearly indicate these limits. The protected area that constitutes the Baoudoumboin inter-village forest shared by eight

riparian villages covers an area of 328 hectares.

In addition, the action plan developed has resulted in the planting of more than 200 trees in this forest, every rainy season, since 2012. The firebreaks made at the beginning of the dry season allow the effective fight against bushfires. The surveillance of the forest by members of the Wend La Pangaide Association helps to fight effectively against poaching and abusive wood cutting, while a solar



borehole supplies water to wild animals. All these actions have allowed for the strengthening of the vegetation cover, species that were on the verge of extinction have reappeared and have allowed the soil to regenerate. Wildlife has also multiplied in this reserve. The experience has created a microclimate favorable to the life of animals and men.

2.1.2. People of the Mai-Ndombe Province in DR Congo invest in the management of community forests threatened by anarchic industrial and artisanal exploitation

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In the Democratic Republic of Congo (DRC), forests are often allocated to industrialists or artisanal loggers for the production of timber or charcoal. This often anarchic exploitation constitutes a serious threat to natural resources and the survival of local populations.

The territory of Oshwé in the Mai-Ndombe Province covers an area of 4,158,998.260 ha. Timber exploitation is practiced there without an appropriate forest management program. It is aggravated by the carbonization activities practiced by artisans to meet the demand for charcoal in large Congolese cities and even in other countries.

In addition to this anarchic exploitation of the forests by industrial and artisanal loggers, local populations and native peoples who are members of the Imoma, Mbentenko and Bokwankoso groups in particular, destroy trees in search of land for cultivation, even when they are nourishing species, including plants useful for traditional pharmacopoeia or for honey production. These cuttings, not associated with reforestation, destroy the forest cover, thus disrupting rainfall and the agricultural calendar. They cause animals to flee the devastated areas and push the populations in search of game to move over great distances, which sometimes leads them to areas occupied

by other groups and are sources of conflict.

Faced with this situation, the local communities and native peoples of Mbentenko, Bokwankoso and neighboring villages have requested permission from the authorities to acquire forest concessions. They joined forces with the communities with which they share the traditional forest area to delimit the two concessions acquired.

To support this process, the team from the NGO Lothman Développement has led sessions to raise awareness and inform these populations on a permanent basis about several topics: climate change and community forestry as a means of combating the effects of this change; more appropriate forest preservation and management practices for better community development.

These communities have set up constituent assemblies for each of the two concessions acquired. Each of these assemblies includes all the inhabitants of each community and is chaired by an elected representative who is assisted by four delegates.

Through the effective participation of village councils and other community members, these populations also participated in the selection of members

of the Local Development Committees (LDCs) and Local Monitoring Committees (LMCs). The capacities of these committees have been strengthened in various areas, including good governance and the use of management and monitoring tools.

The NGO Lothman Développement supported the communities of Mbenteko and Bokwankoso in the drafting of a development plan and a simple management plan for the sites obtained. These plans make it possible to allocate specific areas of these sites to different activities, taking into account the presence of natural resources to be managed or preserved and the quality of the soil. Participatory mapping has produced maps of the two community concessions of 36,010 ha and 35,720 ha granted to Mbenteko and Bokwankoso respectively. Several activities are being carried out, including food and fruit agro-ecology, the combination of food crops with tree planting to combat slash-and-burn cultivation, reforestation of bare soil, aquaculture, selective fishing in rivers and streams, and the fishing by women in large community ponds, the reasoned artisanal exploitation of certain forest species for the construction of houses, the preservation of certain spaces for ecotourism and selective hunting, the integrated management of water from rivers, streams and springs, etc.

Meetings were held with traditional authorities to explain the issues of community forestry and the role of the various committees set up.

This community forestry experience

has directly affected 1,220 people in Mbenteko and 1,760 in Bokwankoso in the Mai-Ndombe Province. The experience provides a good opportunity for these communities to assert and recognize their rights to the land and forests where they have lived for generations. It also allows them to improve their socio-economic conditions and to contribute to the fight against deforestation, a source of global warming. These communities can also better manage and preserve their forest concessions, which are their supermarkets.

Today, with the securing of their community forests, the local communities and indigenous pygmies of Mbenteko and Bokwankoso have a space where they can preserve their traditional life in the face of the monopolization and abusive industrial and artisanal exploitation of these spaces for timber. The income generated by fishing in the community ponds, the transport of agricultural products by bicycle and tricycle to the Lokoro River where the bales are parked for their evacuation to the markets of Inongo and Kinshasa, allow for the financing of community development. This experience has also created strong ties between the communities of Mbenteko and Bokwankoso and the neighboring communities, which consider them as models within the Imoma group, thanks to the maintenance of agricultural roads that allow them to open up. Finally, thanks to this experience, nearly 2,500,000 ha of forests have been preserved from the abusive exploitation of their resources since 2016.