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Managing uncertainty: An economic evaluation of community-based adaptation in Dakoro, Niger

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Executive summary

Climate change adaptation is one of the top priorities for developing countries or is quickly becoming one. In the face of climate change, development policy will need to embed adaptation in its core development strategies. Given the urgency to build resilience and enhance societal capabilities to deal with adverse climate evolutions and shocks – often in an environment of radical uncertainty – a next logical question to ask is which adaptation strategies are likely to build resilience. In other words, **which are those strategies that can provide an effective response to the necessity of adaptation, particularly in the communities of the Global South**?

One of the key adaptation approaches put forward is community-based adaptation. Particular characteristics of this approach involve (1) putting an accent both on so-called 'hard' and 'soft' adaptation strategies; (2) asserting the importance of acting at a community level alongside regional or national strategies; (3) embedding adaptation practices and actions into community life by co-designing approaches to adaptation; and not least (4) stressing the importance of both short-run measures (disaster risk reduction) as well as longer term adaptive capacity.

Community-based adaptation is thought to be highly effective for the following reasons:

- Through co-definition and co-design of adaptation strategies with communities there is increased uptake and viability of adaptation strategies because communities develop a strong sense of ownership.
- By enhancing communities' awareness and understanding of climate change and uncertainty, communities are able to create responsive plans and make decisions with greater flexibility and relevance.
- By embedding new knowledge and understanding into community structures, the existing structures and institutional mechanisms are expanded and strengthened. In turn, this is a key driver for individuals to flexibly adapt to change and for collective structures to be able to adjust to unexpected changes in an environment of uncertainty.

The hypothesis this research aims to test is the following: **is community-based adaptation an efficient and effective strategy for building resilience and adaptive capacity? If yes, to what extent?**

In order to answer this question, we use an extended Social Cost-Benefit Analysis (SCBA) to compare and contrast the benefits and investment of CARE International's Adaptation Learning Programme (ALP) in Dakoro, Niger.

Due to its geographical location and socio-economic characteristics, Niger is highly dependent on climate conditions and highly vulnerable to climate variability. Given that roughly 40% of its GDP is reliant on agricultural output and 80% of its population lives in rural areas, climate shocks or anomalies impact on its economy and the livelihoods of its population in a disproportional way. In addition, agricultural production does not keep up with population growth therefore putting an increasing number of households at risk of malnutrition. As a result, climate vulnerability is but one in a web of complex interdependences between climatic, socio-economic, institutional and ecological factors.

The climate data on Niger, and the area of analysis Dakoro, is inconclusive. Even if considering that overall precipitations will slightly increase or remain stable, as some downscaled models do, all climate models suggest significant increases in mean temperatures. In short, climate evolutions coupled with population growth are likely to exacerbate existing vulnerabilities.

To build a SCBA model we undertook extensive empirical research to collect qualitative information and quantitative data directly from a sample of households in four communities. The data collected is the foundation for the construction of indicators that represent evolution in forms of economic, social and environmental capital. The data also allowed us to measure the net, or additional, impact by taking into account both what would have happened in the absence of ALP and what proportion of the change observed could be attributable to other actors or programmes in the area.

The results suggest that ALP's investment in Dakoro has yielded high returns. It has managed to increase the economic capital of communities in terms of revenue and savings, as well as social and environmental capital. Social indicators include typical development outcomes such as health and education while environmental ones encompass the impact of avoided deforestation, reforestation and avoided land degradation.

Even if we only take into account the benefits ALP has generated to date i.e. over a time-span of four years, findings suggest that for every £1 invested in communities, there has been a return of more than £4, see Table 1.

Table 1: Results of evaluative Social Cost-Benefit Analysis (time span: 2010-2013) in £2013

	Net Present Value (net discounted benefits)	Benefit:Cost Ratio
0% discount rate	£184,129.84	4.45
5% discount rate	£158,044.91	4.34
12% discount rate	£129,330.39	4.19

In order to capture the future value of community-based adaptation in these communities we further extended the evaluative model to forecast capital evolutions to 2020. This required the use of three core climate scenarios in order to compare what would have been the evolution of the different forms communities' capital of under a no intervention scenario, compared to an intervention scenario. Even under a high discount rate, results remain positive and returns are high, as shown in Table 2.

Table 2: Results of forecastive Social Cost-Benefit Analysis (time span: 2010-2020) under different rainfall and temperature scenarios in £2013

		Net Present Value	Benefit:Cost Ratio
Worst case climate scenario	12% discount rate	£230,426.50	6.1
Moderate climate scenario	12% discount rate	£185,235.10	4.9
Best case climate scenario	12% discount rate	£165,536.28	4.4

Although a sufficient condition for an intervention to be considered effective is that the Net Present Value (NPV) should be >0 and the benefit:cost ratio >1, it is also important to compare these returns with previous studies to get a sense of scale. Our review of a variety of previous economic analyses of adaptation and Disaster Risk Reduction (DRR) interventions suggests that the returns on investment of ALP are comparatively high. The sensitivity analysis conducted also points to the fact that returns are always positive even if taking into account strict economic benefits *only*. In short, our results suggest there is a strong rationale for designing holistic interventions that tackle DRR while building longer-run adaptive capacity. Indeed, returns on investment to community-based adaptation appear higher than returns on investment to interventions that focus on DRR only.

We conclude that community-based adaptation can be a promising avenue for building cost-effective adaptation strategies to climate change. Future research should:

- Replicate the analysis to appraise and evaluate different adaptation approaches. Comparing results across different adaptation interventions (warranting, drought-resistant crops, women's savings groups etc.) could indicate the most cost-effective adaptation strategies.
- Determine a common set of outcomes to be considered when evaluating community-based adaptation interventions. This alone would allow a robust comparison of different socio-economic appraisals.
- Take note that wide uncertainties regarding climate variables, such as future rainfall and temperatures patterns, mean that different scenarios need to be considered when forecasting the impacts of adaptation interventions into the future. This especially holds for analyses at a local level, where climate uncertainties are considerably high.

Our report also entails recommendations for policy-makers and development practitioners:

- While our findings would need to be compared to alternative adaptation strategies, a community-based approach appears to present dual dividends: it enhances the decision-making ability of communities at a local scale as well as considerably impacting on 'hard' outcomes, such as an increase in agricultural production. This means that a community-based approach may increase adoption of adaptation and development activities, such as the introduction of improved seed varieties.

- Similarly, community-based adaptation impacts on the overall development of communities. Indeed the benefits considered in our analysis are based on typical development outcomes such as health and education. Our findings suggest that community-based adaptation responds both to short-run disaster mitigation measures as well as long-run development needs. This means that adaptation strategies need to be planned in tandem with development priorities or, put differently, that adaptation needs to be embedded in development interventions.

1. Introduction

As the possibility of keeping global temperature increase to less than 2 degrees Celsius by the end of the 21st century appears unattainable under current projections, societies need to adapt to climate change[1]. Adaptation to climate change poses new challenges for development practitioners and policy-makers given that the latter are progressively required to take into account not only current prevailing conditions in the developing world, but equally future projections of changes in rainfall patterns and temperatures. Indeed, these will drastically affect agricultural production, infrastructure, the health of populations and broader livelihoods in developing countries.

While a variety of adaptation strategies are being trialled in developing countries, a key question is, which adaptation strategies are efficient and effective in enhancing societies' resilience to climate change? Testing for efficiency and effectiveness can involve the use of a variety of research methods, ranging from qualitative to quantitative appraisal and evaluation techniques[2]. However, one of the most prevalent tools to analyse efficiency and effectiveness from a socio-economic standpoint is Social Cost-Benefit Analysis (SCBA), including its variants such as Social Return on Investment (SROI). By comparing the wider benefits (economic, social and environmental) generated by an intervention to its costs, the use of SCBA determines whether available resources are used in an efficient and effective way. Ultimately, a comparison of costs and benefits entailed by different interventions having the same objective (in this case resilience to climate change) can improve our understanding as to which of the existing adaptation strategies are more efficient and effective in delivering the intended change.

In this research, we use a SCBA approach to appraise and evaluate CARE International's Adaptation Learning Programme (ALP) in Niger. ALP is based upon the premise that community-based adaptation is a highly effective response to the adaptation agenda for a variety of reasons:

- Through co-definition and co-design of adaptation strategies with communities there is increased uptake and viability of adaptation strategies because communities develop a strong sense of ownership.
- By enhancing communities' awareness and understanding of climate change and uncertainty, communities are able to create responsive social structures with greater flexibility and relevance.

By embedding new knowledge and understanding into community structures, the existing structures and institutional mechanisms are expanded and strengthened. In turn, this is a key driver for individuals to flexibly adapt to change and for collective structures to be able to adjust to unexpected changes in an environment of uncertainty.

1 World Bank (2012), Turn Down the Heat: Why a 4ºC Warmer World Must be Avoided, A Report for the World Bank by the Potsdam Institute for Climate Impact Research and Climate Analytics. Available at: http://climatechange.worldbank.org/sites/default/files/Turn_Down_the_heat_Why_a_4_degree_centrigrade_warmer_world_must_be_avoided.pdf

2 UNFCCC (2011), Assessing the Costs and Benefits of Adaptation Options: An Overview of Approaches, United Nations Framework Convention on Climate Change, Nairobi Work Programme on Impacts, Vulnerability and Adaptation to Climate Change. Available at: http://unfccc.int/resource/docs/publications/pub_nwp_costs_benefits_adaptation.pdf

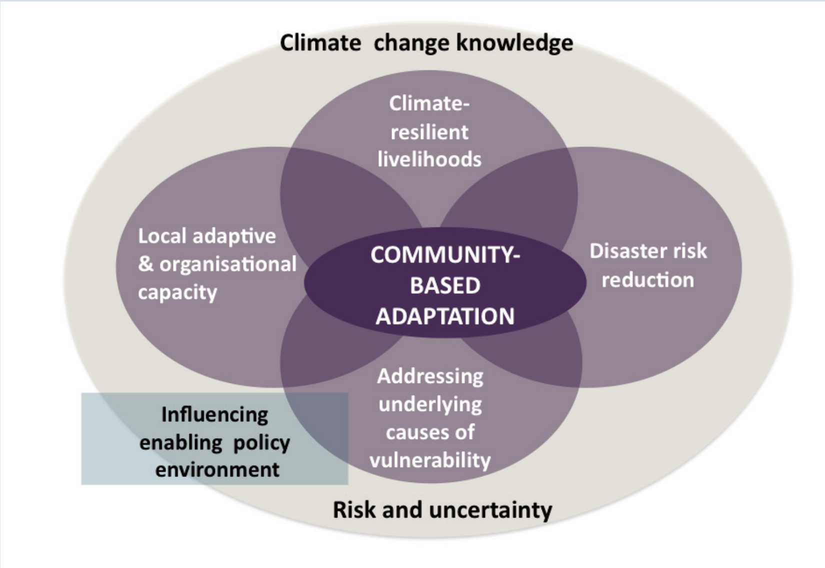
Box 1: The Adaptation Learning Programme

In 2010 CARE International (CARE) launched the Adaptation Learning Programme (ALP) to: identify the problems faced by communities in the context of a changing climate, determine potential current and prospective solutions both for communities themselves as well as for the wider region, and to build a robust community-based adaptation approach, while taking into account broader macro-institutional conditions and strategies, both regional and national.

Rather than designing a strategy in a top-down fashion, this five year, four-country, four-donor, multi-layered programme heavily focuses on the co-production of solutions to climate change impacts, therefore putting a significant emphasis on community involvement, structures, and decision-making. This rationale, among others, is rooted in an acceptance that adaptation to climate change encompasses both 'hard' economic elements and 'soft' socio-institutional ones.

The programme aims to generate learning on community-based adaptation to climate change, in order to inform good practice for community-based adaptation practitioners as well as local, national and regional policy decisions on adaptation. The framework used by ALP is presented in Figure 1.

Figure 1: Scope of Adaptation Learning Programme



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Although our socio-economic analysis of community-based adaptation in Kenya through ALP generated considerable interest and discussion in terms of the efficiency and effectiveness of investing in community-based adaptation[3], it

3 Nicholles, N, Vardakoulias O (2012) Counting on Uncertainty: The economic case for community based adaptation in North-East Kenya London: **nef (new economics foundation)**

remained a wholly forecastive exercise. It was widely agreed that an evaluative study was required, to strengthen understanding of the effectiveness of community-based adaptation. If the original cost-benefit model could be simplified, a more accessible analytical framework for socio-economic evaluation could be created. ALP's work in Niger began in 2010 and owing to its longevity, the project was selected for this research. The objectives of the evaluation were as follows:

- To undertake an evaluative socio-economic analysis of community-based adaptation through the use of extended cost-benefit analysis (accounting for triple bottom-line impacts).
- To analyse the results relative to the 'broader' picture, i.e. compared to no adaptation and/or to other development interventions that do not take adaptation into account.
- To simplify the model developed for ALP Kenya in 2011 so that the approach, learning and results may be used by ALP and local government actors to make allocative decisions about local adaptation strategies to climate change.

The key hypothesis this report aims to test is whether and to what extent ALP has evidence to support that community-based adaptation constitutes an efficient and effective adaptation strategy. To test our hypothesis and to meet the objectives of this research we conducted empirical research on four ALP communities in the region of Dakoro, Niger.

This report presents the methodology and findings of the research: Chapter 2 sets out the context of climate change in Niger; Chapter 3 presents our approach to capturing change and the results of the data collected; Chapter 4 presents the social cost benefit analysis; and Chapter 5 concludes.

2. Context of the analysis

Climate change in Niger

Due to its geographical location and socio-economic characteristics, Niger is highly dependent on climate conditions and highly vulnerable to climate variability. With roughly 40% of its GDP reliant on agricultural output and 80% of its population living in rural areas, climate shocks or anomalies impact on its economy and the livelihoods of its population in a disproportional way.

Droughts are one of the major drivers of vulnerability in terms of food insecurity and malnutrition. Since 1980, Niger has experienced no less than seven severe droughts. These have successively undermined agricultural and livestock production, upon which a large fraction of the population depends. Vulnerability to droughts and climate variability is exacerbated by a series of additional factors and risks, including: low initial endowments to respond to shocks; other major shocks to production, including recurrent locust outbreaks and, to a lesser extent, floods, desertification and land degradation; and poor infrastructure to deal with these risks. Figure 2 presents the economic impacts of these shocks from 1980-2010.

Figure 2: Impacts of shocks on agricultural and livestock production in Niger (1980-2010)
Source: World Bank [4]

In short, climate vulnerability is but one in a web of complex interdependences between climatic, socio-economic, institutional and ecological factors[5]. It is worth

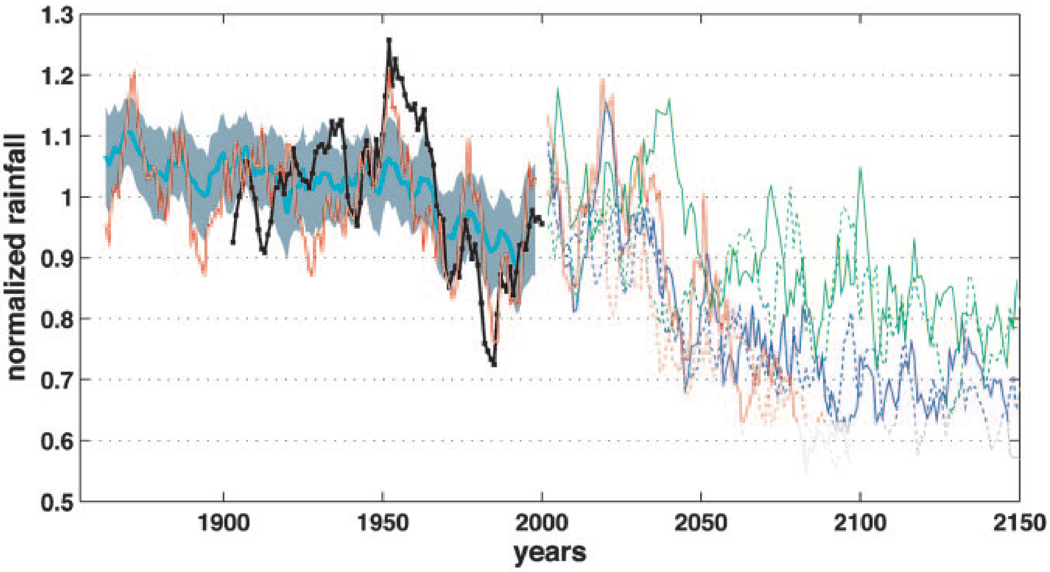
4 World Bank (2013), Agricultural Sector Risk Assessment in Niger: Moving from Crisis Response to Long-Term Risk Management. Agriculture and Environment Services (AES) Department and Agriculture, Rural Development, and Irrigation (AFTAI) Unit in the Africa Region. Report No. 74322-NE. Available at: http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2013/01/31/000333037_20130131141714/Rendered/PDF/743220ESW0P12900Box374318B00PUBLIC0.pdf

5 République du Niger (2010), Chocs et vulnérabilités au Niger: Analyse des données secondaires, World Food Programme. Available at: http://documents.wfp.org/stellent/groups/public/documents/ena/wfp228158.pdf

noting that despite the significant increase in agricultural production illustrated in Figure 2, production per capita has been decreasing since the 1960s[6]. This means that agricultural production does not keep up with population increase, therefore putting an increasing number of households at risk of malnutrition.

It is widely agreed that, in Sahel ecosystems, there has been a decreasing trend in rainfall since the mid-20th century. Nonetheless, following a dry spell that lasted up until the 1980s, average rainfall has been increasing ever since. This broad aggregate, however, should not mask (1) the increase in extreme precipitations, (2) anomalies among rainy seasons and (3) the fact that this relatively wetter spell might not endure given current chaotic oscillations of precipitation patterns. Indeed, some downscaled global models suggest a slow but sure decrease, rather than increase, in rainfall patterns. See Figure 3.

Figure 3: Historical and projected rainfall patterns in the Sahel
Source: Held et al.[7]

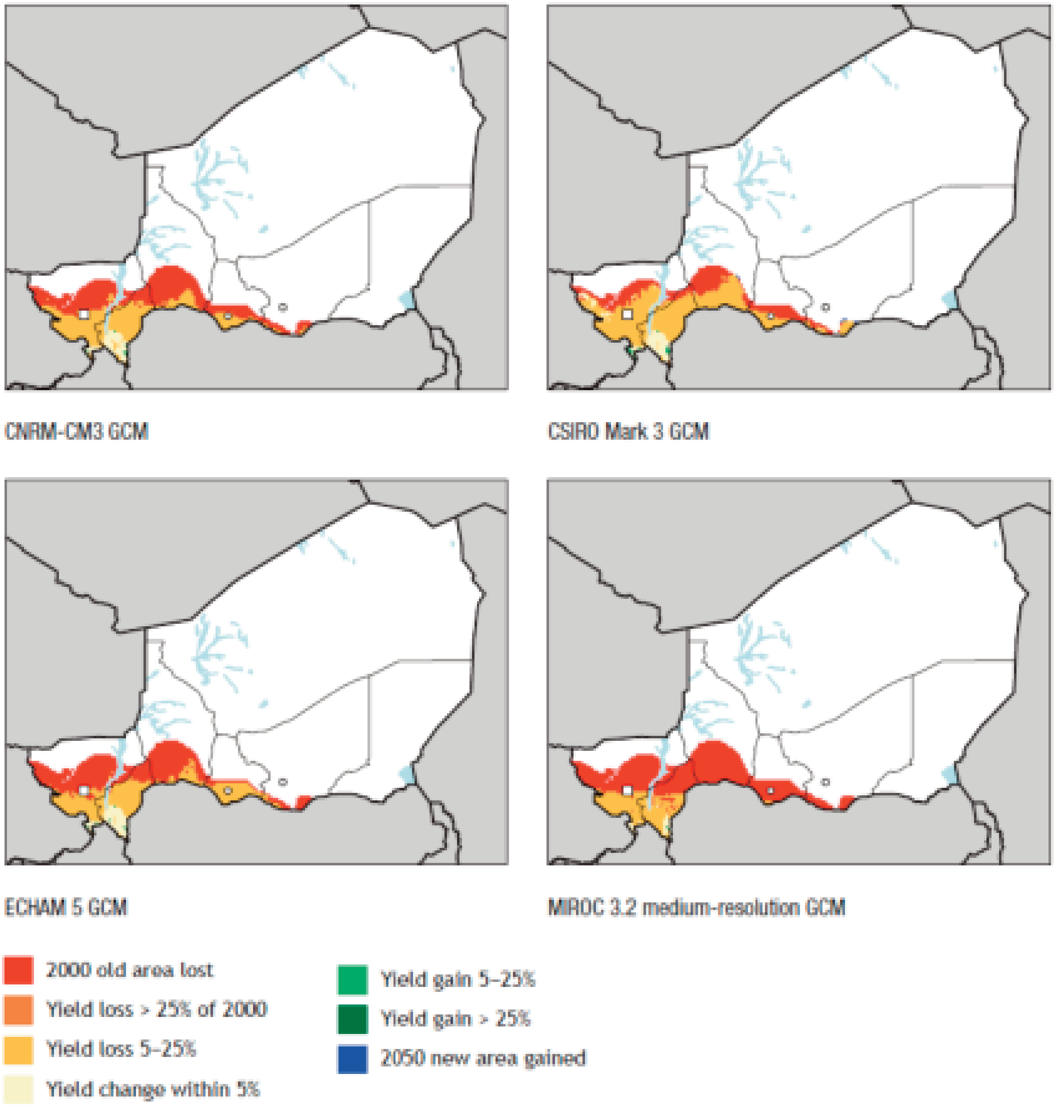


Even if considering that overall precipitations will slightly increase or remain stable (as some downscaled models do), all models suggest significant increases in mean temperatures. The impact of temperature increase on soil productivity and moisture is unlikely to be compensated for by a rise in precipitation. Indeed, the majority of models forecast a decrease in the Length of Growing Period (LGP), and therefore of agricultural production, as a consequence of temperature increase, see Figure 4.

6 See notably : Ozer (2007), «Analyse pluviométrique au Niger : récentes modifications et impacts environnementaux». University of Liège. Available at: http://orbi.ulg.ac.be/bitstream/2268/16133/1/OZER_NIAMEY1.pdf. And : République du Niger (2010), Chocs et vulnérabilités au Nier: Analyse des données secondaires…Op. Cit.

7 Held IM, Delworth TL, Lu J, Findell KJ, and Knutson, TR (2005), 'Simulation of Sahel drought in the 20th and 21st centuries', PNAS, vol. 102 no. 50. Available at: http://www.pnas.org/content/102/50/17891.full.pdf+html

Figure 4: Projected yields of rain-fed Sorghum under different precipitation and temperature scenarios
Source: Yaye et al.[8]



In short, the evolutions highlighted here, coupled with population growth, are likely to exacerbate existing vulnerabilities.

8 Yayé, H, Danguioua A, Jalloh A, Zougmoré R, Nelson GC, and Thomas TS (2013), 'Niger', in Jalloh, A Nelson, GC, Thomas, TS, Zougmoré, R, Roy-Macauley, Harold (2013) West African agriculture and climate change A comprehensive analysis, International Food Policy Research Institute. Available at: http://www.ifpri.org/publication/west-african-agriculture-and-climate-change

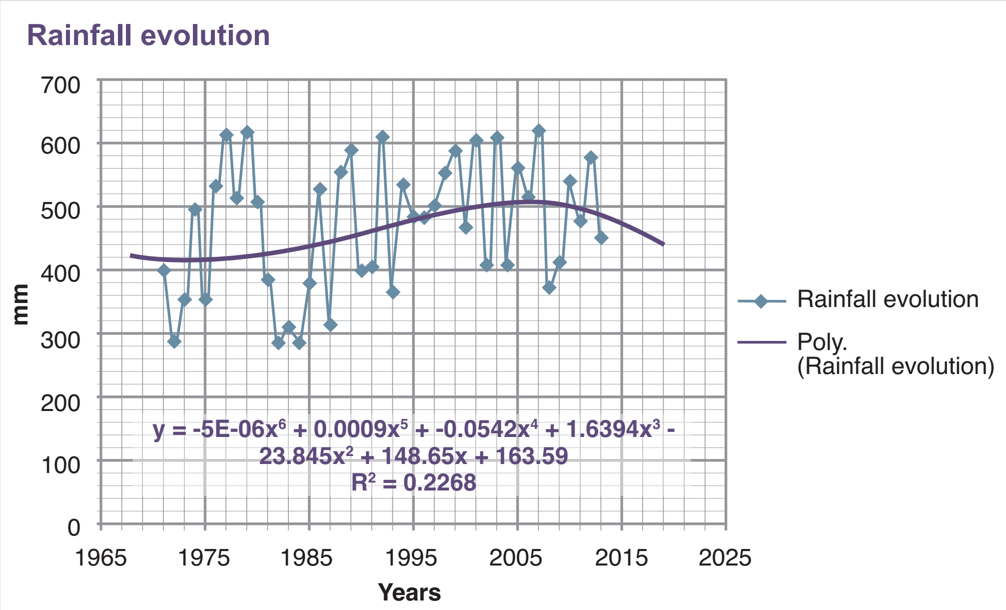
Climate change in Dakoro

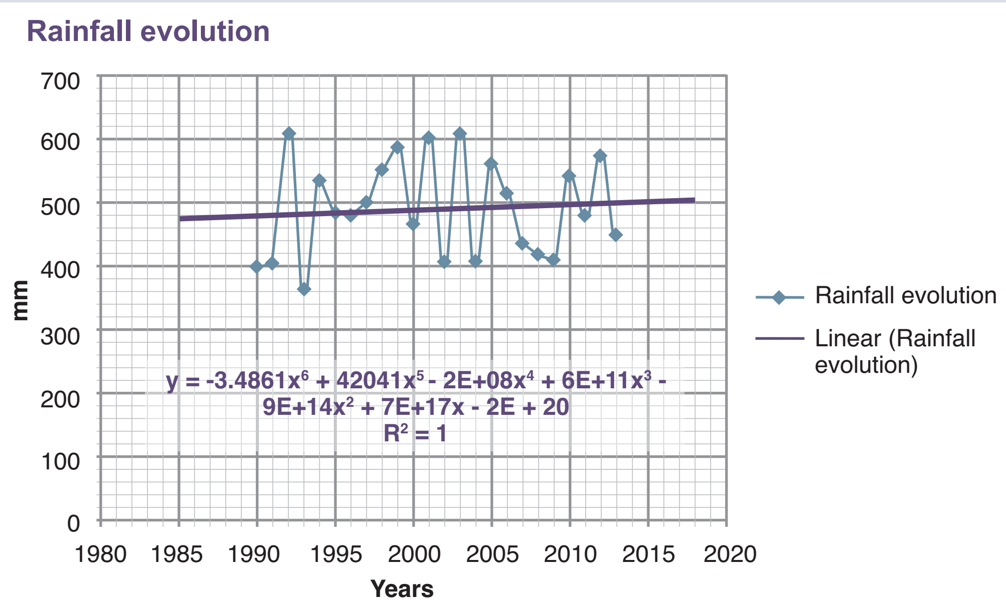
Located in the Sahelo-Saharan ecological zone, the province of Dakoro where ALP's work takes place is particularly vulnerable to precipitation anomalies. Box 2 presents the location of Dakoro on international and regional scales.

Box 2: Location of Dakoro

Although we found no climate model forecasting the likely precipitations and temperature patterns for the region of Dakoro, past evolutions suffice to highlight its vulnerability levels. From the year 1981 to 2000, the province has been hit by six severe or catastrophic droughts, i.e. the equivalent frequency of one severe or catastrophic drought occurring every 4.8 years[9]. Our analysis of existing raw data, see Box 3, from the weather station of Maradi (120km south of Dakoro) shows that precipitation patterns in the region are chaotic, presenting a high variability on a year-to-year basis[10]. This, in particular, presents high risks for rural communities. Indeed, econometric analyses conducted by the World Bank suggest that the output of major crops is correlated to rainfall by a factor of 0.60[11]. Other studies conducted in the region of Maradi have empirically analyzed the effects of droughts on socio-economic livelihoods in the region, including: malnutrition; a depletion of assets and savings; livestock diseases; and emigration patterns, as a consequence of the aforementioned[12].

Box 3: Rainfall evolution in the region of Maradi (1965 to 2013 and 1985 to 2013)[13]





The sample communities considered in our research are therefore located in a particularly vulnerable environment, where the overwhelming majority of agriculture is rain-fed and water resources are severely constrained – particularly throughout the dry months (October to May).

9 World Bank (2013), Agricultural Sector Risk Assessment in Niger: Moving from Crisis Response to Long-Term Risk Management…Op. Cit.

10 INS Niger (2010), Annuaire Statistique des Cinquante Ans d'Indépendance du Niger, République du Niger, Ministère de l'Economie et de la Finance & Institut National de la Statistique. Available at: http://www.stat-niger.org/statistique/file/Annuaires_Statistiques/Annuaire_ins_2010/serie_longue.pdf.

11 World Bank (2013), Agricultural Sector Risk Assessment in Niger: Moving from Crisis Response to Long-Term Risk Management…Op. Cit.

12 Mamouda, MNA (2010), 'Climate change adaptation and food insecurity in Maradi District – Niger', Parc. Estrat. Brasília-DF, v. 16, n. 33. Available at: http://www.fao.org/fsnforum/sites/default/files/files/93_Networks_for_FS/4_%20Moussa%20na%20Abou%20Mamouda.pdf

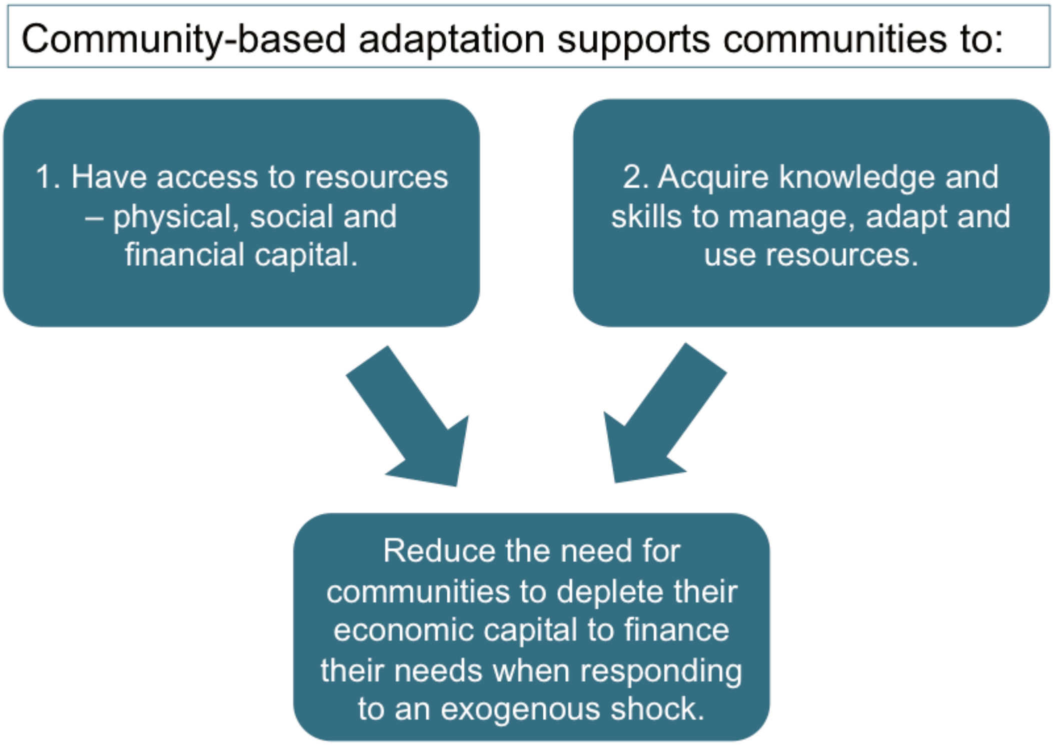
13 For the rainfall patterns across the period 1932 (since the beginning of records in Maradi Airport) and 2013, see Appendix 1.

3. Methodology: understanding change and impact

Broad analytical framework

Looking at community-based adaptation from a socio-economic perspective is useful to understand its impact and is also an effective framework for this evaluation, see Figure 5.

Figure 5: The socio-economic perspective of community-based adaptation



These three elements are interrelated in that having access to resources and acquiring the knowledge and skills to manage those resources leads to a reduced need to deplete a family or community's 'capital' to survive when a shock occurs. Put another way, it is this framework that we are testing in this evaluation.

Approach

Building on the approach used for ALP Kenya, this study merges traditional cost-benefit analysis with the principles that underpin social return on investment (SROI)[14] and follows a three pronged approach:

14 Lawlor, E., Nichols, J., and Neitzert, E. (2008). Seven Principles of Measuring What Matters London: **nef** (the new economics foundation).

- Building theories of change through stakeholder engagement with primary stakeholders and the ALP team.
- Measuring quantitative social and economic capital evolutions using empirical research with primary stakeholders.
- Assessing quantitative environmental capital evolutions and climate variability through extensive literature reviews and secondary, desk-based research in order to fill the gaps identified in the empirical analysis.

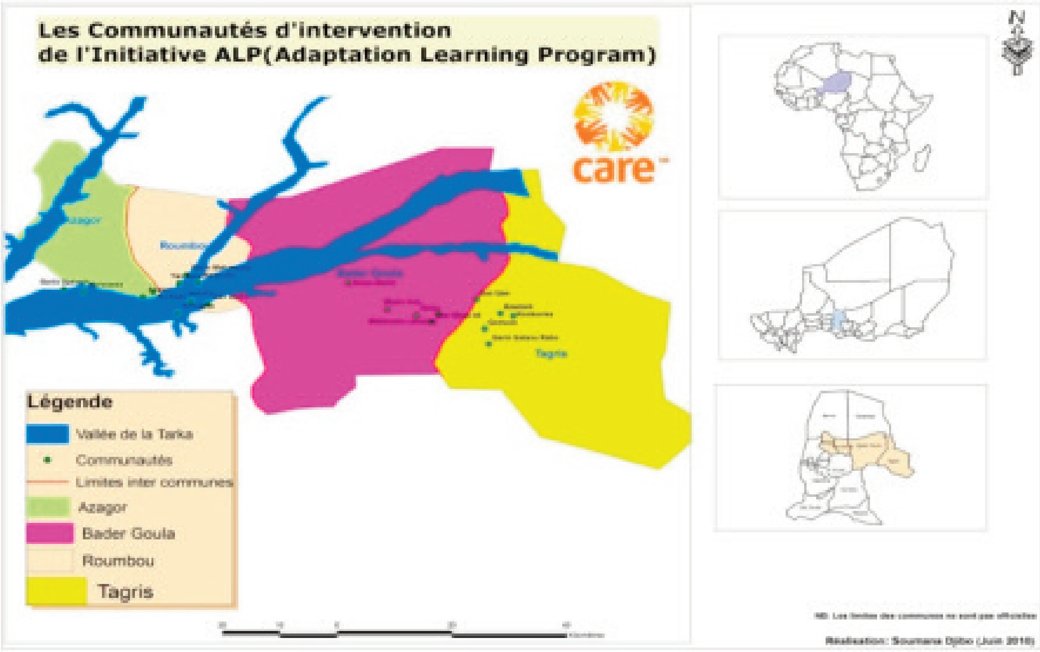
We spent 10 days in Niger, of which six days were spent with the team in Dakoro creating the foundations for the evaluation. Firstly, a theory of change was developed through focus groups with four communities, in order to understand the impact of climate change before ALP, and the strategies and outcomes experienced since the programme began in 2010. Secondly, indicators for the main social, economic and environmental outcomes were selected and the tools to collect the data were developed. The ALP team were trained in socio-economic evaluation (in particular how it differs to other evaluations), and the foundations of social return on investment, and provided feedback on the data collection tools. The tools were piloted with one community in our presence; the ALP team conducted the primary research while we observed and guided. Finally, the tools were refined and the sample constructed. The ALP team collected the empirical data and sent it to us for analysis and completion.

There are two main components in this evaluation: modelling communities' resilience to shocks relative to a business-as-usual trend, and then modelling how this resilience impacts on the longer-run prospects of communities – relative to business-as-usual. In summary, it explores how ALP has created value, relative to investment, on three forms of capital: economic, social and environmental.

Sample communities

A representative sample was constructed based on the composition of the communities in which ALP Niger works. ALP works with 20 communities across four communes in the department of Dakoro, see Figure 6.

Figure 6: Map of communities in which ALP Niger works



The three most important characteristics of the communities that were considered in the construction of the sample were (1) their ethnic group, (2) their level of vulnerability, and (3) their proximity to the Tarka Valley, as these factors influence the effectiveness of community-based adaptation. The communities comprise a mixture of three ethnic groups: Hausa, Fulani and Toureg, with Hausa being the dominant group among the 20 communities. To reflect this in our sample, two Hausa communities, one Fulani and one Toureg were selected. It was agreed that the most feasible sample size would be 5% of households within the communities, broken down by level of vulnerability.

The levels of vulnerability are defined by taking into account household baseline conditions of income and assets. The vulnerability categories were defined by communities themselves. Communities were asked to collectively determine and identify which households were to be classified from 'extremely vulnerable' to 'moderately vulnerable' based on:

- The amount of land possessed
- The amount of livestock possessed (headcount)
- The possession of tools for agricultural production
- Annual agricultural production of each household
- Social position within the community

- Housing quality (wood, stone, straw etc.)
- Coverage of nutritional needs of the households.

Vulnerability was assessed and weighted across the levels i.e. to account for the fact that in some cases 5% resulted in less than a whole household, see Table 3.

Table 3: Sample construction based on level of vulnerability

	Total households	D = Extremely vulnerable	C = Very vulnerable	B = Vulnerable	A = Moderately vulnerable	Total
Maiwassa	230	6	5	1	1	**13**
Dan Ijaw	124	1	4	2	1	**8**
Kouggou	49	0	1	2	1	**4**
Gomozo	81	2	2	1	1	**6**
TOTAL	484	9	12	6	4	**31**

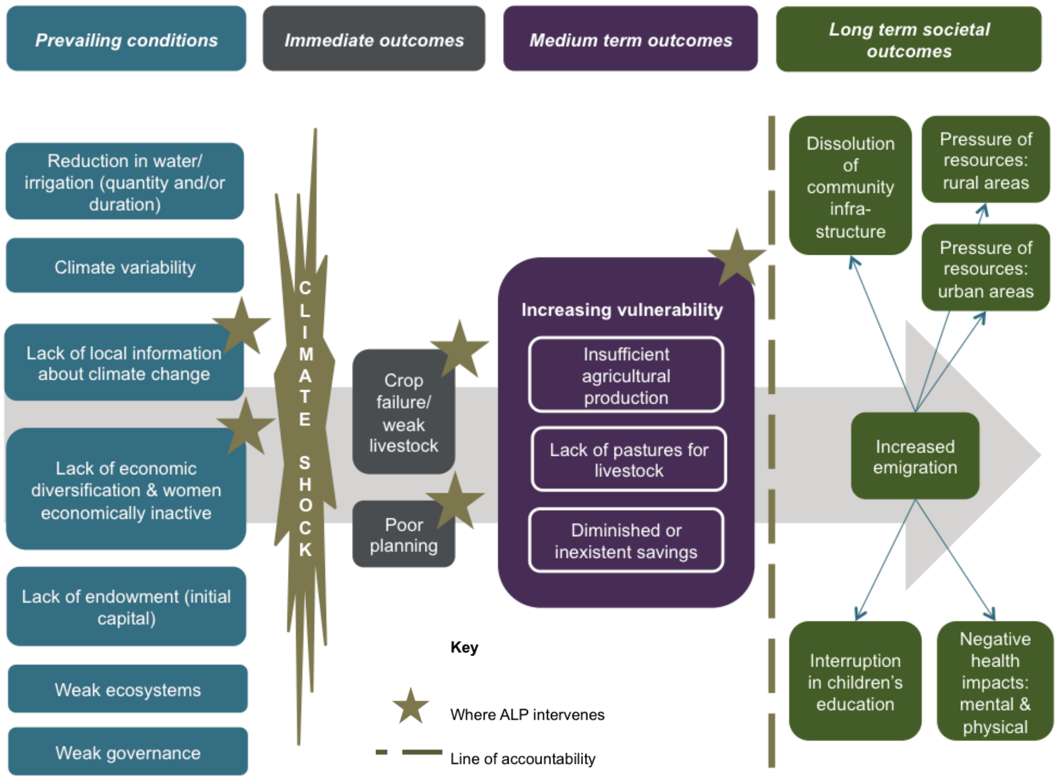
As distance from the Tarka Valley and the market of Dakoro also plays a major role in the communities' resilience to shocks, two communities that were close, and two communities that were far from the Tarka Valley were selected. The communities that formed our sample were Maiwassa, Dan Ijaw, Gomozo and Kouggou.

Theory of change

Stakeholder engagement with four communities explored qualitatively how the communities had experienced the impact of climate change prior to ALP beginning in 2010 and currently, in 2013. Communities were asked to tell us their stories across a range of parameters, with particular focus on economic and social impacts. A counterfactual scenario was also explored, as communities explained how they thought they would have reacted in the absence of ALP and ongoing climate uncertainty. Many recounted their experience of ALP and community-based adaptation, demonstrated their strategies and initiatives and explained the difference it has made to how they perceive climate change and the role it has on their lives.

Figure 7 presents the need for ALP, as expressed by the challenges induced by climate change.

Figure 7: Theory of change for business-as-usual



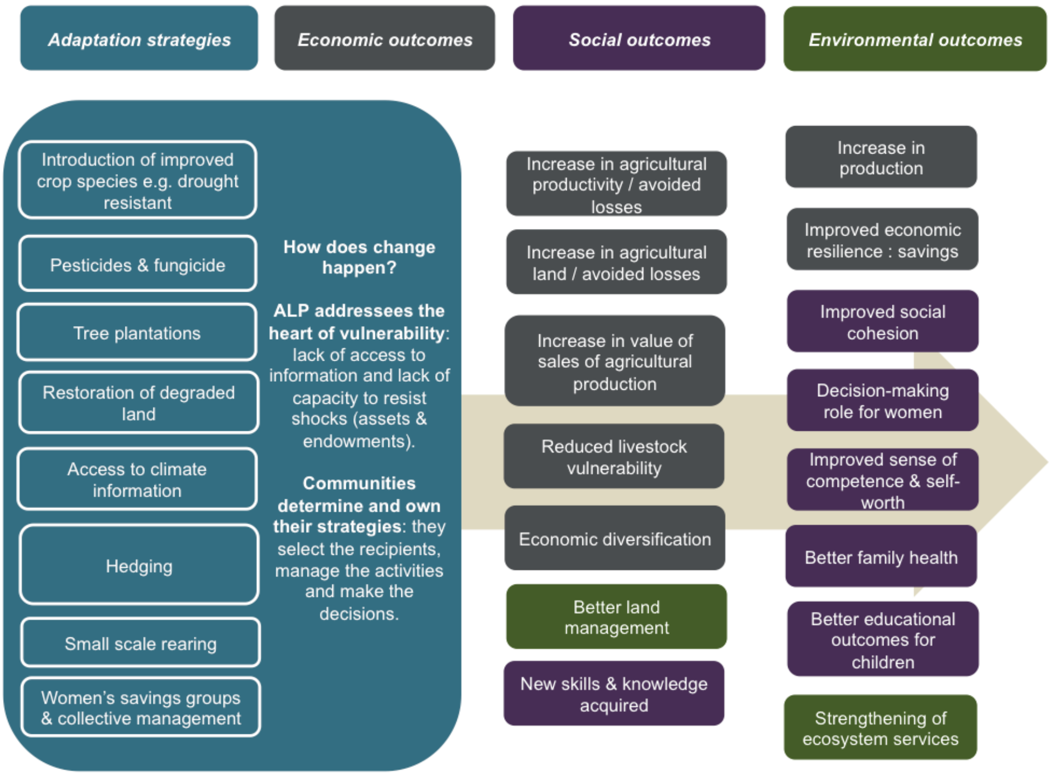
The prevailing conditions are the reasons that ALP intervenes in the communities because collectively they increase vulnerability to a climate shock. When a climate shock does occur this often results in weakened economic capital (crop failure or weak livestock) and a vicious cycle of not being able to plan and develop strategies for forthcoming shocks ensues. These, alongside the prevailing conditions, increase communities' vulnerability from an economic perspective.

Communities reported that the long-term impact of increased vulnerability results in migration from villages to other rural or urban areas, which can have a number of impacts: breakdown in community infrastructure; increased resource pressure on both urban and rural areas; interruption in children's education; and a detrimental impact on both physical and mental health.

ALP has clear strategies to prevent these longer-term outcomes from occurring: to increase communities' resilience to the uncertainty and impacts of climate change. Denoted by the green stars in Figure 7, ALP intervenes to address the lack of local information about climate change, the lack of economic diversification, and women's economic role within communities. It then works to address weakened economic capital and poor planning, which is about focusing on the core needs of the community to build their resilience. This is where ALP is aiming to influence, as denoted by the line of accountability. The line of accountability is a tool that allows us to understand ALP's sphere of influence and better measure impact.

Once communities articulated the need for ALP's intervention they then shared the social, economic and environmental outcomes they had seen following the adoption and integration of adaptation strategies. Figure 8 presents the theory of change as captured through the stakeholder engagement. It is worth noting that the theory of change at a project/community level differs from a programmatic theory of change (e.g. for ALP as a whole) in a number of ways. The theory of change developed at a community level is an inherently empirical exercise based on stakeholder engagement, i.e. allowing communities to create their own theory of change based on changes households have experienced. While it is linked to the programmatic theory of change, it downscales broader changes in order to capture impacts at a micro level.

Figure 8: Theory of change for community-based adaptation



Among the four communities that participated in the stakeholder engagement, common outcomes emerged across social, economic and environmental parameters. Also common to all was the experience of an 'awakening' when ALP began working with them (éveil in French). Communities reported that this awakening allowed them to see things differently, absorb new information and consequently plan their approach to adaptation in a new way.

ALP supports the process of action planning for community-based adaptation, which enables communities to decide on relevant and locally appropriate adaptation strategies. Each community has a mixture of adaptation strategies selected by them. Indeed, this point is crucial to understanding the theory of change: communities determine their own strategies, select the recipients and make the decisions about who is responsible and how resources are allocated. These decision-making processes are informed by climate vulnerability and capacity analysis, and climate information in some form. Adaptation strategies are multiple and usually involve activities related to livelihoods, risk reduction or advocacy initiatives. These aim to reduce vulnerability and risk, and result in climate-resilient and more equitable livelihoods, which are adapted over time. Example strategies range from improving crops (such as drought-resistant crops), community-based hedging mechanisms (known as warranting), small-scale rearing (one or two goats) and women's collective savings structures.

The qualitative information to create the theories of change guided us as to which hypotheses needed to be tested and evidenced through quantitative data collection. These hypotheses are that:

- Economic capital improves through: increasing production (either agricultural productivity or land; increasing the value of sales or reducing livestock vulnerability); economic diversification (mostly where women undertake economic activities); and improving savings. All contribute to greater resilience from an economic perspective.

- Social capital improves through: learning new skills and acquiring knowledge, and making collective decisions. Communities reported: having better relationships and a sense of cohesion; improved sense of self-worth as a result of feeling in more control of their future; and better general educational and health outcomes for families and children. The decision-making role of women changed through ALP's work, as many of the strategies are run by women and they reported enjoying their new-found role within their families. Interestingly, whilst the men showed support for the women's active participation and management of economic resources, women's increased independence (such as allowing women to go to the market) was not experienced in the same way across all the communities. ALP Niger's gender study provides greater detail on how gender relations have evolved since 2010 with a useful analysis that demonstrates differences by ethnic group[15].

- Environmental capital improves through: strategies that encourage better land management and the strengthening of ecosystem services. Tree plantations and the restoration of degraded land support the maintenance of critical ecosystem services in fragile ecosystems of the Sahel.

The hypothesis is equally that these three forms of capital interact in various ways. An improvement of ecosystem services, for example, underpins the economic sustainability of communities by preventing land degradation, which could reduce incomes from agriculture. Similarly, economic capital impacts on social capital, for instance by preventing the breakdown of communities and/or emigration of youngsters from the communities. Finally, institutional empowerment can be a critical economic driver, by ensuring that communities are able to adapt and build resilience strategies in the future.

15 ALP Etude de Genre (ALP Gender Study), 2013

Outcome measurement

In order to test these hypotheses a questionnaire was built to measure quantitative change among key economic, social and environmental variables. Rather than focusing on a restrictive set of outcomes, the aim was to see whether, and to what extent, the intervention of ALP has affected broad economic, social and environmental aggregates. These include communities' income from agricultural activities, education, health, social capital and the key ecosystem services upon which communities rely. As such, data collection consisted of evidencing change in adaptive capacity and evidencing change in typical development outcomes. In order to measure change, a retrospective approach was adopted i.e. capturing the level of capital before ALP intervened (2009), both baseline, and post-intervention (2013). This approach has been used to measure 'gross' change, that is, change that does not yet take into account the counterfactual (what would have happened anyway) or the contribution of other actors/factors in driving this change. We present the key results by form of capital in this section. The counterfactual is addressed in the following section.

Key economic outcomes

All the communities with whom ALP works in Niger are agro-pastoral and rely heavily on agricultural and livestock revenue for their livelihoods. The economic data we collected therefore focused on the evolution of agricultural and livestock returns since the beginning of the programme. Some additional key variables, such as savings and degree of diversification were also assessed.

In terms of **agricultural** activities, the data collected points to (1) an increase in agricultural productivity for all major crops (2) an extension of agricultural productivity and (3) an increase of agricultural revenue since the beginning of the programme. The only major crop for which productivity declined throughout the period 2009-2013 is Sorghum, see Figure 9. However, interpreting why this occurred is not particularly straightforward. For instance, the observed increase in agricultural land might be synonymous with an extension to more marginal (less productive) land, which can influence overall productivity, see Figure 10.

Figure 9: Evolution of agricultural productivity (kg / hectare / year)

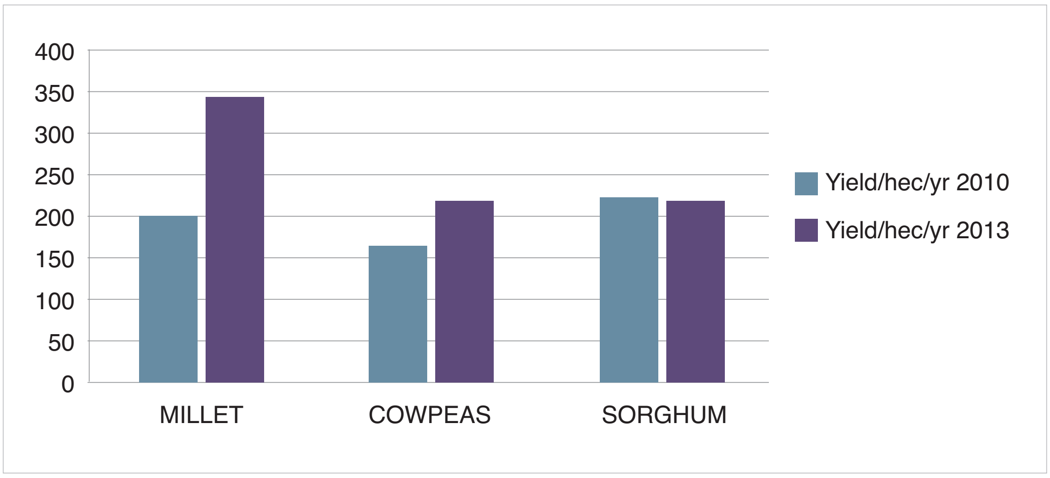
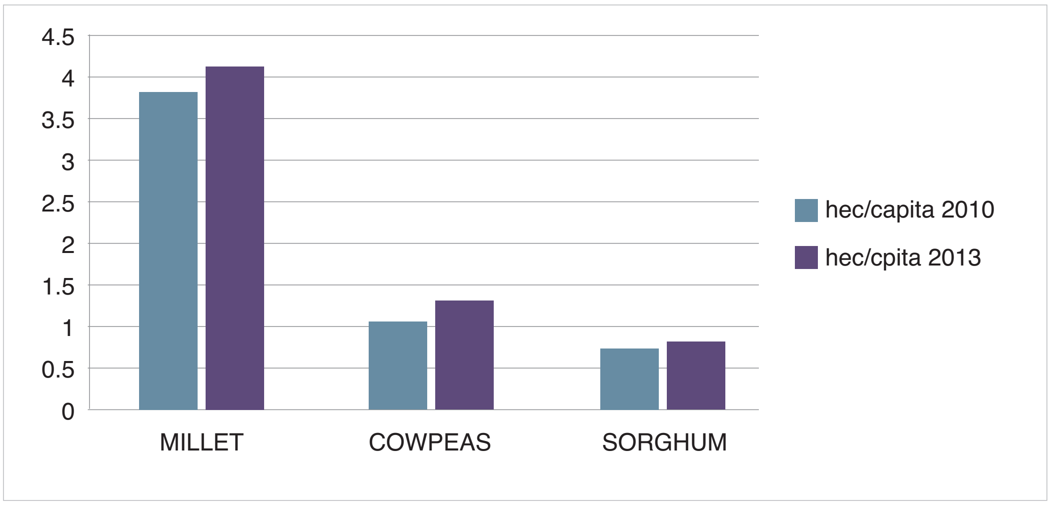


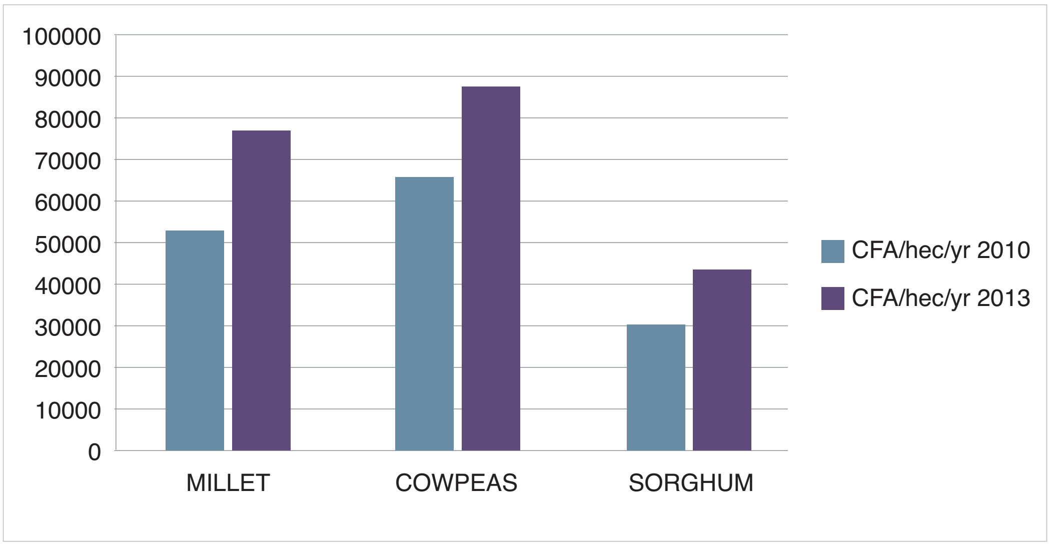
Figure 10: Evolution of land tenancy



In addition, this slight decrease needs to be compared to a business-as-usual trend (see section on Additionality).

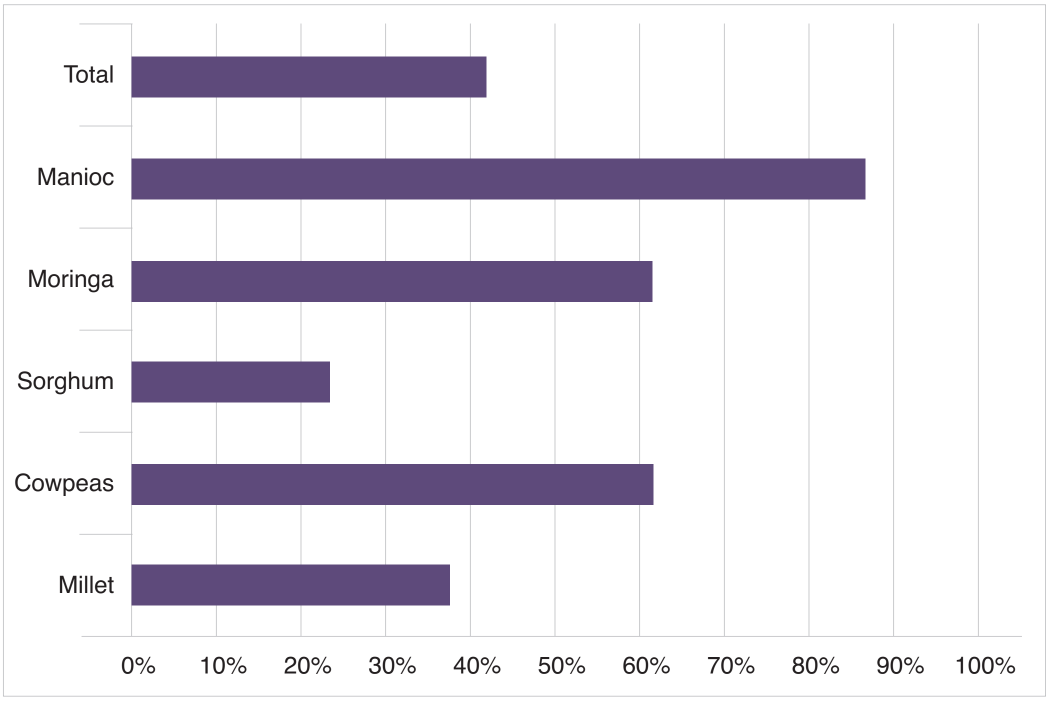
Moreover, agricultural returns have increased for all crops during the same period, as represented in Figure 11. However, it is worth pointing out that agricultural returns differ to agricultural yields. The fact that returns per hectare (in Niger's local currency of CFA Franc - FCFA) have increased more than actual productivity, could be indicative of the impact of warranting: an adaptation strategy whereby the grains collected by the community are stored at the end of the rainy season and subsequently sold in the market when prices are higher. However, further analysis would be required to test this hypothesis.

Figure 11: Average returns per hectare



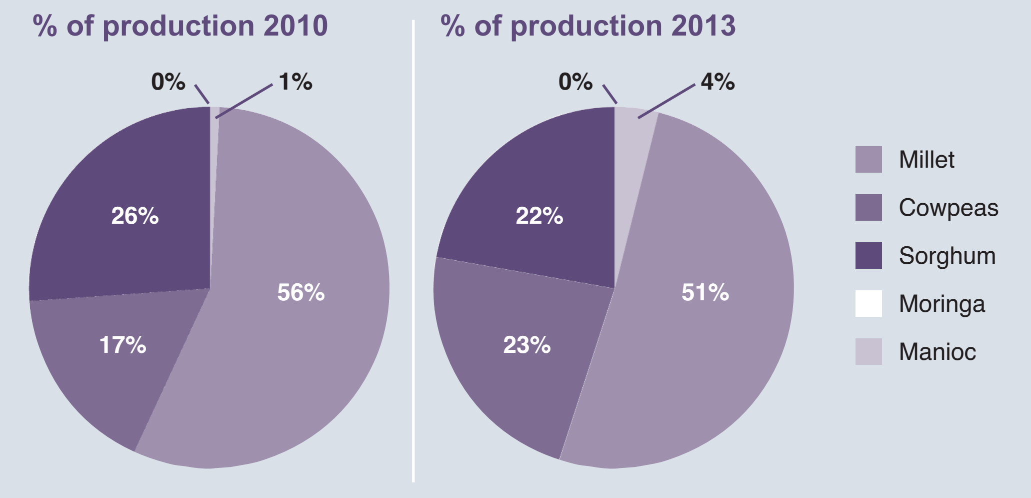
The combination of these factors (intensification, extensification and warranting) has driven a 41.8% average increase in agricultural revenue between 2009 and 2013, as shown in Figure 12. This increase is net of debt repayment and costs of production inputs.

Figure 12: Change in net revenue from crops



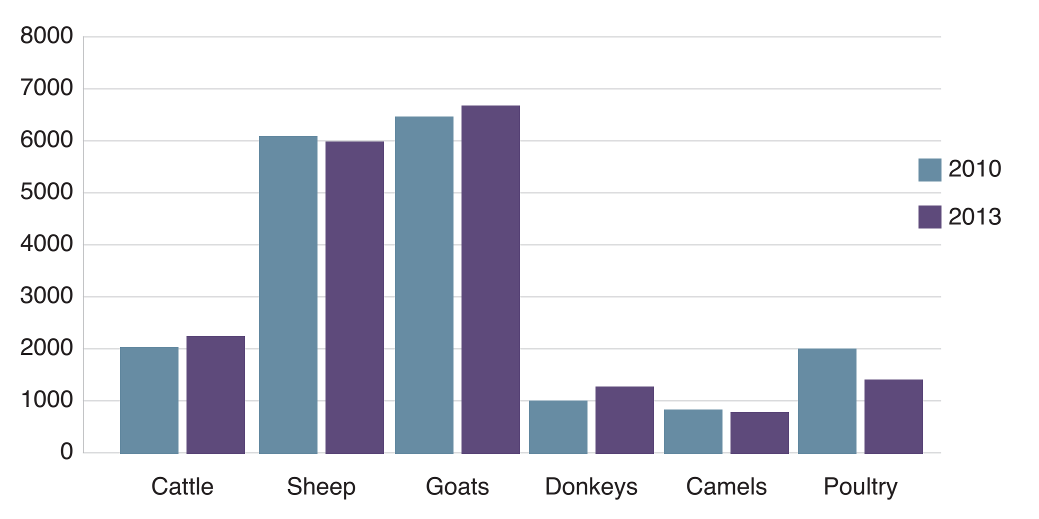
It is also important to mention the evolution in terms of crop diversification in the communities. The data collected suggests a modest diversification has taken place throughout the period 2009-2013, as presented in Box 4.

Box 4: Structure of agricultural production



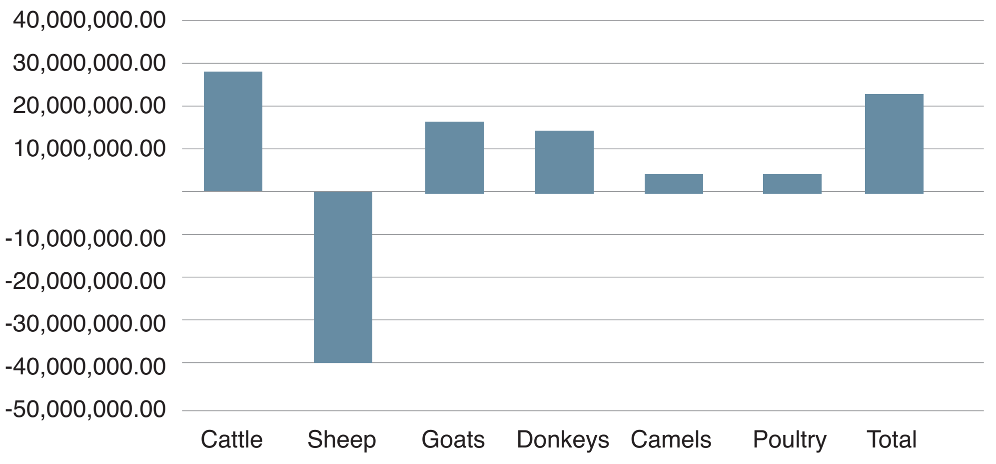
The evolution of **livestock** activities, however, is less clear-cut. On the one hand, there appears to have been a modest decrease in the total ownership of livestock – expressed in headcounts of cattle, goat, sheep, donkeys and camels and poultry, see Figure 13. On the other hand, the total value of, and revenue derived from, livestock and poultry have increased, see Box 5.

Figure 13: Total livestock and poultry expressed in headcounts (2009-2013)

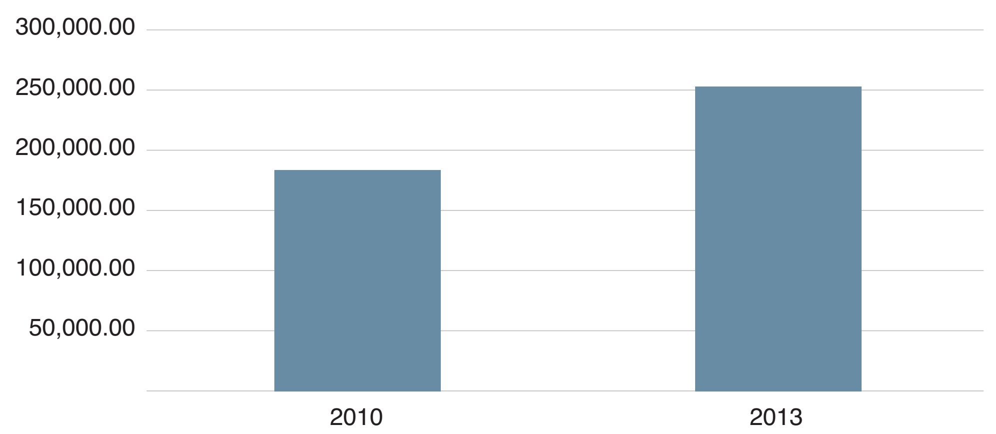


Box 5: Average income from livestock and evolution of value per type of animal (FCFA 2013)

Evolution of value of livestock (FCFA) 2010-2013



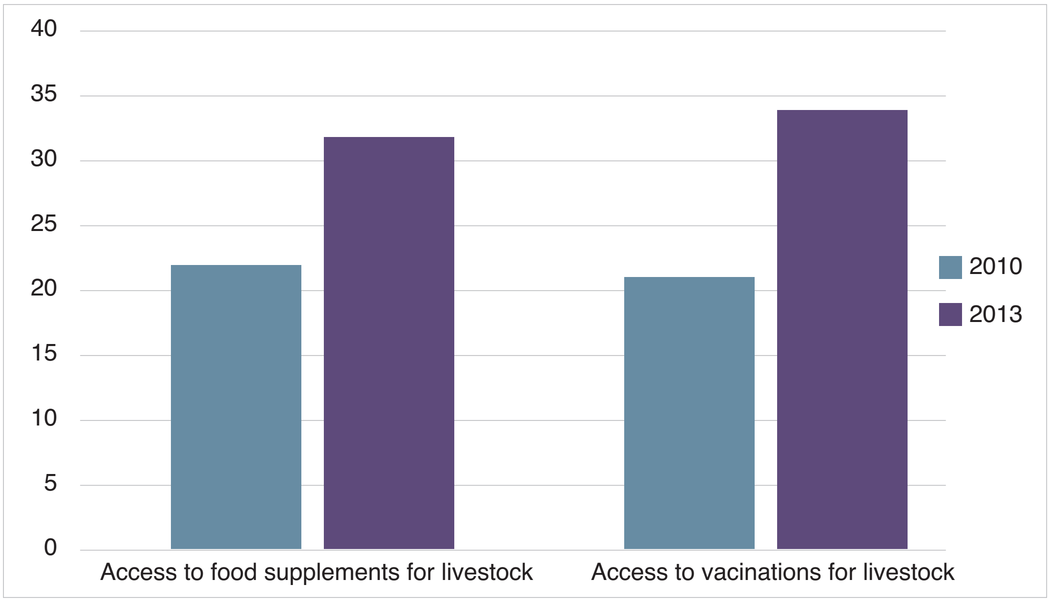
Income from livestock (FCFA)



A variety of hypotheses can be formulated to explain why returns to livestock increase while headcount numbers decrease:

Firstly, this evolution can be explained by an increase of the share of healthy livestock. Healthy livestock is evidently more valued in the market and therefore generates higher returns to communities. Notably, the empirical evidence collected suggests that this evolution has been driven by an improvement in communities' access to (1) vaccinations and (2) food supplements for livestock during the dry seasons, see Figure 14. By investing more in food supplements and vaccination for their livestock, communities might therefore be simply shifting resources from the purchase of additional livestock or poultry to investing more in the health of existing livestock stock. This shift, in turn, can explain why total livestock revenue has increased despite a decrease in headcount numbers per household.

Figure 14: Number of respondents having access to food supplements or vaccinations for their livestock



Secondly, a decrease in livestock headcounts can also be indicative of communities placing more emphasis on, and investing more resources in, agriculture. The two hypotheses are not mutually exclusive.

As with agricultural production, the evolution of livestock headcount and livestock revenue in the communities needs to be assessed relative to the counterfactual. Indeed, a decrease of headcount livestock can be considered as a negative evolution only if the counterfactual scenario is a stable or increasing number of livestock. However, in many circumstances, a business-as-usual trend might actually consist of a *greater* decrease of the stock. As such anything over and above this decrease could be considered a positive impact.

Further key findings on economic outcomes are presented in Table 4.

Table 4: Additional economic data

	2009 (pre-ALP)	2013 (post-ALP)	% change
Average yearly household budget (FCFA 2013)	266,449	399,353	+49.8%
Average yearly savings, including in-kind savings (FCFA 2013)	63,083	86,056	+36.4%
Average time required to replenish lost income and assets after a drought	4.6 years	2.5 years	-44.7%

On aggregate the empirical data suggests a positive evolution of yearly household budget as well as yearly savings, albeit to a lesser extent. This is consistent with existing literature which suggests that amongst the poorest households in developing countries, the marginal propensity to save is low. Put simply, a household with low income is more likely to spend an extra dollar gained than to save it; as such, although savings increase with income, they do not necessarily do so proportionally.

Finally, households were asked to estimate the time they needed to replenish lost income and assets following a significant drought event per and post-ALP implementation. This was done by asking communities how much time was required to replenish their stocks after the last drought event, and how much they time they considered would have been required had ALP been operating during the last drought event. Results suggest a faster replenishment rate of nearly half the time following ALP's programme.

Key social outcomes

ALP's community-based approach is designed to generate significant social outcomes. Our empirical work was therefore geared to capture these, based on the theory of change. Whilst some social outcomes are more straightforward to quantify – based upon existing academically established techniques, such as health and education – other 'softer' outcomes are less easy to quantify. Such is the case of social capital, institutional capital or changes in gender dynamics.

However, the fact that these soft outcomes are less prone to quantification does not mean they have any lesser importance in building resilience or in enhancing development more broadly. Institutional strengthening, for instance, can generate numerous positive externalities both in terms of community members' participation in decision-making (an inherently valuable process) and also on broader economic outcomes. The same holds for the well-documented role of women's empowerment in driving socio-economic change. In addition, it is widely documented that building resilience is not solely a matter of changes in material conditions but a multi-dimensional process involving the flexibility of institutions, of social structures and of collective knowledge and skills in communities. The results of the social outcomes are presented in Table 5 and Figures 15, 16 and 17.

Table 5: Evolution of key social variables

Type of outcome	Indicator	% evolution (2009-2013)
Health	Quality-Adjusted Life Years (QALYs)	+128%
Education	Number of children attending school > 6 months per year	+33%
Social capital	Number of persons in the "solidarity network" of the household	+23%
Gender (and institutional capital	Five-point scale on the extent to which women have an influence community and household decision-making	+112%
Adaptive capacity	Five point scale on the extent to which community members believe in their capacity and knowledge to establish resilience strategies in the future	+258%

The indicators used for health and education outcomes are based on standard approaches that are prevalent in the respective fields of health and education economics. Quality-Adjusted Life Years (QALYs) were calculated by asking sampled households to rank their health condition both on physical and mental health grounds, see Box 6. To capture a change in education we combined the number of children attending school with average school attendance in order to obtain the extra school years gained.

Box 6: Quality-Adjusted Life Years

The QALY is a measure of the value of health outcomes. Since health is a function of length of life and quality of life, the QALY was developed as an attempt to combine the value of these attributes into a single index number. The basic idea underlying the QALY is simple: it assumes that a year of life lived in perfect health is worth 1 QALY (1 Year of Life × 1 Utility value = 1 QALY) and that a year of life lived in a state of less than this perfect health is worth less than 1. QALYs are therefore expressed in terms of 'years lived in perfect health': half a year lived in perfect health is equivalent to 0.5 QALYs (0.5 years × 1 Utility), the same as 1 year of life lived in a situation with utility 0.5 (e.g. bedridden) (1 year × 0.5 Utility). QALYs combine subjective data (e.g. self-stated physical and mental health conditions) with objective data (e.g. life expectancy) to measure the disease burden associated with different health conditions. It can also be used for measuring the value of different health conditions – notably in cost-benefit analysis – through a combination of the empirical data obtained and measurement of the 'statistical value of life'.

Figure 15: Change in number of QALYs and change in QALYS per capita

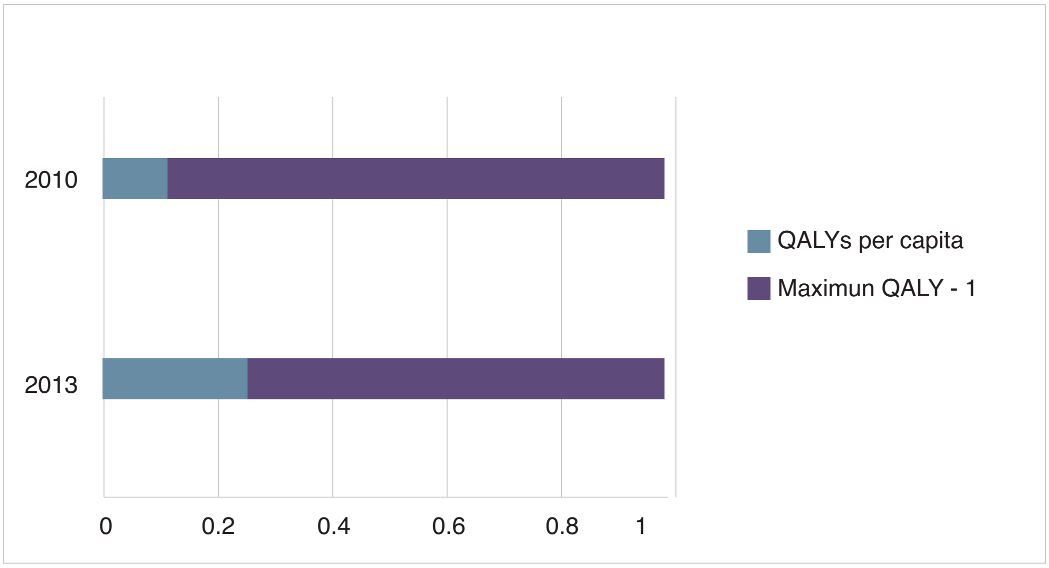


Figure 16: Change in number of children attending school for over 6 months

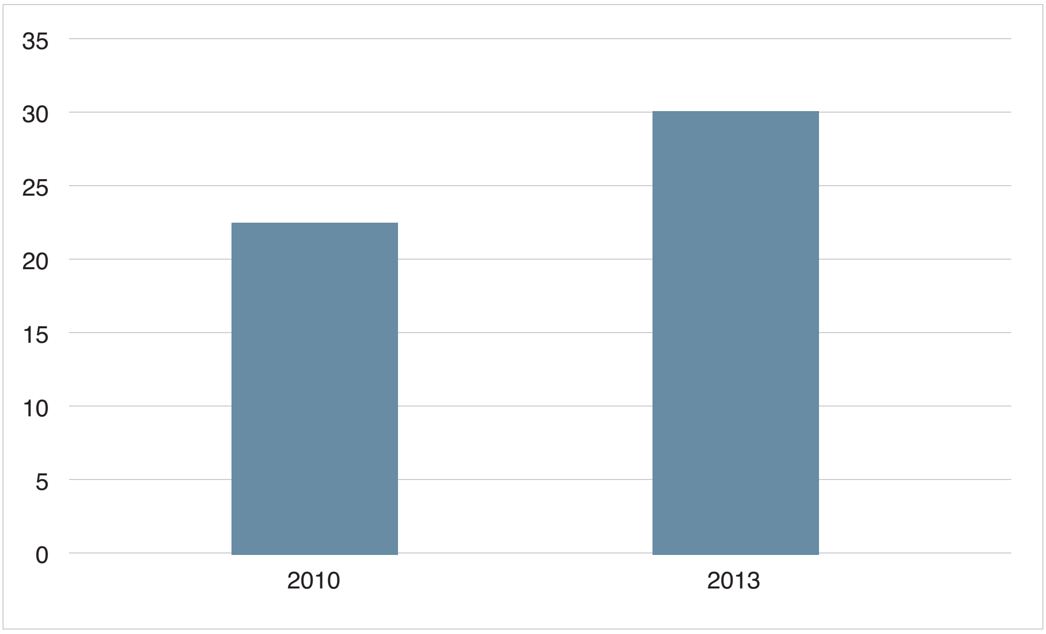
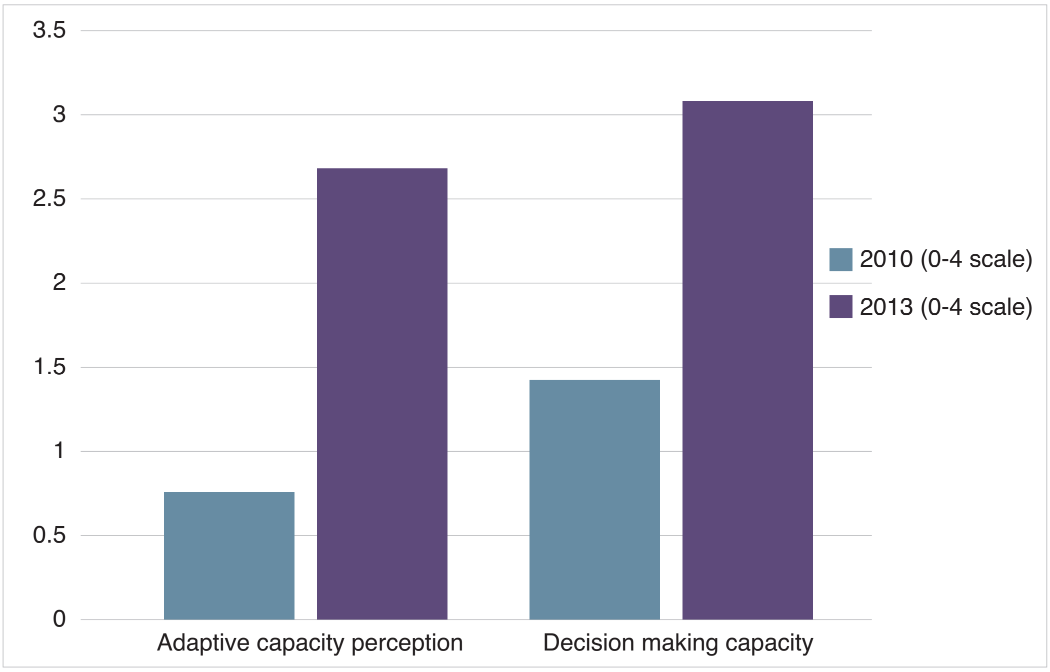


Figure 17: Change in perception of adaptive capacity for men and women, and decision-making capacity for women only



Social capital was measured by investigating the evolution of the solidarity circle of households, i.e. the number of other households directly supporting the livelihoods of the sample households. An enlargement of this circle is used as a proxy indicator for social capital within communities. Finally, we used subjective indicators to capture the community perceptions of changes in the evolution of women's role on decision-making structures and the evolution of trust in household and community adaptive capacity.

Key environmental outcomes

The two environmental outcomes measured in this research relate to desertification, which is the biggest ecological threat in Sahel ecosystems. ALP's interventions have aimed to tackle this issue through building the capacity of households to implement sustainable land management techniques, as well as through the provision of resources targeted at reforestation; avoiding further deforestation; and finally restoration of degraded lands.

The outcomes are intimately linked to the ecosystem services that are directly supporting the socio-economic livelihoods of communities. Reforestation and avoided deforestation, for example, can directly provide resources such as timber and fodder to communities. Equally, sustainable land management and the restoration of degraded lands can avoid a further extension of agricultural land to less productive spots. Finally, both can affect micro-climate patterns in the communities. The results of the environmental outcomes are presented in Table 6.

Table 6: Evolution of key environmental variables

Outcome	Indicator	Evolution (2009-2013)
Avoided deforestation and reforestation	Number of trees planted or maintained	+64,165
Improved land management	Hectares of degraded lands restored	+1,575

Since the beginning of the programme, our data suggests that the number of trees maintained (i.e. avoided deforestation) or planted amount to 64,165 for the four communities. This is an average of 75 trees per household. Similarly, a total of 1,575 hectares of degraded lands have been restored. This represents an average of 1.85 hectares per household.

Additionality

The outcome data presented so far is indicative only of the 'gross impact', i.e. the evolution of key forms of capital across time without taking into consideration what would have happened in a counterfactual (business-as-usual) scenario, had ALP not taken place. Gauging the counterfactual allows us to estimate the role of a programme in creating outcomes. It is from this that we calculate the 'net', or 'additional', impact.

Owing to the variety of actors involved in the area of Dakoro we asked communities (1) to list the organisations and actors that contributed to the changes observed and (2) to estimate the proportion of contribution from these different actors to the outcomes. The results of this contribution exercise are presented in Table 7.

Table 7: Percentage contribution of different actors according to the perception of communities

	Economic impacts	Social impacts	Environmental impacts
Local government	9	7	8
ALP	**53**	**55**	**60**
Other NGOs	15	14	11
State programmes	15	18	14
Community actions	8	6	7
TOTAL	100	100	100

Communities perceive the role of ALP differently according to the outcome; ALP has played a greater role in creating an environmental impact rather than social or economic impacts. It is important to note that there is a risk of social desirability of answers in much social research i.e. the respondents answer according to what they think the interviewer wants to hear. The limitations of this exercise should be clear, as it indeed possible that some form of social desirability of answers was provided by the communities. However, it is also worth noting that the value of subjective questions is the opportunity for the communities to share their perspective and perception. As a result, we take these answers as indicative and feed them into our analysis of the counterfactual.

Although these results are important and interesting the exercise does not capture evolution due to climate variability. 2009 was a particularly bad year in terms of aggregate rainfall and duration of the rainy period. It was followed by four relatively good years, which could explain part of the increase in agricultural and livestock revenue and, by extension, the improvement of social and environmental conditions prevailing in the communities, see Box 7.

Box 7: 2009 vs. post-2010 rainfall patterns

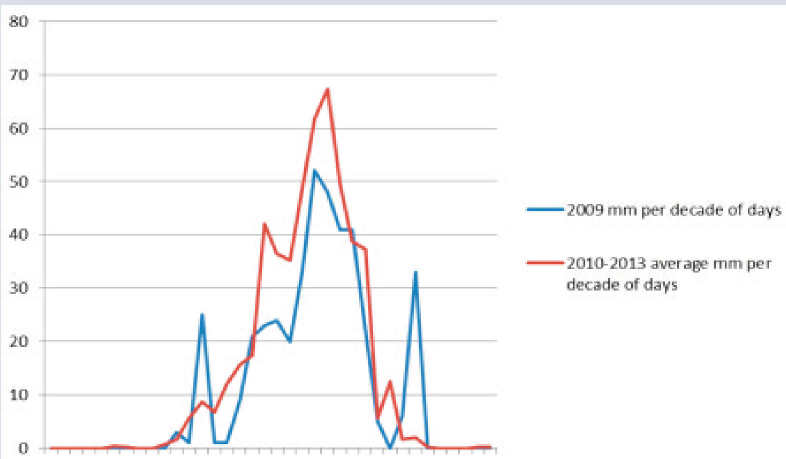
Rainfall evolution (2009-2013)

***NEF Consulting** calculations*

	mm of rain	Days of rainfall (events with >5mm)
2009	409	44
2010	539	59
2011	479	44
2012	571	52
2013	448	43

Rainfall pattern and variability

***NEF Consulting** calculations*



As such, it is critical to capture the counterfactual, and two methodological approaches were considered:

Option 1: Using national level data on the evolution of agricultural and livestock production and productivity, and comparing this data to observed changes in communities. However, this approach might entail substantial biases. Firstly, national (or even regional) data masks the substantial disparities in production and productivity among different sites and locations e.g. comparisons between production in marginalised communities versus production in areas with relatively intensive/modern practices. This means that aggregate averages might be poor proxies for understanding what would have happened in marginalised communities of Dakoro in the absence of ALP. Secondly, despite an increase in total agricultural production throughout the past three decades, the existing evidence suggests that production per capita has been decreasing[16]. Given that our data has been collected at a household level and therefore reflects production per household, it is neither comparable to production per capita per se, nor to aggregate production figures. The option of benchmarking the change observed relative to national level data was therefore excluded due to a lack of directly comparable data.

Option 2: Using regression analysis to understand the extent to which evolving climate patterns might have determined the increase of production and productivity. This method can be used to estimate the extent to which the observed increase in production can be explained by weather patterns across different years, and therefore provide an estimation of the production that should have been expected had the intervention not taken place. Despite this approach being more robust, it is important to stress that regression analysis is dependent to a great extent on the quantity and quality of available data. For instance, although climate patterns are sufficiently documented, the occurrence of other external shocks, such as locusts, is poorly reported - beyond whether they occurred or not. However we considered this approach less imprecise than option 1.

Due to the limits of the first option, we used regression analysis to determine the contribution of climate evolutions to agricultural production and livestock. This was done by using a historical data series for the region of Maradi, the closest possible to Dakoro, see Appendix 1.

Our results suggest that for each extra mm of rainfall, 120 additional units of agricultural output are generated. Conversely, a decrease of 1 mm in rainfall induces a loss of 120 units of output. By using this coefficient for the period 2009 to 2013 in our sample communities, it was determined that agricultural production for the three major crops (Millet, Sorghum and Cowpeas) should have been expected to increase by 3.75% throughout the period 2009-2013,

16 See notably : Ozer (2007), «Analyse pluviométrique au Niger : récentes modifications et impacts environnementaux». University of Liège. Available at: http://orbi.ulg.ac.be/bitstream/2268/16133/1/OZER_NIAMEY1.pdf and, République du Niger (2010), Chocs et vulnérabilités au Nier: Analyse des données secondaires…Op. Cit.

compared to 30.80% as our findings suggest. As such, the net increase (impact due to ALP) is of the order of 27%. Taking into account the contribution of other actors to the programme, ALP has directly contributed to a 13.8% increase of agricultural production. Table 8 presents the counterfactual for all major crops and the net impact of ALP.

Table 8: Measurement of the counterfactual for major crop production (expressed in kg)

Crop	Production 2009	Estimated 2013 production under BAU	Actual production 2013 (ALP)	Gross impact of ALP	Net Impact of ALP
Millet	267,053.88	271,733.88	307,584.03	+40,530.16	+35,850.16
Cowpeas	81,993.42	86,673.42	141,207.48	+59,214.06	+54,534.06
Sorghum	123,304.26	127,984.26	129,470	+6,165.74	+1,485.74

A similar approach was replicated to determine the quantitative link between livestock returns and rainfall patterns. The coefficients determined for economic capital were then transposed to social and environmental capital to calculate net impact. Although imprecise, we deemed this to be the most robust approach to assessing the business-as-usual of social and environmental capital evolution. The net economic, social and environment impacts of ALP, factoring for counterfactual and attribution, are presented in Appendix 2.

4. Approach to Social Cost-Benefit Analysis

Scope

Determining what is included and excluded from a socio-economic analysis is of critical importance in order to understand the results of a social cost-benefit analysis. Our approach to this analysis can be summarised as follows:

- **To include not only strict economic outcomes, but also broader social and environmental outcomes.** Such an approach therefore considers three forms of capital (economic, social and environmental) rather than one. This requires the monetisation of social and environmental outcomes in order to be compared like-for-like with economic outcomes and with investment in the programme. Although monetisation of non-market goods entails uncertainties, excluding these from the analysis means that an entire range of benefits become automatically invisible. In short, while accepting the shortcomings of 'pricing the priceless', this analysis takes the stance that an imprecise number is better than excluding outcomes which matter to communities.

- **To focus on a restrictive set of outcomes that can reflect broad aggregates or the 'big picture' for communities and decision-makers, rather than an exhaustive list.** This means that we do not focus, say, on the turnover of hedging schemes or the impacts of micro-lending within the community. Rather, we investigate whether and to what extent this set of micro-interventions have influenced broad aggregates such as revenue, health or education. This responds to a need to replicate the analysis in different contexts, which is made possible by establishing a common set of outcomes that can be used in other contexts.

- **To consider not only strict typical disaster risk reduction outcomes, but equally more classic development outcomes.** Indeed, the frontiers between an adaptation intervention and a development one are blurred and often artificial. As such, it is sensible to consider whether and to what extent adaptation enhances human development and vice-versa.

- **To create the framework for the analysis in the spirit of community-based adaptation.** The outcomes and impacts have been co-determined through a bottom-up process, and only then complemented with objective indicators, in order to measure what matters.

Table 9 outlines the variables used in the SCBA, as well as valuation approaches and sources. An overview of the process is presented in Appendix 3.

Table 9: Description of variables used in the Social Cost-Benefit Analysis

Category	Variable	Indicator	Data collection method	Monetary valuation proxy	Source for valuation proxy
Economic	Agricultural revenue	Net returns to agriculture (market and subsistence)	*Empirical*	Market value	Empirical
	Livestock revenue	Net returns to livestock (market and subsistence)	*Empirical*	Market value	Empirical
	Savings	Monetary and in-kind stock of savings	*Empirical*	Market value	Empirical
Social	Health	Quality Adjusted Life-Years (QALYs)	*Empirical*	Statistical Value of Life approach (average GDP per capita of Niger for a full QALY, i.e. year in perfect health)	Miller, 2000[17]
	Education	Extra years of schooling	*Empirical*	Returns to primary education for an extra year of schooling	Psacharopoulos & Patrinos 2002[18]
	Social capital	Number of individuals in the solidarity circle	*Empirical*	Value of goods donated to other households within the community per year	Empirical (questionnaire application)
	Women's participation	Increased participation of women in decision-making	*Empirical*	Willingness-to-Accept compensation exercise	Empirical (focus groups)
	Community empowerment	Increased confidence in implementing adaptation strategies	*Empirical*	Opportunity cost of time (hourly minimum wage) for participation in community actions and decision-making	Empirical
Environmental	Avoided deforestation and reforestation	Number of trees planted/maintained	*Empirical*	Value of timber Value of fodder Value of tCO2eq emissions sequestrated	World Bank, 2009[19]
	Restoration of degraded/desertified lands	Hectares of land restored	*Empirical*	Value of land per hectare (market price)	Empirical

17 Miller, TR (2000), 'Variations between Countries in Values of Statistical Life', Journal of Transport Economics and Policy, Vol 32 (2).

18 Psacharopoulos, G, Patrinos, HA (2002), 'Returns to Investment in Education : A Further Update', World Bank Policy Research, Working Paper No. 2881

19 World Bank (2009), Impacts des Programmes de Gestion Durable des Terres sur la Pauvreté au Niger, Unité Environnement et Gestion des Ressources Naturelles, Département du Développement Durable, Région Afrique. World Bank Report No 48230-NE.

As outlined in Chapter 3 this analysis considers both the counterfactual as well as the potential contribution of other actors, including the autonomous strategies of communities, to the outcomes identified.

The benefits generated by the intervention are then juxtaposed to the financial investment of ALP in the communities. Financial costs include both programmatic expenditure and management costs associated with these.

Time delimitation

We have run two distinct modelling simulations:

- A strict **evaluative simulation** that focuses only the costs borne and benefits generated throughout the period 2010-2013; and
- An analysis **combining evaluative data with a forecast to 2020**. While the results of the former can be considered more reliable, and the latter more hypothetical, there is a clear rationale for forecasting potential impacts into the future.

Firstly, benefits do not suddenly cease to occur as a consequence of artificial time delimitations. For instance, the impacts of the introduction of improved crop varieties are unlikely to stop happening this year. As such, analysing up to 2013 only, may considerably underestimate the benefits generated by community-based adaptation. Indeed, one of its key characteristics is the focus on sustainability: by embedding new practices, knowledge and skills into community structures, community-based adaptation aims precisely to ensure the sustainability of adaptation beyond the time-span of ALP's intervention.

In short, although an evaluative model may be perceived to be 'safer' in terms of deriving conclusions on strategies that are already in place, forecasting into the future can, despite complexities, depict a better representation of the magnitude of benefits.

Forecasting and uncertainty

Forecasting into the future requires a consideration of likely climatic evolutions over the next seven years. Indeed, the evolution of economic capital (and, by extension, social and environmental capital) is critically dependent on climate variables – most importantly rainfall patterns. As evidenced in chapter 2 however, the rainfall and temperature patterns in Dakoro are far from linear and do not point to a clear trend. Similarly, the available data does not show clearly depicting trends in the distribution of rainfall during the rainy season, as well as demonstrating potential interruptions to and start/end dates of the rainy season.

Numerous scenarios are therefore required in order to forecast uncertainty and the evolution of capital, and these need to be based on historical data. These scenarios are outlined in Table 10.

Table 10: Different scenarios for a forecastive analysis

Scenario	Description
Replicating 1980s scenario (worst case)	An average rainfall of 411.5mm per year throughout the period and four major drought events - three of which consecutive.
Replicating 1990s scenario (moderate case)	An average rainfall of 489mm per year throughout the decade and one major drought event.
Replicating 2000s scenario (best case)	An average rainfall of 495.2mm throughout the decade and one major drought event.

A 'no drought' scenario was excluded from the analysis. This is because Dakoro has experienced six severe or catastrophic droughts in the past 29 years. This represents a frequency of one drought every 4.8 years, on average. It is also synonymous with a 20% probability of drought occurrence per year.

Through datasets of the Nigerien climate centre Aghrymet we were able to determine the impacts of shocks on agricultural production for the region of Maradi. Through an econometric analysis we estimated the impacts of the level of rainfall on agricultural production and livestock. The coefficients derived allowed us to forecast the evolution of production under a business-as-usual scenario (what would have happened without ALP) compared to the evolution of production post-ALP. Whilst, evidently, community-based adaptation does not shield nor exempt communities from shocks, a higher level of savings and other initial conditions prior to the shock mean that the reduction can be less dramatic and that communities are apt to bounce back more rapidly, as evidenced in chapter 3.

Results

Table 11 presents the results of the evaluative analysis for the four communities combined. The results suggest that under any discounted rate, the intervention yields highly positive returns even if not taking into account further impacts beyond 2013.

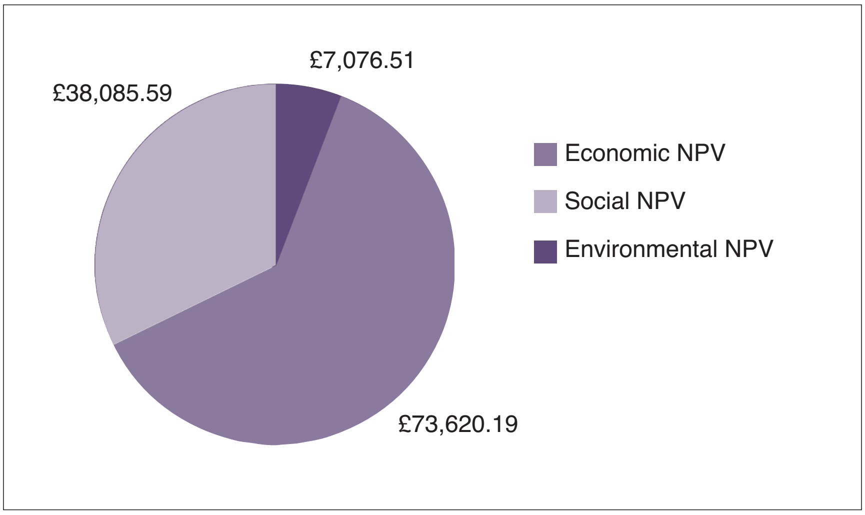
Table 11: Results of evaluative analysis (time span: 2010-2013) in £2013

	Net Present Value (net discounted benefits)	Benefit: Cost Ratio
0% discount rate	£184,129.84	4.45
5% discount rate	£158,044.91	4.34
12% discount rate	£129,330.39	4.19

More importantly, even if accounting *only* for economic returns, benefit-cost ratios range from 1.9 and 2.06. That is, even when social and environmental impacts are left out of the equation, the intervention still yields between £1.9 and

£2.06 per pound invested. Further, returns are still positive at the highest discount rate of 12%, with economic capital representing most of the value, see Figure 18.

Figure 18: Net Present Value of different capitals under a 12% discount rate



When forecasting over a longer time span, the benefits of the programme increase even further, see Table 12, and this is due to a combination of two factors:

1. The investment period of ALP ends in 2014, while benefits continue to accrue to communities. The net benefits therefore increase compared to costs, which remain stable after 2014 (see Appendix 4 for a visual representation).
2. A critical assumption in the model is that the time required to recover from a drought post-ALP is approximately half that required in a no intervention scenario (2.5 years versus 4.6 years). This substantially increases the output gap between the business-as-usual and the intervention scenario. It also means that the worse the climate scenario, the higher the returns generated by community-based adaptation, see Table 12. When relaxing this assumption, by assuming that the same time is required to recover regardless of the intervention, then returns are still positive, albeit lower.

Table 12: Results of combined evaluative and forecastive analysis (time span: 2010-2020) in £2013

		Net Present Value (net discounted benefits)	Benefit: Cost Ratio	*Economic B:C ratio only*
1980s scenario (worse)	0% discount rate	£399,413.48	9.8	*4.5*
	5% discount rate	£340,751.38	8.5	*3.9*
	12% discount rate	£230,426.50	6.1	*2.8*
1990s scenario (moderate)	0% discount rate	£321,080.23	7.9	*3.6*
	5% discount rate	£273,922.99	6.8	*3.1*
	12% discount rate	£185,235.10	4.9	*2.3*
2000s scenario (best)	0% discount rate	£286,934.97	7.06	*3.2*
	5% discount rate	£244,792.66	6.1	*2.8*
	12% discount rate	£165,536.28	4.4	*2.06*

Interestingly, our results are positive even if only taking into account economic benefits generated. As such, even if not placing confidence in social and environmental values, the net economic benefits generated are, at minimum, £2.06 for each £1 invested in communities.

These results need to be put into perspective. Table 13 compiles the results of a sample of previous cost-benefit analyses on adaptation and DRR programmes. The results of our analysis suggest that ratios ranging from approximately £4 to almost £10 per pound invested are indicative of a highly socially-profitable investment. Indicatively, the ratios we found are indeed higher than ratios of all previous analyses except for one, which suggests an extremely high result $37.3 per $1 invested. However, this analysis does not consider explicitly the counterfactual and attribution, which means that results might over-estimate the benefits of the programme compared to costs. Further, this comparison is only indicative. Indeed, these studies are not comparable like-for-like: first and foremost because the outcomes they consider are different; and secondly because the time frames considered are highly variable among different analyses.

*Table 13: Indicative Benefit: Cost ratios of a sample of DRR[20] and climate adaptation interventions Source: **NEF Consulting** compilation*

Country	Type of intervention	Benefit: Cost ratios	Source
Nepal	Adaptation	1.13 – 2.04	Willenbockel, 2011[21]
Nepal	DRR	1.55 – 5.81	White & Rorick, 2010[22]
India	DRR	3.17 – 4.58	Venton, 2004[23]
Sudan	Adaptation	2.4	Khogali & Zewdu, 2009[24]
Malawi	Adaptation	37.3	Tearfund, 2010[25]
Belarus, Georgia & Kazakhstan	DRR	3.1 – 5.7	World Bank, 2008[26]
Kenya	Adaptation	0.93 – 3.13	Nicholles & Vardakoulias[27]

20 Disaster Risk Reduction

21 Willenbockel, D. (2011), 'A Cost-Benefit Analysis of Practical Action's Livelihood-Centred Disaster Risk Reduction Project in Nepal'. Brighton: IDS. Available at http://community.eldis.org/?233@@.59ecc208!enclosure=.59ecc20e&ad=1

22 White, BA, Rorick, M (2010), 'Cost-Benefit Analysis for Community-Based Disaster Risk Reduction in Kailali, Nepal', Mercy Corps, Nepal. Available at: http://www.mercycorps.org.uk/sites/default/files/mc-cba_report-final-2010-2.pdf

23 Venton, C (2004), 'Disaster Preparedness Programmes in India: A Cost-Benefit Analysis', Network Paper 49. Available at: http://www.odihpn.org/humanitarian-exchange-magazine/issue-38/justifying-the-cost-of-disaster-risk-reduction-a-summary-of-cost%E2%80%93benefit-analysis

24 Khogali, H. and D. Zewdu (2009) 'Impact and Cost Benefit Analysis: A Case Study of Disaster Risk Reduction Programming in Red Sea State Sudan'. Sudanese Red Crescent Society, Khartoum, Sudan. Available at: http://www.preventionweb.net/files/globalplatform/entry_bg_paper~sudanredseaimpactandcostbenefitanalysis2009.pdf

25 Tearfund (2010), 'Investing in Communities: The Benefits and Costs for Building Resilience for Food Security in Malawi', Available at: http://www.e-alliance.ch/fileadmin/user_upload/docs/Publications/Food/2012/Investing_in_communities_web.pdf

26 World Bank (2008) 'Weather and Climate Services in Europe and Central Asia: A regional review' Working Paper 151. The World Bank, Washington, D.C., U.S.A. Available at: http://elibrary.worldbank.org/doi/pdf/10.1596/978-0-8213-7585-3

27 Nicholles, N, Vardakoulias O (2012) Counting on Uncertainty: The economic case for community based adaptation in North-East Kenya London: nef (new economics foundation). Available at: http://www.careclimatechange.org/files/adaptation/Counting_on_Uncertainty_July12.pdf

Conclusion and recommendations

The key question this research aimed to answer is whether and to what extent community-based adaptation is an efficient and effective adaptation approach. While our previous report, *Counting on Uncertainty*[28], strictly forecasted the impacts of ALP strategies that had not yet taken place, this research is based on solid, evaluation data. Our findings suggest that returns are considerably higher than the ones we had previously envisaged. Returns on investment ranging from £4 to virtually £10 per £1 invested are high by any standard. We are highly confident in the range of these results, for two main reasons:

1. The sensitivity analysis conducted suggests that even if considering strict quantitative economic benefits only, returns are still positive. As such, even for those sceptical of monetisation (i.e. those who do not place confidence in non-market valuation) the fact that economic returns are positive on their own is sufficient to consider community-based adaptation as cost effective.
2. Our analysis has taken into extensive consideration both the counterfactual as well as the contribution of other actors in achieving the outcomes identified in the field. It is therefore highly unlikely that impacts are over-estimated or inflated.

An interesting feature of community-based adaptation is that final outputs and outcomes generated do not necessarily differ from non-community-based ones. What matters, in this context, is how these outputs and outcomes are generated rather than what these outcomes actually consist of. However, by comparing the degree of uptake of activities and strategies between community-based interventions and other types of interventions, it could be possible to determine whether community-based ones are the more effective, even on more traditional grounds, e.g. for increasing agricultural revenue. Although our results do not permit a clear-cut answer to this question, the returns generated could be compared to other (non-community-based) interventions sharing similar objectives.

In more practical terms, the evaluative Social Cost-Benefit Analysis used for this research can be more easily replicated than a forecastive one. This report is accompanied by guidelines for practitioners to undertake simpler, evaluative Social Cost-Benefit Analyses in the future. A relatively standardised framework for evaluating adaptation interventions allows for subsequent comparisons of different strategies – not least to support budget decisions for NGOs and local governments in developing countries. This broader aim has been one of the main rationales for selecting only a handful of central key variables, rather than an exhaustive set of outcomes. Indeed, a progressive standardisation of socio-economic analyses of adaptation projects or programmes, requires a slow but sure identification of the outcomes that are the most significant in evidencing improved resilience.

28 Nicholles, N, Vardakoulias O (2012) Counting on Uncertainty: The economic case for community based adaptation in North-East Kenya London: **nef (new economics foundation)**

Whilst this research has been a first step in this direction, further refinement of the approach would be required to up-scale the analysis, especially if community-based adaptation is scaled to more communities in the developing world:

- If comparisons are to be made across different forms of adaptation strategies in order to identify the most cost-effective approaches to adaptation, then a set of common criteria and outcomes need to be defined. These need to move beyond simple economic outcomes to embody 'soft' components of adaptation, as well as environmental impacts of interventions. Such a definition would then allow comparison of the returns-on-investment of different forms of intervention in a more transparent manner, while supporting communities to determine their own strategies.

- Forecasting future climate conditions is a challenging exercise, especially on a local scale. Even downscaled regional climate models present numerous uncertainties and lack accuracy[29]. As such, only an exploration of a variety of rainfall and temperature scenarios using historic data to derive assumptions can generate meaningful results and conclusions. However, rainfall and temperature data on a local scale is not always available in developing countries. Increasing the capacity of authorities to collect this data is of critical importance both for planning purposes and for programme appraisal and evaluation.

Finally, our approach and findings have important implications for future design of adaptation strategies in developing countries:

- While our findings would need to be compared to alternative adaptation strategies, a community-based approach appears to present dual dividends: it enhances the decision-making ability of communities at a local level as well as considerably impacting on 'hard' outcomes, such as increased agricultural production. This means that a community-based approach may increase adoption of adaptation and development activities, such as the introduction of improved seed varieties.

- Community-based adaptation impacts on the overall development of communities. Indeed, the benefits considered in our analysis are based on typical development outcomes such as health and education. Our findings demonstrate that community-based adaptation responds both to short-run disaster mitigation measures as well as long-run development needs. This provides socio-economic evidence that adaptation strategies should be embedded in development interventions.

29 This notably because (1) ENSO and NAO effects are poorly represented and (2) because land cover changes are scarcely taken into account in these models. For further information see: Chase, T.N., R.A. Pielke, Sr., and C. Castro, (2003), 'Are present day climate simulations accurate enough for reliable regional downscaling?', Water Resources, Update 124: 26-34. Available at: http://pielkeclimatesci.files.wordpress.com/2009/10/r-250.pdf

Appendix 1: Rainfall evolution 1932-2013 (Maradi Airport)

Figure 19: Rainfall pattern (1932-2013)

Source: INS Niger (2010), Annuaire Statistique des Cinquante Ans d'Indépendance du Niger, République du Niger, Ministère de l'Economie et de la Finance & Institut National de la Statistique. Available at:
http://www.stat-niger.org/statistique/file/Annuaires_Statistiques/Annuaire_ins_2010/serie_longue.pdf

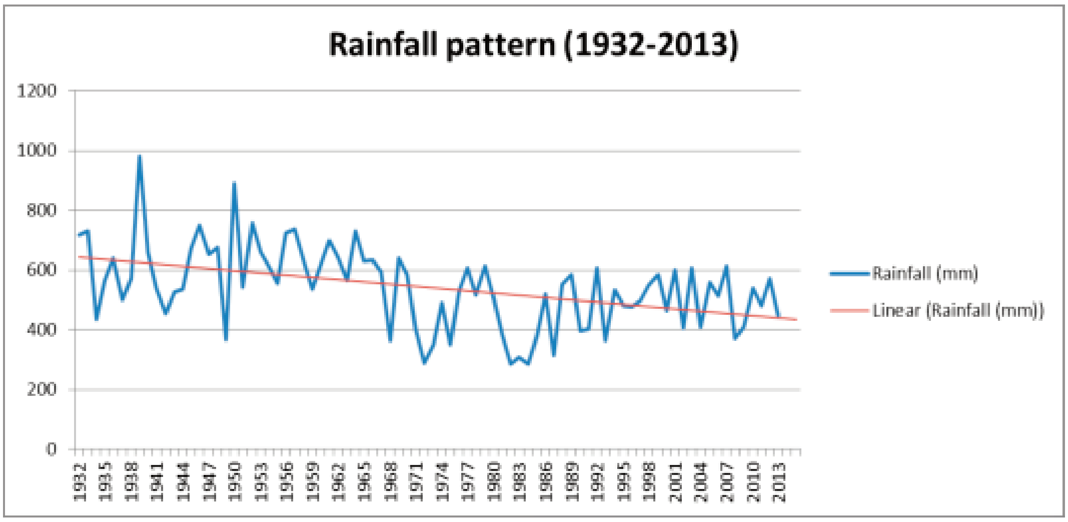
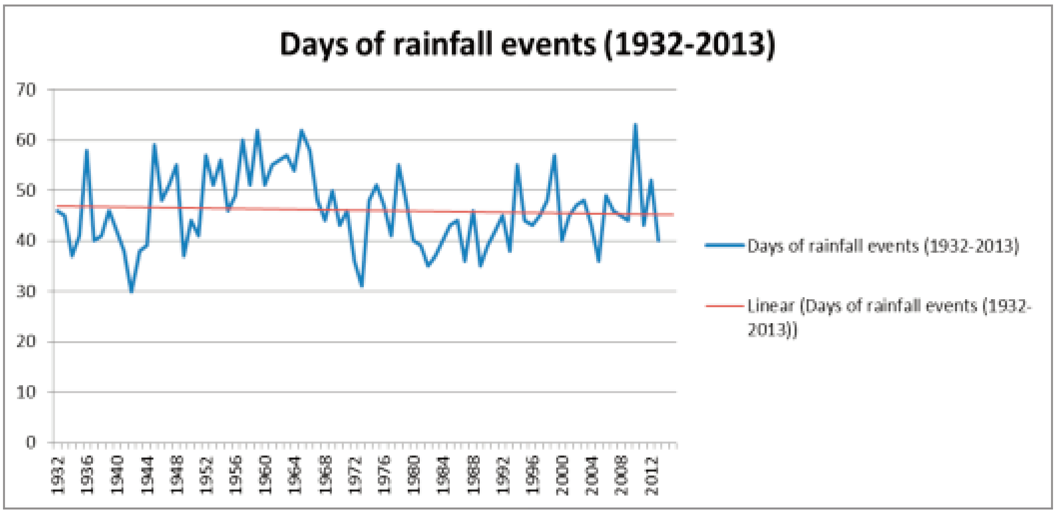


Figure 20: Days of rainfall events (1932-2013)

Source: INS Niger (2010), Annuaire Statistique des Cinquante Ans d'Indépendance du Niger, République du Niger, Ministère de l'Economie et de la Finance & Institut National de la Statistique. Available at:
http://www.stat-niger.org/statistique/file/Annuaires_Statistiques/Annuaire_ins_2010/serie_longue.pdf



Appendix 2: Determining net impacts

In order to calculate the percentage change in production that would have occurred regardless of ALP’s intervention, we built a simple econometric model that specified which other factors might have influenced the increase in production observed. In this model, the dependent variable is the agricultural yield. The independent variables are: (1) total rainfall; (2) mean temperatures; and (3) a binary dummy variable representing the occurrence of other external shocks (0 or 1) such as locusts. Our results suggest that for each extra mm of rainfall, 120 additional units of agricultural output are generated. Conversely, a decrease of 1 mm in rainfall induces a loss of 120 units of output. See Figure 21 for our regression statistics.

Based on these coefficients we calculated the agricultural output that should have been expected for 2013, had ALP’s intervention not taken place. Any increase over and above the agricultural output expected under a ‘no intervention’ scenario is the benefit of the programme, net of counterfactual, see Table 14.

Figure 21: Regression statistics to determine net impact

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.998092399
R Square	0.996188437
Adjusted R Square	0.984753748
Standard Error	13.24635633
Observations	15

ANOVA

	df	SS	MS	F	Significance F
Regression	6	45859.70604	15286.56868	87.11985519	0.048557116
Residual	2	175.465956	175.465956		
Total	8	46035.172			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	23240.05367	1747.183225	13.30144048	0.047771099	1039.985899	45440.12143	1039.985899	45440.12143
Rainfall_mm	120.8050793	10.03529926	120.3002897	0.044445611	10.65035501	270.9598036	1.650355006	270.9598036
Non_climate_shock	361.7178043	26.97902817	13.40736968	0.047395067	704.5188599	18.91674879	704.5188599	18.91674879
Temperature_C	-350.7109661	28.69667957	-12.22130822	0.051975179	-715.336852	13.91491982	-715.336852	13.91491982

Table 14: Net impact of ALP on agricultural production (kg)

Type of crop	Baseline production in 2009	Actual production in 2013	Estimated production under BAU	Net impact (benefit)
Millet	267,053.88	307,584.04	271,733.88	35,850.16
Cowpeas	81,993.42	141,207.48	86,673.42	54,534.06
Sorghum	123,304.26	129,470.00	127,984.26	1,485.74

This means that although part of the increase can be attributable to better weather conditions compared to 2009, this is only part of the story. The difference between both is attributable to the work of ALP.

The counterfactual for other variables (social and environmental) was assumed to be the same as for the economic variables, i.e. we assumed that the % change that would have occurred anyway, for social and environmental outcomes, was the same as for the economic ones. We further subtracted from the gross impact the contribution of other actors to the generation of benefits (see section on Additionality). This gave us the net outcome incidence (gross impact minus counterfactual, minus the contribution of other actors in achieving these outcomes), see Table 15.

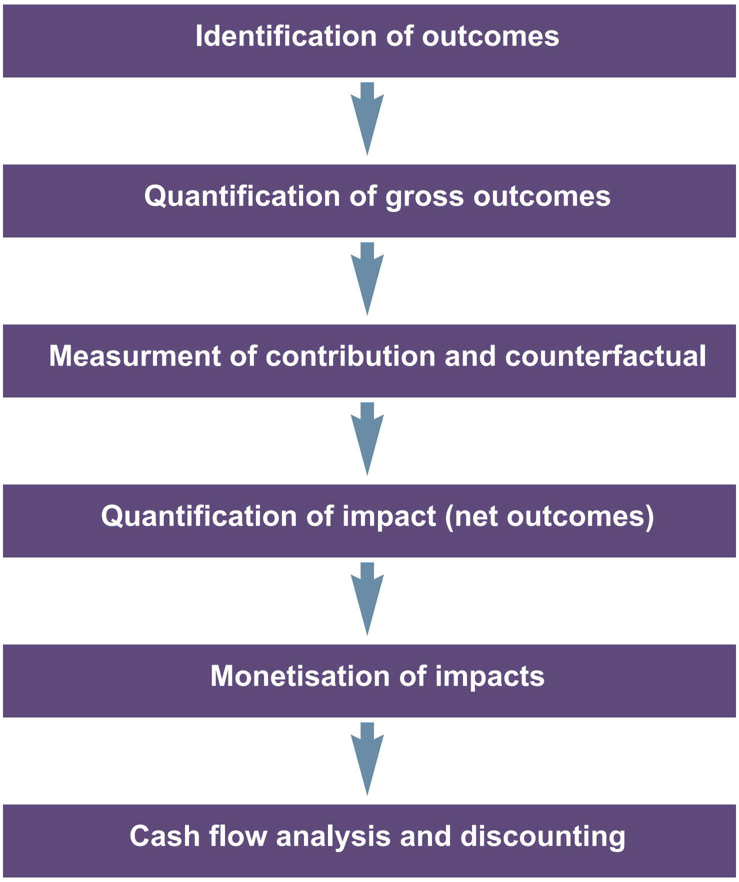
Table 15: Net outcome incidence per indicator, per form of capital.

	Outcome	Indicator	Outcome incidence	Deadweight	Attribution	Net outcome incidence
ECONOMIC BENEFITS	Agricultural revenue	Net evolution of revenue	£153,273.72	0.27	0.53	£21,857.25
	Livestock revenue	Net evolution of revenue	£74,397.87	0.27	0.53	£10,609.34
	Total Savings (stock)	Stock of savings (money and nature/livestock)	£30,312.49	0.27	0.53	£4,322.64
SOCIAL BENEFITS	Health	Quality Adjusted Life Years gained	70.80337673	0.27	0.53	10.10
	Education	School-years gained	93.08	0.27	0.53	13.27
	Social capital	Additional funds provided to other community members	£60,013.52	0.27	0.55	£8,912.67
	Empowerment	Increased confidence in making adaptation decisions	0.384615385	0.27	0.55	0.057119665
	Gender empowerment	Decision-making capacity within household	0.323076923	0.27	0.55	0.047980519
ENVIRONMENTAL BENEFITS	Avoided land degradation	Hectares under improved land management	1,576	0.27	0.60	255.6992197
	Avoided deforestation	Number of trees planted or maintained	34,649	0.27	0.60	5622.853735

Appendix 3: Social Cost-Benefit Analysis process

This flow diagram illustrates the process of our SCBA.

Figure 22 The SCBA process



Appendix 4: Visual representation of results

In order to visualise the main results of our study, Figures 23-25 present graphical representations of the relationship between benefits and costs under different discount rates.

Figure 23: Benefits and costs of ALP under a 0% discount rate

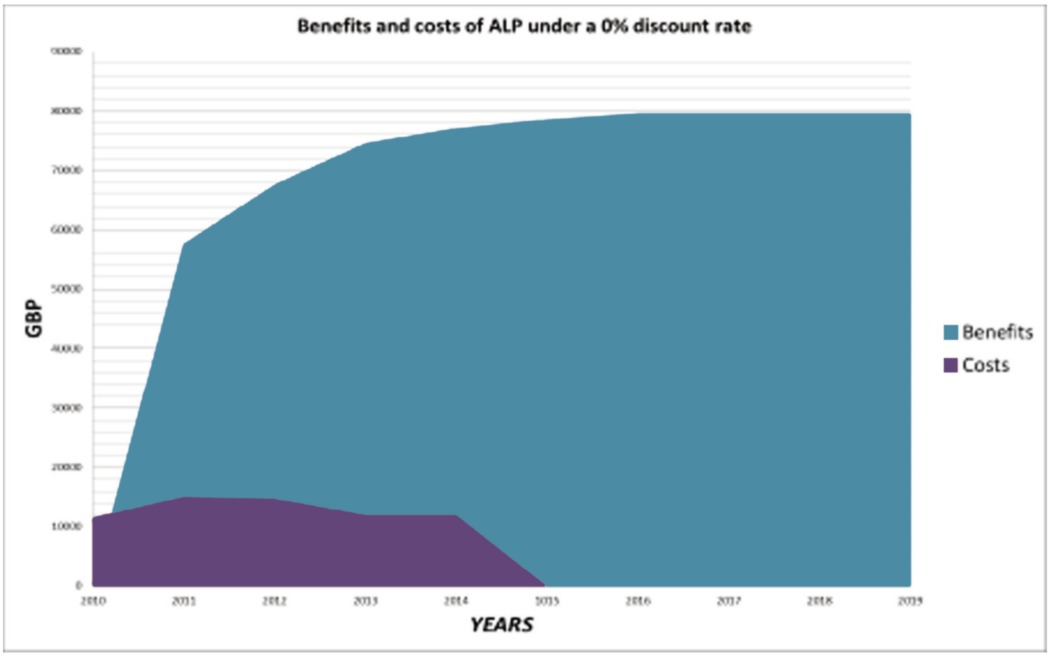


Figure 24: Benefits and costs of ALP under a 3% discount rate

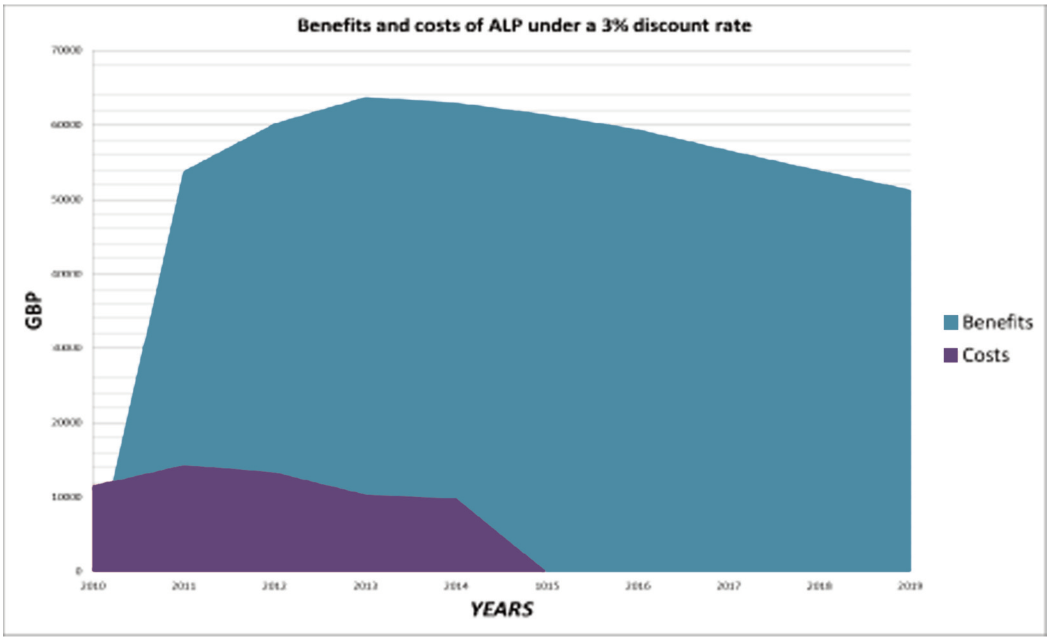
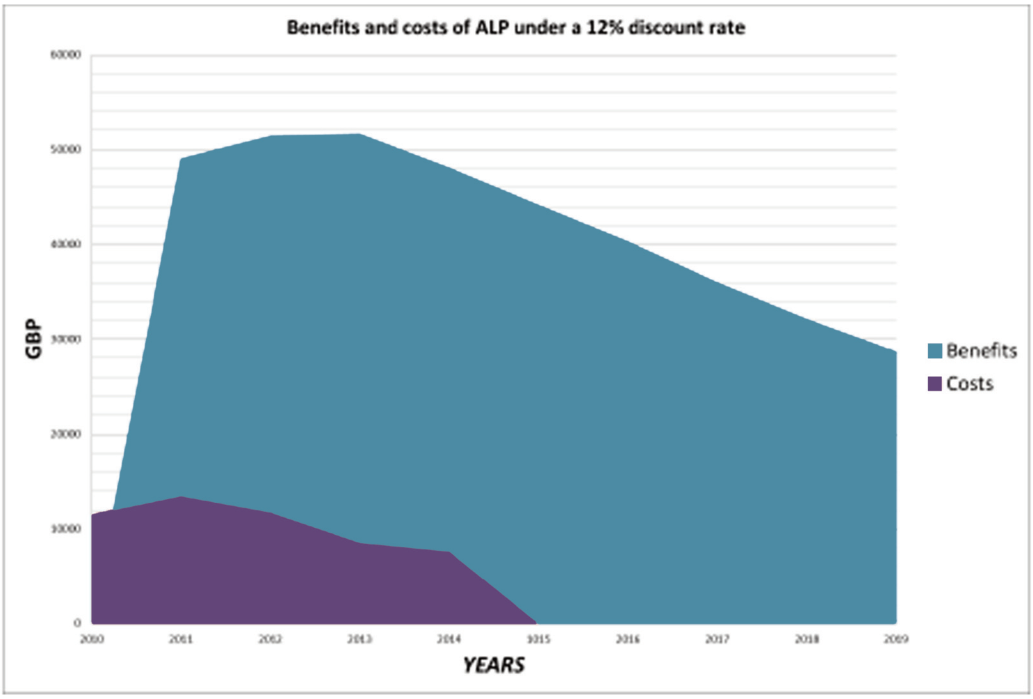


Figure 25: Benefits and costs of ALP under a 12% discount rate



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