



Economic performance of climate change adaptation activities in the Volta Basin

Jacques Somda, Marcel Innocent Naba, Alice Paule Onadja



CENTRAL AND WEST AFRICA PROGRAMME (PACO)



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Authors and affiliations

Jacques Somda, International Union for Conservation of Nature (IUCN),
Central and West Africa Programme (PACO)

Marcel Innocent Naba, Consultant

Alice Paule Onadja, International Union for Conservation of Nature (IUCN),
Central and West Africa Programme (PACO)

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01 BP 1618 Ouagadougou 01; Tel.: +226 5036 4979 - 5036 4895

Email : paco@iucn.org

Web : www.iucn.org/paco

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LIST OF ACRONYMS AND ABBREVIATIONS

VBA	:	Volta Basin Authority
AEN	:	Agence de l'Eau du Nakanbé (Nakanbe Water Agency)
BAAC	:	Benefits arising from Adaptation Activities to Climate Change
DCAAC	:	Direct Costs of Adaptation Activities to Climate Change
RCAAC	:	Residual Costs in spite of Adaptation Activities to Climate Change
TCAAC	:	Total Costs of Adaptation Activities to Climate Change
TCAACp	:	Total Costs borne by producers in implementing Adaptation Activities to Climate Change
IWRM	:	Integrated Water Resource Management
MFA	:	Ministry for Foreign Affairs (MFA) of Finland
NGO	:	Non Governmental Organisation
PACO	:	Central and West Africa Programme (Burkina Faso)
PAGEV	:	Project to Improve Water Governance in the Volta Basin
RPAAC	:	Relative Performance of Adaptation Activities to Climate Change
REAAC	:	Revenues of Adaptation Activities to Climate Change
IUCN	:	International union for conservation of nature
TSZ	:	Technical Support Zone

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EXECUTIVE SUMMARY

Climate change poses a major challenge to economic and social development throughout the world and particularly in Africa. Thus, many African countries have developed and are implementing national climate change adaptation plans of action. However, very little attention has been paid to evaluating costs and benefits of promoted adaptation actions to reduce impacts at country level and on the most vulnerable socioeconomic groups. Increasingly, economic aspects of adaptation to climate change capture interest in the literature and deliberations on adaptation measures to be taken. These aspects are also taken into consideration in donor policies. In fact, policy makers at all levels of the administration need information to answer the following questions:

- How many losses caused by climate change can be avoided for economies and societies, and using what adaptation measures?
- What investments will be required to fund these measures?
- Will the benefits arising from these investments be greater than the costs of such investments?

This study presents an evaluation of the economic performance of some adaptation activities promoted by the International Union for Conservation of Nature (IUCN) in Burkina Faso and Ghana. The overall objective of the evaluation is to contribute to participatory learning about economic benefits of climate change adaptation initiatives. Specifically, it aims at (1) identifying and analyzing the content, scope and relevance of adaptation activities and (2) evaluating the costs and benefits generated by such activities.

Economic evaluation methods were applied to adaptation activities using the income statement techniques and cost-benefit analysis in order to contribute to the discussions on whether it is legitimate for the government to invest in activities whose expected benefits are geared to private households. The costs of carrying out adaptation activities include direct costs incurred by beneficiaries (inputs and factors of production), funds provided by projects, and residual losses in spite of implementing adaptation activities. The benefits of adaptation activities are not only monetary. They include monetary values of products generated by the adaptation activity and non-monetary contribution to the restoration of degraded ecosystems. Economic and environmental data were collected using a questionnaire and a semi-structured interview guide with 194 participants who had executed four adaptation activities (reforestation/tree planting, gardening, rearing of small ruminants and secured warranting of crops). Descriptive statistics and contents analysis techniques were used to analyse the collected data.

The findings confirm that it is legitimate for the government to invest public resources in climate change adaptation measures. In fact, the survey sample experienced several climate related events during the last five years of which the main ones are drought (97% of respondents) and floods (86%). The proportion of people who have actually been affected by floods and droughts is respectively 36% and 76%. This justifies their participation in adaptation activities promoted by the project. Thus, gardening/vegetable production is practiced by 49% of the sample. Reforestation /tree planting involved 37% of the sample. The construction of compost pits, secured warranting and livestock have been developed respectively by 29%, 19% and 4% of respondents. The results of economic analysis show that from a private point of view, adaptation activities have been financially beneficial to the participants. In fact, one CFA franc invested in adaptation activities has generated 169 CFA Francs for gardening/vegetable production, 22 Francs for rearing small ruminants, 20 CFA Francs for secured warranting and 16 CFA Francs for reforestation/planting fruit trees. From a society point of view, investments made by the project and beneficiaries generated an internal rate of return of 30%, much higher than the interest rate of bank savings in Burkina Faso.

However, constraints were identified on the level of the beneficiaries' skills to successfully carry out adaptation activities. This situation has certainly influenced the level of the economic and ecological performance obtained. It implies that the promotion of adaptation activities in rural communities must include building technical skills and ensuring proper monitoring and evaluation to enhance the contribution of such activities in reducing the impacts of climate hazards.

Key words: climate hazards, costs, benefits, adaptation, Volta Basin, Burkina Faso, Ghana

1. INTRODUCTION

Adaptation to climate change is an economic priority for African populations at local, national and regional levels. Policy makers at all levels of the administration need information to answer the following questions:

- How many losses due to climate change can be avoided in economies and societies, and with what adaptation measures?
- What investment will be required to fund these measures?
- Will the derived benefits from these investments outweigh the costs of such investments?

However, the answers to all these multiple questions are still rare in climate change literature and especially on adaptation to its impacts. Studies have highlighted the lack of tools for systematic assessment of climate risks. The Intergovernmental Panel on Climate Change has noted that "several adaptations can be performed at low cost, but a comprehensive estimate of the costs and benefits of adaptation are presently lacking". Significant work has been done to identify adaptation measures recorded in national adaptation programmes of action, carried out in more than 40 least developed countries. In contrast, little or no systematic approaches have been used to calculate and compare the economic costs and benefits of these measures based on field data.

In the absence of such approaches, it is almost impossible to identify gaps in the implementation of adaptation measures proposed to local communities and especially to adjust the content of concerned technological packages. It is therefore opportune to experiment the economic analysis tools on adaptation in order to improve the decision-making processes at local, national and transnational levels.

The International Union for Conservation of Nature (IUCN) has initiated several projects and programmes related to climate change adaptation in West Africa. Its mission is to influence, encourage and assist societies to conserve the integrity and diversity of nature and ensure that natural resources are used in an equitable and sustainable manner. To this end, IUCN produces scientific information and avails it to decision-makers and users of natural resources for well-informed decision making.

This performance evaluation of adaptation actions thus contributes to achieving its mission. It was carried out on adaptation actions that the Central and West Africa Programme (PACO) has supported in Burkina Faso and Ghana through two projects: the Project "Improving Water Governance in the Volta Basin" (PAGEV) and the project on capacity building on climate change adaptation (CC-Sida)¹.

The overall objective of the evaluation is to contribute in participatory learning about the economic benefits of climate change adaptation initiatives. Specifically, it aims at (1) identifying and analyzing the content, scope and relevance of adaptation activities and (2) evaluating the costs and benefits generated by promoted adaptation activities through analysing technical, environmental and economic performances.

¹The 2 projects are funded by the Swedish International Development Agency (Sida). The Ministry of Foreign Affairs of Finland funded the conduct of this evaluation through the "Climate Change and Development" project.

2. LOCATION AND FEATURES OF THE INTERVENTION AREA

The intervention area of this study is in the Volta Basin and covers the Centre-East region of Burkina Faso and the North-West region of Ghana. The basin total area is about 400,000 km², of which 85% is shared between the two countries. The basin has been subjected for decades to intense exploitation of natural resources which undermines the economic development of dependent local communities in six countries (Benin, Burkina Faso, Côte d'Ivoire, Ghana, Mali and Togo). This intense exploitation is partly causing the silting of waterways and shoreline erosion of which one of the consequences is the quantity and quality decline of ecosystem goods and services that support the well-being of the populations.

Added to these anthropogenic phenomena are the effects of climate change. Rural communities in the Volta Basin will face continuous alterations of the climate in the region (Giesen et al, 2010). Several climate hazards with negative effects on the livelihood resources of local communities of the basin have been identified. The most serious are floods, drought and strong winds. The observed effects by communities include decrease and/or loss of agro-sylvo-pastoral productions, loss/reduction of incomes, destruction of infrastructure, increased health problems, etc. Several adaptation options are needed to avoid the vicious circle of poverty and vulnerability to climate change.

In this context, the IUCN with financial support from the Swedish International Development Agency (Sida) has facilitated the execution of projects in the Nakanbé sub-basin. A 1600 km² pilot site was selected from downstream of the Bagré dam in Boulgou (Centre-East) Province and the Gambaga escarpment in the Garu Tempene Districts in Ghana (Upper East Region). Villages covered by the study are Zékézé, Sambaregou, Belayerla, Beka, Sablogo, Bissiga, Lalgaye, Tenkodogo, Soudigui and Mogr-Noore in Burkina Faso and Mognori in Ghana. This area is mainly characterized by blackish clay and sandy loam soils. Map 1 shows the intervention area.

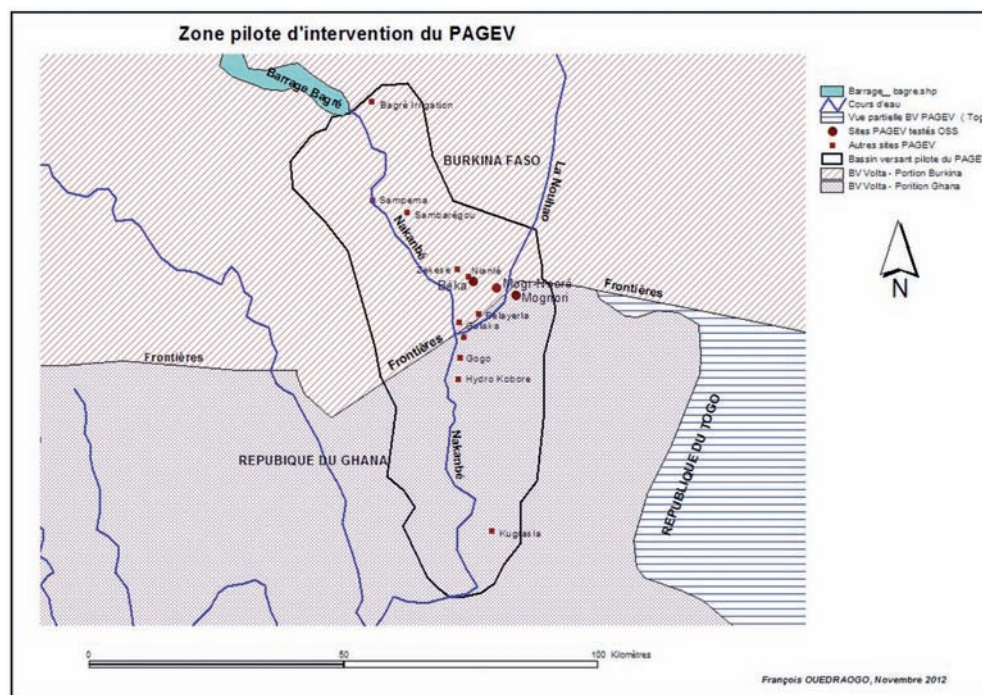


Figure 1 : Location of the intervention area

3. METHODOLOGICAL APPROACHES AND LIMITATION OF THE STUDY

3.1. Conceptual considerations

Performance evaluation is one of the economic evaluation techniques of an activity or intervention. It allows showing that an intervention or activity is successful, technically and / or financially or economically. The concept of performance refers to the idea of accomplishing an action. This action has to be undertaken and completed, without any a priori about its nature or the level of the expected result. In a common understanding, performance is precisely the fact of obtaining a result, which of course implies that this result should be "good". This concept comprises three components which are relevance, effectiveness and efficiency. Each of these components measures the relationship between the objectives of an intervention, the resources used and the results obtained (Figure 2). Thus, the effectiveness is the extent to which the development intervention's objectives were achieved, or are expected to be achieved, taking into account their relative importance, while efficiency is a measure of how economic resources/inputs (funds, expertise, time, etc.) are converted to results (OCDE, 2002). Finally, relevance is the extent to which the objectives of a development intervention are consistent with beneficiaries' requirements, country needs, global priorities and partners' and donors' policies.

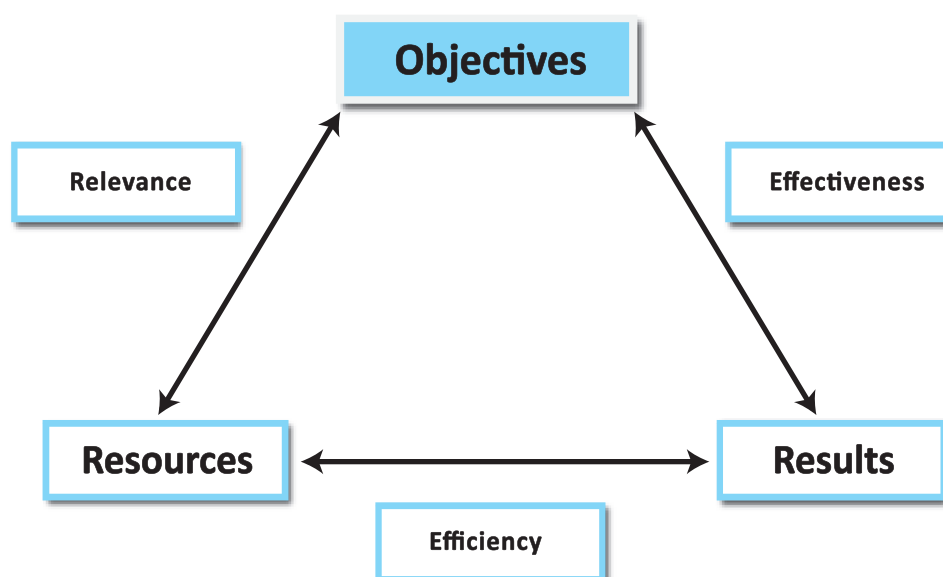


Figure 2: The three components of performance

Within the framework of this study, the economic performance of adaptation actions has to do with the execution of actions capable of generating economic and environmental results. In general, positive results are expected. Analysis of the economic performance of actions therefore takes into account an assessment of the relevance, effectiveness and efficiency of the promoted actions, as well as economic results achieved.

3.2. Data collection methods

The nature of promoted actions and the type of actors involved in the implementation have guided the choice of the appropriate approach. The option to involve the main actors in the process of collecting and analyzing information has been preferred in order to minimize the risk of errors. The review of available secondary data in project documents helped clarify the extent of primary data collection in the field and the various actors to be involved.

Data collection was conducted through focus group interviews and individual surveys. Focus group interviews involved actors who took part in collective actions such as seedling production, reforestation and exploitation of non-timber forest products (NTFPs). They were collected in Mogr-Noore, Beka and Bissiga communities. Each focus group brought together twenty participants including 10 women. Depending on the nature of the intervention, focus groups were formed into groups of men and women. Individual interviews were also conducted with technical and non-governmental organizations that play an active role in the execution of the two projects. These interviews (individuals and groups) made it possible to collect information on environmental variables including key climate hazards, activities promoted, and quantities of valued resources, strengths and weaknesses as well as opportunities for capitalisation and sustainability of interventions. A semi-structured questionnaire was used for this purpose. Villages covered by group interviews are Bena, Syaléghin and Tikaré in the Bissiga Council and Lagwenda in the Tenkodogo Council.

Alongside, an individual questionnaire survey was conducted on a sample of beneficiary actors involved in the execution of adaptation actions. Target sample of 194 individuals (Table 1) was surveyed out of a forecast of 204, which is 95% of achievement. The total number of beneficiaries of various adaptation actions covered by this evaluation is estimated at 500 people. The data collected during this investigation concern the description of promoted adaptation actions, their implementation costs and cash income generated per production cycle.

Table 1 : Survey sample (Number of persons, unless otherwise indicated)

Countries/Council	Planned	Accomplished	Coverage rate (%)
Burkina Faso	154	147	95
Bissiga	100	94	94
Bittou	54	53	98
Ghana	50	47	94
Total	204	194	95

Source : authors (2012)

3.3. Data analysis methods

Individual survey data were analyzed using Excel and SPSS software. Descriptive statistics were calculated on a number of variables to characterize participants involved in promoted adaptation actions. Then, income statement techniques were used to estimate the costs and revenues generated by these actions, in order to evaluate their economic performance (financial and technical). A cost-benefit analysis was done to assess the internal rate of return and the net present value of investments in relation to climate change adaptation activities. Finally, data from group interviews were also statistically processed through the frequencies of various responses to questions asked.

3.3.1. Analysis of income statement of adaptation activities

Analysis of income statement is based on the simplified accounting method described by Boehlje and Eidman (1984). This method provides information on the level of production achieved in adaptation activities and quantities of inputs. Thus, the levels of production and inputs were estimated for gross revenue and the cost of production for each activity. The difference between the gross revenue and the cost of production was used to estimate the benefits of adaptation activities to climate change (BAAC). Revenues and costs related to the carrying out of activities were estimated as follows:

- revenues from adaptation activity to climate change (REAAC) include the monetary value of the total quantity produced;
- total costs incurred through the implementation of adaptation activities to climate change (TCAAC) include:
 - a. Direct costs (DCAAC) which correspond to the sum of the monetary values of the inputs used. Depending on the adaptation activity carried out, the direct costs of production include seeds, fertilizers and pesticides used, manpower used in the production and grain winnowing/threshing, livestock and veterinary inputs, small farming implements.
 - b. Residual costs (RCAAC) correspond to the sum of the monetary values of residual losses incurred after the execution of the action and due to the climate hazards. The possibility of negative residual impacts from climate hazards was discussed by Weikmans (2012), in that it is impossible for an adaptation activity to eliminate all the impacts of climate hazards. Actors have estimated the value of losses in spite of the execution of adaptation activities.

The following formula was used to estimate the benefits of climate change adaptation activities to (BAAC) per promoter:

$$BAAC = REAAC - \sum_{i=1}^N DCAAC_i - \sum_{j=1}^M RCAAC_j$$

These benefits represent the levels of financial performance in absolute terms which make it difficult to compare performance between adaptation activities. In order to facilitate their comparison, the ratio of financial performance was calculated representing the financial performance in relation to each CFA Franc invested in the production of adaptation activity. The following formula was used to calculate the relative performance of adaptation activities (RPAAC)

$$RPAAC = \frac{BAAC}{TCAAC_p}$$

Where $TCAAC_p$ = Total cost incurred by the producer in executing adaptation activities and corresponds to the sum of direct costs (DCAAC) and residual costs (RCAAC).

Descriptive statistics of mean, standard deviation, minimum and maximum were calculated to assess the central trends and dispersion of benefits derived from adaptation activities carried out by the populations.

The analysis of income statement was applied to adaptation activities for which the collected data allowed to do so. It concerned gardening, livestock, fruit reforestation, secured warranting. For the production of compost and non-timber forest products, the quality of the data did not allow for income statement to be used. Finally, analysis of the income statement includes the sample surveyed on intervention sites in Ghana and Burkina Faso.

3.3.2. Cost-benefits analysis of investments in adaptation activities

The implementation of adaptation activities is based on a decision to allocate associated financial resources. Cost-benefit analysis is based on the assumption of maximizing the difference between the benefit and the cost of an investment. This difference measures the level of efficiency of the decision to allocate resources to a given investment (Brent, 1996). The application of this method required data used for the preparation of the income statement of activities. But, in addition to direct and residual costs incurred by promoters, funds received from projects were included. Funds received by promoters were obtained from the contracts signed between service providers and IUCN: rural development technical services and NGOs. Thus, revenues and costs related to the execution of activities were estimated as follows:

- Revenues derived from adaptation activity to climate change (REAAC);
- Total costs incurred (TCAAC) during the execution of adaptation activities include costs incurred by IUCN through projects and those borne by the producers (TCAACp). Contracts were signed between IUCN and executing partners of the Burkina Faso and Ghana sites.

Two performance indicators for investments in adaptation activities were calculated: (1) the net present value (NPV) and (2) the internal rate of return (IRR). The following formulas were used:

$$NPV = \sum_{t=1}^3 \frac{(REAAC - TCAAC)^t}{(1+i)^t}$$

$$0 = \sum_{t=1}^3 \frac{(REAAC - CTAAC)^t}{(1+IRR)^t}$$

Where i is the discount rate, $t = 1$ to 3 years the number of years covered by the analysis, and other parameters as previously defined. Finally, the cost-benefit analysis concerned investments on the sites in Burkina Faso.

3.4. Limitations of the study

Data collection coincided with the rainy season, with significant pockets of flooding in the area, including some study sites such as Mogr-Noore and Beka (Photo 1). This situation made it impossible to visit all sites to consolidate the data collected.



Flooded field during the survey in August 2012 in the village of Zékézé (Burkina Faso)

Floods in 2012 have destroyed 23 133 ha of sorghum, 88.25 ha of rice, niebe, groundnut, cotton, soya, pawpaw farms and carried away animals. The affected sites are Zékézé, Bèka, Yanti, Bélayerla and Mogr-Nooré ».

Source: Agriculture Officer in Tenkodogo (personal communication, September 2012)

4. SOCIO-ECONOMIC AND CLIMATE HAZARDS PROFILES OF RESPONDENTS

The surveyed sample is relatively homogeneous in terms of economic activity, with 94% engaged in agriculture as their main activity. Livestock breeding and petty trade are secondary activities for 26% and 15% of respondents respectively. Generally, they are engaged in several economic activities depending on the periods of the year. The majority are not educated (68%), while 21% are literate in the local language and 10% attained the level of primary education. The average household size is 8 persons with more than 51% with 6-10 dependents in their household (Table 2).

Table 2: Distribution of respondents according to number of dependents

Household size (number of persons)	Number of persons	Frequency (%)
1 to 5	48	24,7
6 to 10	99	51,0
11 to 15	28	14,4
16 and more	19	9,8
Total sample	194	100

Source: Survey data from beneficiaries (2012)

The surveyed sample has experienced several hazards in recent years of which the main ones are drought (97% of respondents) and floods (86%). Thus, the years 2007, 2008 and 2012 were cited as the years they witnessed floods, while 2011 was considered a dry year. Table 3 summarizes the classification of two main climate hazards within the study sample.

Table 3: Classification of the two main climate hazards observed

Main climate hazards observed	Rank by respondents (Persons)		Final rank		
	1 st	2 nd	As per the sample (% of persons)	As per the total (% of persons)	Final Classification
Flood	74	92	86	47	2 nd
Drought	120	68	97	53	1 st
Total	194	160	194	354	

Source: survey data (2012)

Several features enable communities to describe each of the hazards to which they were exposed. The main manifestations of floods include heavy rainfall (95.7%) and silting of some waterways (4.2%). Droughts are manifested by insufficient and / or irregular rainfall (87.3%), destruction of vegetation cover (21.4%) and the late start of production activities (3.1%).

An analysis of the levels of exposure and sensitivity to the two main climate hazards observed was made by respondents. The findings (Table 4) indicate that 47% of the 166 people who mentioned flooding have been exposed to this hazard. Their livelihoods are located in areas where floods occur. However, the proportion of people who have actually been affected by floods is estimated at 36%. These people have lost all or part of their production due to the floods.

Tableau 4: Distribution of respondents according to causes of climate hazards

Main climate hazards	Exposure (%)	Sensitivity (%)
Floods	47	36
Drought/serious heat	100	76

Source: Survey of beneficiaries (2012)

Agriculture, the mainstay of the majority of respondents, was mainly affected by climate hazards. Thus, 78.4% registered declines in crop yields resulting in low production. The short-term effects reported by 51% of respondents include tree mortality and land drying up. A long-term persistence of these hazards will lead to food insecurity, displacement of populations towards other lands with its corollary of resource degradation and emergence of conflicts on resource use. In addition to lower yields, 11.2% of promoters cited animal mortality as another impact. Droughts cause drying up of pastures and lack of food and water for animals. Drought would also favour the occurrence of non-climate hazards such as termites that contributed in the destruction of trees and the fostering of bushfires.

Several actions are taken by communities to adapt to the negative effects of the two main climate hazards. The findings of the survey (Figure 4) show that the main adaptation activities carried out with the intervention of the IUCN are eight in number. Three adaptation practices are the most frequently implemented by the survey sample: soil fertilization (22%), reforestation (15%) or construction of compost pits (13%).

Soil fertilisation is in fact a restoration of soil properties (structure and chemical composition) of farmlands. It makes more use of organic manure and chemical that improves the structure and level of fertility. Reforestation or tree planting is a common local adaptation activity carried out on household farmlands. It concerns useful trees (fruit trees, fuelwood, shelters, etc...). The construction of manure pits or production of composts is an activity driven by interventions, but the adoption rate is still low. Constructed pits are not stabilized and are subject to regular destruction by climate hazards such as flooding.

Other practices are relatively less common, such as pesticide use, making of stone barriers, use of improved variety, relocation of crops from river banks and the fight against bushfires. Others are rare with the survey sample. It concerns the practice of vegetable production (about 3% of respondents)

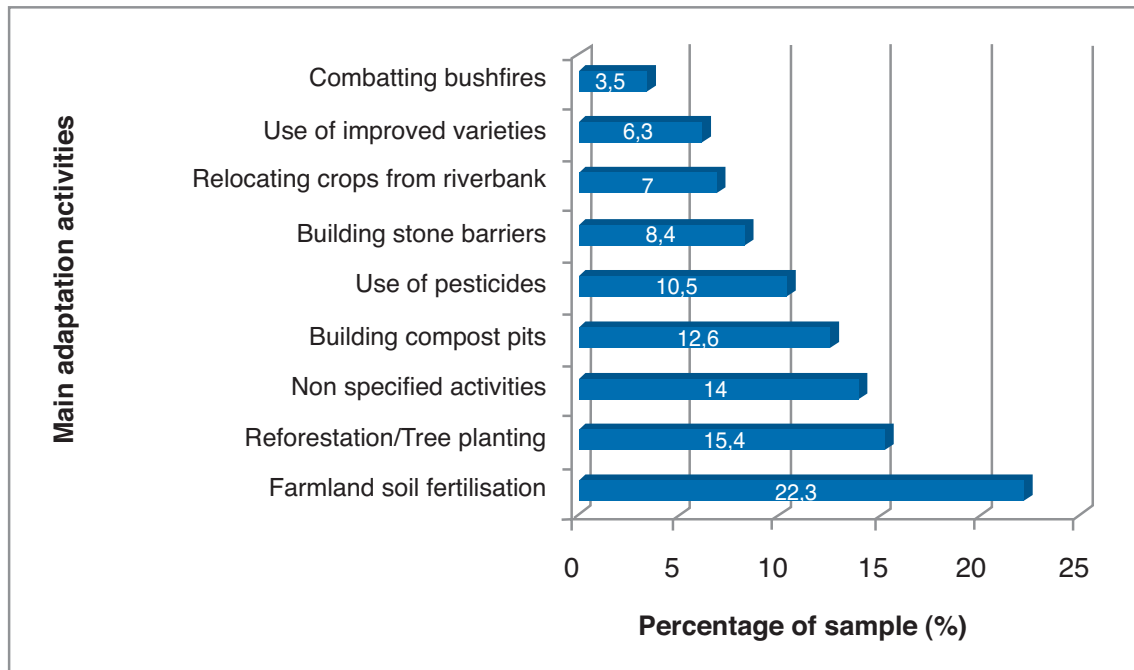


Figure 3: Main adaptation activities carried out without intervention

Although these adaptation activities are already known in the surveyed communities, their effectiveness remains mixed for several reasons. Firstly, they have not been promoted in the past on the basis of their potential role in building the capacity to adapt to the effects of climate change. It should also be noted that some respondents (14% of the sample) were not able to accurately describe the type of adaptation activity carried out before the intervention. However, this group might have implemented adaptation before joining the IUCN-led adaptation activities.

The analysis of the participating sample in the activities promoted by IUCN (Figure 5) indicates that vegetable production was the most appealing activity to communities in the intervention sites. It is practiced by 49% of the sample. Reforestation/tree planting involved 37% of the sample. The construction of compost pits, secured warranting and animal breeding have been done respectively by 29%, 19% and 4% of respondents. Finally, the exploitation of non timber forest products involved 2% of the sample. A gender-based analysis shows that women are more present in gardening (41%) and least in reforestation (7%). This is explained by the fact that reforestation is done in farmland that are usually managed by men. The rearing of small ruminants has been specifically promoted for women (100%).

In general, it should be noted that about 40% of the sample take part in more than one promoted activity. This shows that the combination of activities within the same household is also an adaptation strategy against the adverse impacts of climate hazards in rural areas. This strategy is consistent with the principle of diversification of livelihoods resources as a risk management technique.

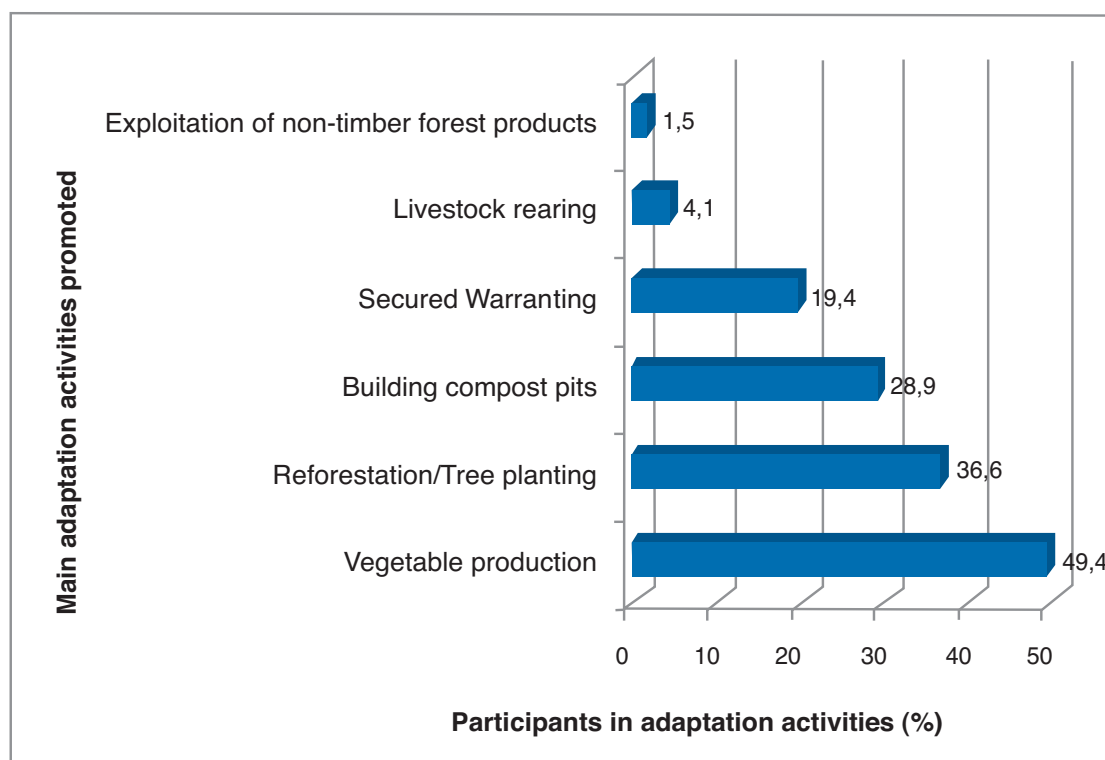


Figure 4: Participation in adaptation activities promoted by the intervention

The comparison between situations before and after intervention shows an increase of adaptation activities. In particular, reforestation/tree planting practiced by communities before the intervention increased from a gross adoption rate of 15% to 37% of respondents. The construction of compost pits for the production of compost increased from 13% to 29% of practitioners. Gardening that was not clearly put forward as an adaptation activity mobilized the highest number of participants (49%) in the intervention to build the capacity to adapt to climate change. Finally, secured warranting promoted as a substitute for local management of agricultural stock also presents an acceptable situation for promoters. However, the small number of participants in the breeding and exploitation of non-timber forest products could be explained by the weak monitoring of execution put in place. This situation has not allowed promoters to make use of best management practices for these activities.

5. DESCRIPTION OF PROMOTED ADAPTATION ACTIVITIES

5.1. Multi-purpose reforestation/tree planting

This activity was implemented in seven villages in Burkina Faso (Zékézé, Mogr-Noore, Beka, Sampema, Sambaregou, Nianlé, Belayerla) and 7 others in Ghana (Gogo Galaka, Basua, Nafkoga, Mognori, Kugrasia, Kubore). It consisted in planting various tree species (fruit and fixing trees) along River Noaho (tributary of Nakanbé (White Volta)) and at a distance ranging from 30 to 70 meters from the shore. This distance which conforms to technical recommendations regarding farming along waterways is the handiwork of riverside farmers. In order to ensure organization of reforestation, monitoring and compliance with application standards for this activity, shoreline management committees were set up by members of the communities. Nurseries were created for the production of seedlings. Seedlings were sometimes purchased to supplement this production due to production difficulties faced by local nurseries. Services in charge of the Environment and Sustainable Development and NGOs were responsible for providing counselling-support, training and guidance to community members.

Table 5 summarizes the status of reforestation in the country during the two intervention phases of PAGEV. Thus, 88,843 trees were planted in Burkina Faso and Ghana with a survival rate of 54.1%. The total distance of shorelines involved in this reforestation is estimated at 41.4 kilometres on the Burkina Faso side and 11.25 km in Ghana.

Table 5: Reforestation activities in Burkina Faso and Ghana

Countries/Phase	Planted	Living	Survival rate (%)	Planted distance (km)	Surface equivalence (ha)
Burkina Faso	65 381	41 071	62,8	41,4	62,3
Phase 1	31 423	17 002	54,1		
Phase 2	33 958	24 069	70,9		
Ghana	23 462	6 976	29,7	11,25	16,9
Phase 1	5 426	2 066	38,1		
Phase 2	18 036	4 910	27,2		
Both	88 843	48 047	54,1	52,6	79,2
Phase 1	36 849	19 068	51,7		
Phase 2	51 994	28 979	55,7		

Source: Field monitoring report, summary, IUCN/PAGEV, July 2012.



Community nursery with mango grafted at Mognori (Ghana)

Source: Project Completion Report, IUCN / PAGEV October 2007

This community-based adaptation activity has several benefits for local communities along the Noaho who are suffering the effects of climate hazards such as floods and strong winds (Somda et al. 2011; Ouédraogo, 2012). In fact, repeated floods in this area are localised on bare shorelines. The reconstitution of the vegetation cover will help reduce the force of floods and thus the destruction of crops, loss of land and animal mortality that are impacts currently observed. In the medium and long term, rehabilitation of ecosystem goods and services in the sub-basin will increase the livelihoods of riparian communities that are still heavily dependent on natural resources. Similarly, the winds observed in some communities will be weakened and will cause less destruction of roofs of houses and falling trees.



Cornfield at Mogr-Noore (Burkina Faso)

Source: Activities monitoring, IUCN / PAGEV July 2012

5.2 Vegetable production

Support to vegetable production in the area was originally designed as compensation for communities' members willing to restore and protect the river banks of the Noaho. In fact, reforestation of the banks has required relocating productions that were taking place very close to the river and which contributed to its degradation. This relocation is a factor that weakens the adaptation capacity of community members affected by the reduction of production and therefore incomes. Consequently, it was proposed as compensation to the people that they practise gardening on reforested lands. A kind of agro-forestry was developed. While the producers water their vegetable crops, they keep up the planted trees during the dry period.

On the other hand, the evaluation of livelihoods, vulnerability and adaptation strategies to the effects of climate hazards in some villages of the area (Somda et al. 2011) reported that vegetable production is an integral part of multiple adaptation strategies in these communities. Similar conclusions were made by Romero et al. (2011) who also stressed that vegetable production is a climate change adaptation activity, most appropriate for women. In the study area, floods and drought are the main causes of crop losses and hence drop in agricultural production and they contribute to impact food security, amongst others. Vegetable production thus helped generate incomes to buy cereals, to contribute to the reduction of food insecurity and to meet other basic needs. It involved both women and men.

Table 6 summarizes the magnitude of promoted vegetable production. Support for vegetable production consisted of motor pumps, vegetable seeds and capacity building of communities on production techniques and monitoring on the plot. Vegetable production was carried out in the same villages as those involved in reforestation for the protection of the Noaho river bank. Technical services in charge of agriculture and water resources and NGOs have provided training to promoters, through counselling-support and monitoring of vegetable production.

Table 6: Vegetable production in Ghana and Burkina Faso

Countries/Achievements	2009	2011	Total
Burkina Faso			
Number of farmers	270	632	902
Surface area (ha)	9,3	41,9	51,2
Ghana			
Number of farmers	302	828	1130
Surface area (ha)	73,5	217	290,5
Total (Ghana et Burkina Faso)			
Number of farmers	572	1460	2032
Surface area (ha)	82,8	258,9	341,7

Source: Field monitoring report, summary, IUCN/PAGEV, July 2012.



Cabbage field at Mognori (Ghana)

Source: Activities monitoring, IUCN / PAGEV, March 2012

In Burkina Faso, the number of participants in this activity increased by 134% with an increase in the surface area planted of 355% in two years of intervention. In Ghana, the number of participants grown from 302 in 2009 to 828 in 2011, that is 174% increase, with an increase in the surface area planted of 195%. In all, the number of participants in vegetable production has increased by 155% with an increase of 213% in the surface area planted between 2009 and 2011. These increases reflect community interest in this activity.



Vegetable production of onions at Kubore (Ghana)

Source: Activities monitoring, IUCN / PAGEV, March 2012

5.3 Breeding of small ruminants

Support to the breeding of small ruminants is part of the diversification of production activities of women. In fact, in the project intervention area, women generally practice crop production and petty trading activities to generate the income they need. These routine activities by women are strongly influenced by climate hazards (floods and drought), and diversification into small ruminants (sheep in particular) seems to be a climate risks management strategy. It therefore enables women to reduce agricultural production losses that destroy the development of petty trading activities, mainly based on agricultural products.

Support for breeding was organized around the principle of rotation of reproduction capital. In the beginning, breeders' endowments were made to 16 women and 4 men. The beneficiaries have to rear animals up to reproduction, and then give some to other women in the community. The products of this activity are sold to generate income for women and their households.

In Burkina Faso, the action started in 2010/2011 enabled 24 women from an initial number of 8, to have a breeding capital of 119 small ruminants, representing about 5 sheep per woman. However, this activity has encountered significant problems of follow up and technical support and monitoring. Consequently, 22 animals were lost (theft or death) and only 16 animals were sold. The services in charge of livestock and NGOs were responsible for counselling and monitoring this activity.



A recipient of the village of Mogr-Noore (Burkina Faso)

Source: Activities monitoring, IUCN / PAGEV November 2010

5.4. Secure warranting

Secure agricultural warranting or "storage credit" is a practice that allows farmers to make better use of their agricultural products while securing rural finance (Duffau et al, 2011). Originally developed as a practice to improve access to credit for rural producers, secure warranting increasingly appears as an adaptation strategy to the effects of climate hazards on financial resources. In fact, in the intervention area, the main sources of income are the marketing of agricultural products, non-timber forest products and livestock products. However, these sources of income are sensitive to flooding and drought which are the main climate hazards faced by communities in the intervention area. The practice of secure warranting therefore allows communities to adapt to the effects of price instability of agricultural products, and floods or drought. It thus strengthens financial resources, one of the livelihood resources of the rural communities.

In practice, secure warranting was supported by IUCN through the guidance of the Wend Kondo association. A storage facility for agricultural products with a capacity of 100 tonnes (Poda, personal communication 2012) was built for the association. This activity involved about 1,077 people including 551 women. This strategy allows producers to store their grain and / or other agricultural products in stores and receive a loan. The loan granted is used to carry out income-generating activities and satisfy financial resource needs of depositors. Storage is subsequently taken against repayment of the loan and sold at higher prices than at the time of deposit or for family consumption. This method has twofold effects of reducing food insecurity and generating income.

5.5. The construction of stabilized compost pits for the production of organic manure

Production of organic manure is a practice that aims to restore the quality and structure of the soil for agriculture. It is perceived by farmers in Burkina Faso as a strategy for adaptation to climate change (Ouedraogo et al, 2010). By improving soil structure, organic manure helps to reduce the vulnerability of this important livelihood resource for rural populations facing erosion caused by floods and strong winds.



Visit of a manure pit in Sambaregou community (Burkina Faso)

Source: Mission Report, IUCN / PAGEV February 2010

Support provided to communities includes the supply of equipment for constructing the stabilized compost pits for the production of organic manure. Local building materials and cement have helped to stabilize manure pits and avoid landslides caused by rain runoff. Training on production techniques has enabled farmers to carry out this activity. The production of organic manure was done in Lalgaye, Bissiga and Tenkodogo in Burkina Faso. A total of 167 households including 44 women have received support for the production of organic manure. The difficulties in monitoring and supervising this activity made it impossible to have sufficient data to conduct performance analysis for the construction of stabilized compost pits for manure.

5.6. Exploitation of non-timber forest products

Non-timber forest products suffer the adverse effects of climate change in the intervention area. Impacts observed by communities include low productivity, scarcity of some useful species. High temperatures and strong winds are the main climate hazards responsible for this situation. To this, one must add on anthropogenic factors such as deforestation, overexploitation of natural resources, expansion of agricultural lands and bushfires. Support to optimize the exploitation of non-timber forest products through improved harvesting and processing seems to be a practical adaptation to the effects of rising temperatures and strong winds. Improved processing methods involve improving the management of forest resources used for non-timber products.

This activity was developed for women to increase their participation in the management of useful forest products in particular and forests in general. It aims at promoting the creation of micro-enterprises of non-timber forest products through market development approach that integrates the production capacity of forests to ensure raw material supply and demand for NTFPs. This activity began in 2011 and planned for the creation of fifteen micro-enterprises run by women's groups on African locust seeds and Shea nuts. About 331 women are participating in this activity. Because of its late promotion within the concerned communities, it was not possible to conduct meaningful performance analysis at this stage.



The future vision of NTFP microenterprises for women

6. ECONOMIC PERFORMANCES OF ADAPTATION ACTIVITIES

Economic performance of adaptation activities were analyzed from three dimensions: financial, economic and social. These three dimensions are essential for the adoption of activities or adaptation options to climate change in affected communities. In fact, an adaptation activity or option should have a level of financial profitability that allows promoters to support all or part of their financial needs. It must also be economically profitable to enable society as a whole to realize that it made a good choice in the allocation of scarce resources. Finally, it should be positively perceived by actors so as to be socially accepted. These three dimensions are particularly important when one considers adaptation as a permanent transition policy in the long term. As pointed out by De Perthuis et al. (2010): *"The legitimacy of government action on adaptation is not automatic because the benefits of adaptation measures are mostly private, which provides incentives to households, enterprises and communities to spontaneously engage in adaptation"*.

6.1. Costs and financial benefits of adaptation activities

The analysis of the costs of adaptation activities shows that direct costs are higher than residual costs from the effects of climate hazards (Table 7). In other words, direct investments by actors are higher than the incurred residual losses. Among the survey sample, there is a high variability of direct and residual costs with respect to the average values, regardless of the adaptation activity.

Vegetable production seems to have lower variability of financial performance among individual respondents. The coefficients of variation indicate a variability of 67% for direct costs and 121% for residual costs. For reforestation/tree planting, coefficients of variation of 69% and 183% were estimated for direct costs and residual costs respectively. For breeding of small ruminants, variations with respect to average values of 72% and 191% were calculated on direct costs and residual costs, respectively. Finally, the direct costs of secured warranting vary by 76% with respect to the average of the sample, as opposed to 198% for residual costs. Variations in direct costs may be due to the differences of technical and management skills of actors. At the level of residual costs, the quality of inputs used likely played a role in the high variability.



Table 7: Financial results of promoted adaptation activities to climate change

Statistics/activity	Gardening (CFAF/ha)	Fruit tree reforestation (CFAF/ha)	Secured warranting (CFAF/tonne)	Breeding (CFAF/workshop)
Average farm size (standard deviation)	0,05 (0,11) ha	0,06 (0,11) ha	0,23 (0,22) tonnes	3 (1) heads
Sample size (including women)	96 (39)	71 (5)	37 (18)	11 (9)
Average value of production (standard deviation)	1 760 274 (1 719 477)	1 814 472 (1 556 902)	450 946 (443 667)	69 188 (47 342)
Average value of direct costs (standard deviation)	467 830 (312 267)	1 453 275 (998 822)	345207 (262 509)	46 438 (33 377)
Average value of residual costs (standard deviation)	186 912 (225 754)	111 568 (203 714)	31 891 (63 279)	10 188 (19 501)
Average value of benefits (standard deviation)	1 105 532 (3 398)	249 629 (2 816 785)	73 848 (462 907)	12 563 (40 553)
Benefit/cost Ratio (%)	169	16	20	22
Ranking per absolute performances	1	2	3	4
Ranking per relative performances	1	4	3	2
Ranking per performance variability	1	3	4	2

Source: survey data (2012), Monitoring mission report, PAGEV (2012)

Likewise, the benefits derived from adaptation activities show high variability with respect to the sample's average. However, benefit from vegetable production is more homogeneous, with a variation coefficient of 0.31%. On the other hand, benefits from reforestation/tree planting, breeding of small ruminants and secured warranting are very heterogeneous, with respective coefficients of variation of 545%, 323% and 627%. Apart from this high variability, promoted adaptation activities were cost-effective, with cost/benefit ratios ranging from 20% for secured warranting to 169% for vegetable production. In terms of private choice, several ranking criteria were used and vegetable production is the most stable in term of financial profitability. Second ranked is reforestation in terms of absolute financial performances, breeding in terms of relative performance and the homogeneity of profit.

Generally, it is expected that the financial results of activities shall be very heterogeneous in a rural population which is very heterogeneous. In addition, the surveyed communities face various degrees of the effects of climate hazards. In the absence of a baseline on the livelihoods of surveyed communities, it is quite impossible to control for this heterogeneity.

6.2. Social cost-benefit analysis of adaptation activities

The cost-benefit analysis was conducted on vegetable production with a simulation of a 10% increase in income from this activity and on the combination of vegetable production with reforestation / tree planting and breeding. The choice of vegetable production to conduct cost-benefit analysis is based on the fact that it has significant financial results, which deserves to be analysed from an economic stand point. It has been the same reason for analysing the combination of vegetable production, reforestation/tree planting and breeding of small ruminants. The objective of this analysis was to find out if vegetable production alone or in combination with reforestation/tree planting and breeding was economically profitable, given their financial profitability.

The results (Table 8) indicate that vegetable production activity promoted as an adaptation activity to the effects of climate hazards is economically viable. The internal rate of return is 30% with a discount rate of 10%. A 10% increase in income from vegetable production will generate an internal return rate of 96%, being an increase of 66 points. The combination of vegetable production with reforestation/tree planting and breeding generates an internal rate of return 122%. In fact, some producers undertake several adaptation activities promoted by the project. In particular, they combine tree planting with vegetable production alongside the river banks of the Nouhao. The positive net present values suggest that investments made by the project and actors are economically profitable over a period of three years.

Table 8: Economic results of adaptation activities to climate change over 3 years

Activities	IRR* (%)	NPV (CFAF)
Gardening	30	2 209 763
10 % increase in gardening income	96	8 043 989
Gardening + Reforestation of fruit trees + Breeding	122	15 629 616

IRR* = internal rate of return; NPV= Net present value,

Source: Survey data (2012), Monitoring mission report, PAGEV (2012)

Economic results suggest that public investments in adaptation activities are profitable for the society. But, this economic profitability can be improved with better monitoring and counselling-support to promoters of such activities. These investments can be considered legitimate for households that are exposed and sensitive to climate hazards.

6.3. Perceptions of promoters about non-monetary benefits

Analysis of group interviews shows that adaptation activities have led to a positive change in people's behaviour. Firstly, awareness was raised that reforestation/tree planting at the Nouhao riverbank has been beneficial for the whole community given that there is a strong link between bank protection and market-based gardening carried out alongside the river. This justifies the increase in the number of vegetable growers between 2009 and 2011.

Reforestation has also promoted the development of eco-citizenship in some communities in Ghana and Burkina Faso. Some testimonies from actors confirm this change of behaviour:

- In Ghana, the people of Mognori village provided, with their own means, pots and seeds for seedling production in 2011;
- In Burkina Faso, there was independent request for fruit trees and the creation of orchards.

Particularly with regard to women, the processing of non-timber forest products is an occupation *for them during the dry season. Mrs. Sana says "the processing of NTFPs occupies us and we avoid always staying at home; and moreover it enables us have a little money."*

Support to vegetable production generated a multiplier effect on the ground. In fact, some producers have decided to buy their personal motor pump instead of the alternating use of the group pump purchased with financial support from the project.



Release of motor pumps in Sambaregou community (Burkina Faso)

Source: IUCN / PAGEV, January 2011

The benefits arising from secured warranting made a large number of beneficiaries to improve on their production strategy. According to the survey, 92.6% of beneficiaries of secure warranting are using improved production techniques. Amongst them, 40.7% use improved seeds and 84.3% fertilizer combined with organic manure.

In the opinion of almost all respondents (98.2%), adaptation actions are very beneficial in reducing the effects of climate hazards. However, these actions do not prevent the occurrence of adverse climate hazards such as droughts and floods. In order to appreciate the benefits of secured warranting, one participant stated during the interviews that: *"Before practicing secured warranting we used to sell our harvest very early, which means as soon the need for money arose. Thus, during the lean period, we had neither money nor grain. With secured warranting the sales period is good for us and we can even get back our grain".* Another added that: *"In lofts, storage is not good enough due to the infiltration of water and parasites."*

However, from the positive perception of promoters of the adaptation activities, there are still weaknesses in the implementation process. The first is the low acquisition of technical and management knowledge about the activities. Figure 6 shows that only 8.0% said they had a good knowledge level of the promoted adaptation actions. The majority (81.8%) believe they have an average knowledge level.

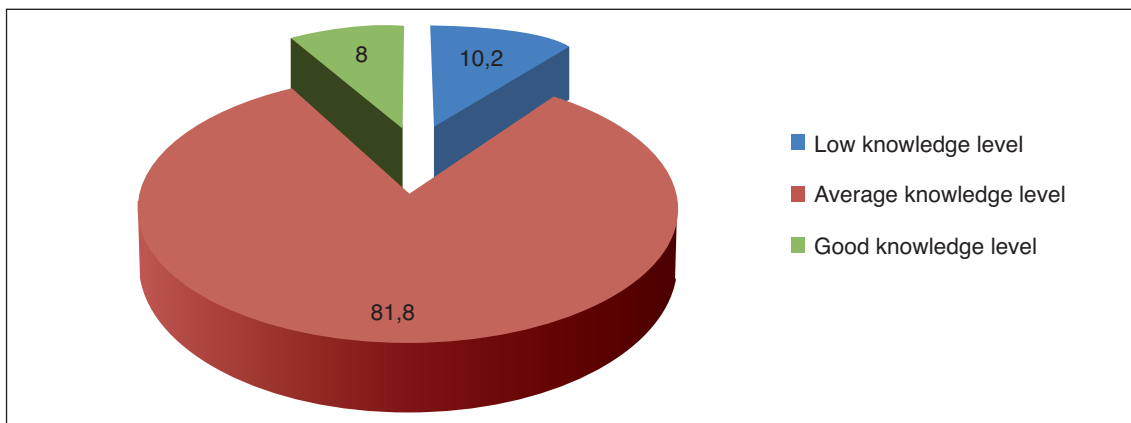


Figure 5: Assessment of the level of knowledge acquired by beneficiaries

The majority of respondents (98.4%) would still like to receive training, particularly in the fields of mango grafting (24.3%), techniques of phyto-sanitary treatment of seedlings (48.2%), techniques of conserving onions (26.7%) and new farming techniques including seeding. The search for markets is still a major concern because poor sales discourage some of the beneficiaries. Particular attention should be given to marketing issues of the promoted adaptation activities.

Asked whether adaptation activities have prompted the development of alternative income generating activities, 46.3% responded in the affirmative. In fact, vegetable production has led to the development of marketing of vegetables and cereals in the concerned villages.



Reforestation of the banks of the White Volta in Kubore (Ghana)

Source: IUCN / PAGEV, January 2011

7. CONCLUSION AND IMPLICATIONS

This study is a first attempt of an economic assessment of field-based adaptation activities. Vulnerability assessments that help to identify climate hazards, their impacts as well as adaptation activities, are not sufficient to demonstrate that adaptation capacities have been strengthened. Investments in climate change adaptation activities still need to demonstrate legitimacy, the reason why assessing economic performance is of interest.

The study explored the legitimacy of adaptation activities promoted by IUCN in the Volta Basin. The financial and economic results show that investments made by both the projects and promoters of adaptation activities were profitable. Moreover, a combination of adaptation activities (reforestation, gardening and breeding) increases the level of profitability. Investing public resources in these adaptation activities is therefore legitimate. But the results also show that improvements can be made if the investments are accompanied by improved technical and management capacities.

Technical and management capacity building for adaptation activities by promoters may reduce direct and residual costs. At the level of direct costs, a good mastery of advanced technologies will enable promoters to procure quality inputs at lower prices; for example through bulk purchases or by choosing appropriate inputs. A mastery of technical itineraries of adaptation activities contribute in reducing residual costs arising from residual effects of climate hazards on production.

Two strongly related major implications emerge from this study. The first concerns the support to the implementation of adaptation activities by external actors. The identification of adaptation activities must be supported by the development of a clear methodology for their implementation. This is particularly important since most of the activities identified existed before the debate on climate change in general and adaptation in particular. The definition of a clear methodology is necessary to highlight the innovations used in these activities in relation to climate hazards and set *ex-ante* relationship between the adaptation activity and the hazard considered. This *ex-ante* identification of relationships facilitates the establishment of a monitoring and evaluation system that would turn the focus on changes made in the execution of adaptation activities.

The second implication is related to the need to adjust existing economic analysis tools to improve understanding of economic results of adaptation activities. Taking into account residual costs in economic analysis of adaptation activities is essential. However, the methodology could be improved if data on the economic values of the climate hazards impacts are available at the start of the intervention. In other words, although the study has demonstrated the cost-effectiveness of evaluated adaptation activities, it was not possible to show the level of reduction of impacts based on the estimated residual cost. This information would have made it possible to show how adaptation activities contributed to the reduction of the impacts of climate hazards, leading to improved economic performance of such activities.

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**INTERNATIONAL UNION FOR
CONSERVATION OF NATURE**

Regional Office
Central and West Africa Program (PACO)
01 PO Box 1618 Ouagadougou 01
Burkina Faso
Phone +226 50 36 49 79
+226 50 36 48 95
E-mail: paco@iucn.org
www.iucn.org/paco