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Towards developing scalable climate-smart village models: approach and lessons learnt from pilot research in West Africa

Jules Bayala, Robert Zougmoré, Catherine Ky-Dembele, Babou André Bationo, Saaka Buah, Diaminatou Sanogo, Jacques Somda, Abasse Tougiani, Kalifa Traoré, Antoine Kalinganire

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Summary

This occasional paper presents a report from a project on “Developing community-based climate smart agriculture through participatory action research in CCAFS benchmark sites in West Africa” which is a joint initiative of CCAFS-West Africa programme and ICRAF-WCA. Other key players of the project are the national research institutes namely Institut de l’Environnement et de Recherches Agricoles (INERA, Burkina Faso), Savanna Agriculture Research Institute of the Council for Scientific and Industrial Research (CSIR-SARI, Ghana), Institut d’Economie Rurale (IER, Mali), Institut Senegalais de Recherche Agricole (ISRA) and Institut National de Recherche Agronomique du Niger (INRAN). After three years of implementation, the present document is describing the approach used and the lessons learnt. The project used participatory action research approach to test combinations of innovations to address the triple goal of climate smart agriculture which are adaptation to climate change, mitigation of the effects of climate change and attaining food security. Results showed that despite differences in relation to the local contexts of the five CCAFS pilot sites in West Africa, the actions have been guided by a number of common elements. The first of the commonalities was building a strong partnership to develop agricultural systems that improve the resilience of ecosystems and people. The second element aimed to strengthening the capacity of key stakeholders (farmers, students and development agents) through vocational and academic trainings. The third targets awareness raising and information dissemination while the fourth involved identifying and testing, in a participatory way, the best fit agricultural practices addressing climate change issues both at plot, community and landscape levels. Finally, assessing the impact of the project activities on the biophysical and social changes was common to all national teams’ project of activities. The field activities of the project included weather forecast information sharing, a combination of integrated soil fertility management, soil and water conservation, vegetation rehabilitation, drought-tolerant crop varieties testing and diversification, as well as the analysis of the change in behaviour of all actors involved in the activities and capacity strengthening. The local communities were more receptive of project interventions that involved individual actions as opposed to the collective ones. This observation led to more focus on individual activities by the national teams while reinforcing those of social capital-building as collective actions are also needed to address climate change issues at community and landscape levels. Training and awareness-raising activities are critical for this last aspect. An evaluation of the project through two consultants appointed by ICRAF reported that the project was well designed and was very relevant in the context of climate change as its objectives are in line with local needs especially national research/development goals. From their assessment, the most promising and sustainable outputs were found to be the individual, low cost and locally-grounded technologies/innovations. In addition, farmers demanded soil and water conservation techniques (e.g., Zaï), agroforestry practices (e.g., Farmer-managed Natural Regeneration, fodder banks and fruit tree planting) and crop diversification (leafy vegetables). The main weaknesses of the project according to the consultants include lack of systematic baseline and actions about assessing greenhouse gas as indicated in the project document. Based on these weaknesses and achievements, recommendations for future actions have been formulated to be used to adjust the activities, particularly for the second phase.

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Contents

List of acronyms and abbreviations

AfSIS	African Soil Information Systems
AGRECOL	AGRiculture ECOLogique. A Senegalese non-governmental organization created in 2002 whose mission is to strengthen the vision, the practice and the promotion of agro-ecology in Senegal and in West Africa
AGRHYMET	Centre Régional de Formation et d'Application en Agro-météorologie et Hydrologie Opérationnelle
BMZ	Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung, Germany
CAWT	Conservation Agriculture with Trees
CCAFS	Climate Change, Agriculture and Food Security
CGIAR	Consultative Group on International Agricultural Research
CIAT	International Centre for Tropical Agriculture
CLIMSOFT	A software suite for storing climatic data in a secure and flexible manner and for extracting useful information from the data
CO_2	Carbon dioxide
CRP	Consortium Research Program
CSA	Climate-Smart Agriculture
CSIR-SARI	Savanna Agricultural Research Institute of the Council for Scientific and Industrial Research
CSV	Climate-Smart Village
DANIDA	Danish International Development Agency
DfID	Department for International Development
ENRACCA-WA	Strengthening the capacity of resilience and adaptation to climate change through integrated management of land, water and nutrients in the semi-arid areas of West Africa
ENSAM	École Nationale Supérieure d'Architecture *Montpellier*
EPIC	Ecosystems Protecting Infrastructure and Communities
FAO	Food and Agriculture Organization of the United Nations
FMNR	Farmer-Managed Natural Regeneration
GHG	Greenhouse Gas
ICRAF	World Agroforestry Centre
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
ICT	Information and Communication Technology
IICT	Instituto de Investigação Científica Tropical
ILRI	International Livestock Research Institute
INRAN	Institut National de Recherche Agronomique du Niger
IPCC	Intergovernmental Panel on Climate Change
IPR/IFRA	Institut Polytechnique Rural de Formation et de Recherche Appliquée
ISFM	Integrated Soil Fertility Management

ISRA	Institut Sénégalais de Recherche Agricole
IUCN	International Union for Conservation of Nature
M&E	Monitoring and Evaluation
MEA	Millennium Ecosystem Assessment
NARS	National Agricultural Research System
NGO	Non-Governmental Organization
PAR	Participatory Action Research
PHAO	Project Harvesting Adaptation Outcomes
PICSA	Participatory Integrated Climate Services for Agriculture
RPL	Regional Programme Leader
SDC	Swiss Agency for Development and Cooperation
ToP-MECCA	Toolkit for Planning, Monitoring and Evaluation of climate change adaptation
TOP-SECAC	Trousse à Outils Planification et Suivi-Evaluation des Capacités d'Adaptation au Changement climatique
UK	United Kingdom
USA	United States of America
WA-WASH	West Africa Water Supply, Sanitation and Hygiene
WCA	West and Central Africa

Glossary

Adaptation: Adjustment in natural or human systems in response to actual or any natural stimuli (including climatic ones) or their effects, which moderates harm or exploits beneficial opportunities.

Adaptive behaviour: Process by which an organism or a species changes its pattern of action to better suit its environment. It is contrasted with structural adaptation, which is the appearance of physical features that confer an advantage upon a species.

Attitudinal change: Modification of an individual's general evaluative perception of a stimulus or a set of stimuli.

Awareness: Ability to perceive, to feel, or to be conscious of events, objects, thoughts, emotions, or sensory patterns.

Behavioural change: Any transformation or modification of human behaviour.

Buffer function: Ability to protect the natural feature or function of interest, and mitigate the impact of stressors typically arising from the existing or anticipated land use outside the feature or area of function.

Climate change: Refers to a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period (typically decades or longer).

Climate information: This type of information includes record temperatures, record precipitation and snowfall, climate extremes statistics, and other derived climate products.

Climate variability: Refers to variations in the mean state and other statistics (such as standard deviations, the occurrence of extremes, etc.) of the climate on all temporal and spatial scales beyond that of individual weather events.

Cost-effective: Economical in terms of the goods or services received for the money spent.

Earth bund: An earth formed into an embankment to hold back water.

Ecosystem services: Benefits people obtain from ecosystems which are grouped into four broad categories: *provisioning*, such as the production of food and water; *regulating*, such as the control of climate and disease; *supporting*, such as nutrient cycles and crop pollination; and *cultural*, such as spiritual and recreational benefits.

Effectiveness: Capability of producing a desired result.

Efficiency: Extent to which time, effort, or cost is well used for the intended task or function.

Food security: When all people (of household, country, region, etc.) at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life.

Gender: Refers to the social attributes and opportunities associated with being male and female, and the relationships between women and men, girls and boys, as well as the relations between women and those between men.

Gender sensitive: Activity designed so that women and men receive even benefits from it and that promotes gender equality throughout its implementation.

Half-moon: Half-circle shaped basin with the excavated soil laid out in a semi-circular pad flattened on the top.

Impact: Change in real people's lives and the environment they live in.

Impact pathway: A visual description of the causal chain of events and outcomes that link outputs to the goal (logic model); and network maps that show the evolving relationships necessary to achieve the goal.

Indicator: An observable and measurable entity that serves to define a concept in a practical way. This can be about current conditions as well as to forecast trends.

Innovation: New idea, product or process and significant technological change of product and process.

Integrated farming system: Farming system where high quality food, feed, fibre and renewable energy are produced by using resources such as soil, water, air and nature as well as regulating factors to farm sustainably and with as little polluting inputs as possible.

Landscape: Refers to the visible features of an area of land.

Livelihood context: It is composed of institutions, processes and policies, such as markets, social norms, and land ownership policies that affect the ability of people to access and use assets for a favourable outcome. As these contexts change they create new livelihood obstacles or opportunities.

Micro-dosing: A precision farming technique, where a small amount of fertilizer (1-4 g) is placed with the seed at planting.

Mitigation: Actions to limit the magnitude and/or rate of long-term climate change. Climate change mitigation generally involves reductions in human (anthropogenic) emissions of greenhouse gases. Mitigation may also be achieved by increasing the capacity of carbon sinks, e.g., through reforestation. Mitigation policies can substantially reduce the risks associated with human-induced global warming.

Multifunctional landscape: A landscape that provides food security, livelihood opportunities, maintenance of species and ecological functions, and fulfils cultural, aesthetic and recreational needs.

Out scaling: Replication, copy-paste, more of the same, expansion, extension, adoption, dissemination, transfer (of technology), mainstreaming, roll-out, or multiplication.

Outcome: Change in people, generally the people using the outputs. We differentiate between two types of outcome – changes in people's practice (e.g. farmers adopting a water-saving technology) and changes in

people's knowledge, attitude and skills (KAS) required to underpin a change in practice (e.g. what the farmers need to learn before they adopt the water-saving technology).

Output: Deliverable that people outside the project or programme might use, for example, tool kits, maps and innovation platforms, often but not always generated by carrying out research.

Practice: Result of accumulated knowledge and know-how and is related to the environment, the perception of the farmer or herder, and the use of the practice.

Rehabilitation: A re-engineering to restore or improve/enhance some aspects of an ecosystem but not necessarily to fully restore all components.

Resilience: Ability of a system and its component parts to anticipate, absorb, accommodate, or recover from the effects of a hazardous event in a timely and efficient manner. Such hazardous events can include stochastic events such as fires, flooding, windstorms, insect population explosions, and human activities such as deforestation and the introduction of exotic plant or animal species.

Restoration: The process of returning an ecosystem as closely as possible to pre-disturbance conditions and functions. Implicit in this definition is that ecosystems are naturally dynamic; it is therefore not possible to recreate a system exactly.

Risk insurance: A process providing protection against the probability or threat of quantifiable damage, injury, liability, loss, or any other negative occurrence that is caused by external or internal vulnerabilities, and that may be avoided through pre-emptive action.

Shock: Possibly an occurring event that can damage well-being.

Smartness (for agriculture): Ability of an agricultural technology/innovation to sustainably increase the productivity, resilience (adaption), reduce/remove greenhouse gases (mitigation) and enhance the achievement of food security and development goals.

Stone bund: Stone formed into an embankment to hold back water.

Strategic option: Operational planning with long term benefits.

Stress: Set of responses of an organism submitted to pressure or constraints from its environment.

Sustainability: Ability for a farming system to generate crop yields that do not decline over time while maintaining the stock of natural resources through better management of these natural resources. In other words, the ability of a farming system to be economically profitable, environmentally sound and good for communities.

Tactical option: Operational planning with short-term benefits.

Technology: Ordered set of operations with a production purpose which can be described independently of the farmer or the herder who implements it.

Transformative change: A continuous set of movement, not just a short burst of movement whilst traversing from one static position to another. It involves very different ways of seeing agriculture and very different ways of doing it.

Up-scaling: Transition, institutionalization, transformation, integration, incorporation, evolution, development.

Vulnerability analysis: Process of estimating the vulnerability to potential disaster hazards of specified elements at risk.

Vulnerability: Degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity (determined by different social, ecological and political factors interacting across different scales), and its adaptive capacity.

Weather forecast: A statement saying what the weather will be like the next day or for the next few days.

Weather forecasting: Application of science and technology to predict the state of the atmosphere for a given location.

Zaï: Technique for recovering encrusted soils that consists of digging holes of 20-40cm in diameter and 10-15cm deep to collect surface water and increase its infiltration into the soil.

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Key words: Adaptation, Climate-smart, Climate change, Climate variability, Food security, Mitigation

1. Introduction

Prevailing food insecurity is being worsened by climate change and a growing global population predicted to reach 9 billion by 2050. To meet the needs of this population, food production must increase by at least 70 percent by 2050 (FAO 2009). The most challenging part of such an increase is the changing climate particularly in Sub-Saharan Africa, which is known as one of the most vulnerable regions (Ramirez and Thornton 2015).

Over the last 55 years, food has increased by 1-2 percent in the well performing Sub-Saharan countries (Wik et al 2008). However, the increased food production in this region has been due to extensification of agriculture, bringing additional and often marginal lands into production with serious implications for the ecological processes that sustain human well-being (MEA 2005; Jose 2009). Integrated farming systems that mimic the structure and function of natural ecosystems can help solve, or at least reduce, land degradation while sustaining ecosystem service deliveries including food production (Jackson et al 2010; van Noordwijk et al 2011; Vermeulen et al 2012). In relation to climate change impacts, reliable food production as well as improved nutritional aspects by combining crop (starch), livestock (proteins) and tree (vitamins and micro-nutrients) will provide more balanced diets to communities (Cannell et al 1996; Matocha et al 2012; Schoeneberger et al 2012). Integrated farming also includes diversification, improved seeds and breeds, and water management. (Figure 1). Diverse and integrated farming systems are expected to reduce the vulnerability of farmers to shocks and climate change stresses (FAO 2011; Neufeldt et al 2012; Bayala et al 2014). However, designing approaches for such ecological farming systems that fit into the broader livelihood context of farmers and farming households are still lacking (Coe et al 2014) or not properly implemented.

Research activities have been historically characterized by an over-generalization of recommendation domains of the findings dismissing the uniqueness of various socioecological contexts (Coe et al 2014). Alternatively, participatory action research (PAR) approaches take into consideration context-specific conditions at community level, and involve the national agricultural research systems (NARS), extension services, community members and other bodies in charge of managing the natural resources base. These approaches aim at developing the expertise of the involved actors in order to bring about changes in their behaviour including their effective participation in research activities from planning, to monitoring and evaluation. This is also a vector of social transformation of research to gradually integrate expertise and farming knowledge in its investigation demarches. Most of the current projects of the region use different entry points to address climate change stresses with underlining goals to sustainably increase agricultural productivity and resilience, reduce greenhouse gases (GHGs) and enhance food security of local communities.

In the case of the CGIAR Research Programme on Climate Change, Agriculture and Food Security (CCAFS), PAR activities pilot baskets of already-proven practices including land and vegetation rehabilitation, water harvesting, agroforestry interventions, cropping practices (improved varieties and cultivars, crop-associations, etc.), and other social forms of organization; the expectation is to allow more success in meeting the food security, adaptation and mitigation goals, in different contexts, therefore rendering agriculture more climate-smart. The choice of these practices by the farmers was based on a range of key farming practices in the region that preserve and restore various ecosystem services and contribute to rehabilitation of natural resources. It is well known that heavy dependence on ecosystem services places the welfare of poor communities in close connection with environmental conditions. As the quantity and quality of natural resources decline,

so does the security of their livelihoods (Reid et al 2010). Reducing current socioecological vulnerabilities and increasing adaptive capacities, however, requires not only a detailed analysis of climate impacts but also a comprehensive understanding of how livelihoods are generated and sustained (Cinner et al 2013). In fact, the assets and capabilities that comprise people's livelihoods often shape vulnerability and the ability to reduce it. Addressing agricultural productivity issues may contribute to improved food availability (including access, utilization and governance) and more income, allowing local people to better adapt to the changing climate. But this has to be done while taking gender into consideration to ensure equity. In addition, appropriate policy environment at various levels (local, national and regional) is required as far as natural resource management is concerned, especially in the large range of landscapes of West Africa.

To address all these issues, CCAFS PAR activities in West Africa test scalable climate-smart practices, monitor and evaluate their impacts on the agro-ecosystems and the resilience of people, as well as the behavioural changes in the participating farmers.

Our working hypotheses are:

1. Multifunctional landscapes with integrated farming systems provide buffer functions at a number of ecological and socioeconomical scales that jointly mitigate human vulnerability, risk and negative impacts of climate change;

2. Iterative process of the participatory approach used will lead to social learning among various stakeholders along the action research chain (learning by doing), and;

3. Appropriate policy regulations will create a conducive environment for long-term investment in agriculture of the local stakeholders.

2. What is CCAFS?

The CGIAR Research Programme on CCAFS is a strategic partnership emerging from new collaboration between CGIAR and Future Earth to overcome the threats caused by a changing climate to achieving food security, enhancing livelihoods and improving environmental management in the developing world. CCAFS brings together the world's best strategic research in agricultural sciences, development research, climate science, and earth system science to identify and address the most important interactions, synergies and trade-offs between climate change, agriculture in a broad sense and food security. As a collective effort, CCAFS has become a hub that facilitates action across multiple CGIAR centres and other CGIAR Research Programmes while involving farmers, development agents, policy makers, donors and other stakeholders to integrate their knowledge and needs into the tools and approaches that are developed.

One of the over-arching objectives of CCAFS is to test pro-poor adaptation and mitigation practices, technologies and policies and assess their effects on the food systems, adaptive capacity and rural livelihoods. CCAFS conducts an adaptive 'place-based' research aimed at decreasing the vulnerability of rural communities and to enable them to prosper under a variable and changing climate. The regional team is seeking complementarity of thematic research supported by a strong network of partners implementing the work. The regional team is spearheading achievement of outcomes and impacts at national and regional levels.

3. Rationale and objectives of the PAR-CSA in West Africa

There is a growing need for agricultural development options that can contribute to smallholder farmers' food security and ability to adapt to climate change while sequestering carbon dioxide from the atmosphere or otherwise minimizing GHG emissions. Despite the will of some countries to start including agriculture in national adaptation plans, these efforts face numerous challenges. Technically and economically attractive and socially acceptable options for adaptation and mitigation need to be developed, tested and validated in ways that provide lasting benefits especially for women, youth, migrants, ethnic minorities and the very poor farmers at community level. Impacts across larger landscapes also need to be assessed for their sustainability. Successes from the PAR need to be fed back into national policy processes to inform the policy discussion.

CCAFS seeks to develop up-scalable options of climate-smart agriculture through improved understanding of adaptation and mitigation opportunities in agriculture for building resilient communities in West Africa. Given the comparative advantage of ICRAF on the issues related to land and vegetation restoration for sustainable agricultural production, CCAFS Regional Programme has partnered with ICRAF Sahel to lead and coordinate the participatory action research that enables an iterative learning and improvement of interventions across the five CCAFS pilot sites in West Africa. A focus on gender participation and the role of women, youth and marginalized groups in decision-making or benefits sharing were seen as essential. The idea was also to work with the existing agricultural adaptation and carbon programmes to take advantage of their ground experience to scale up the PAR activities.

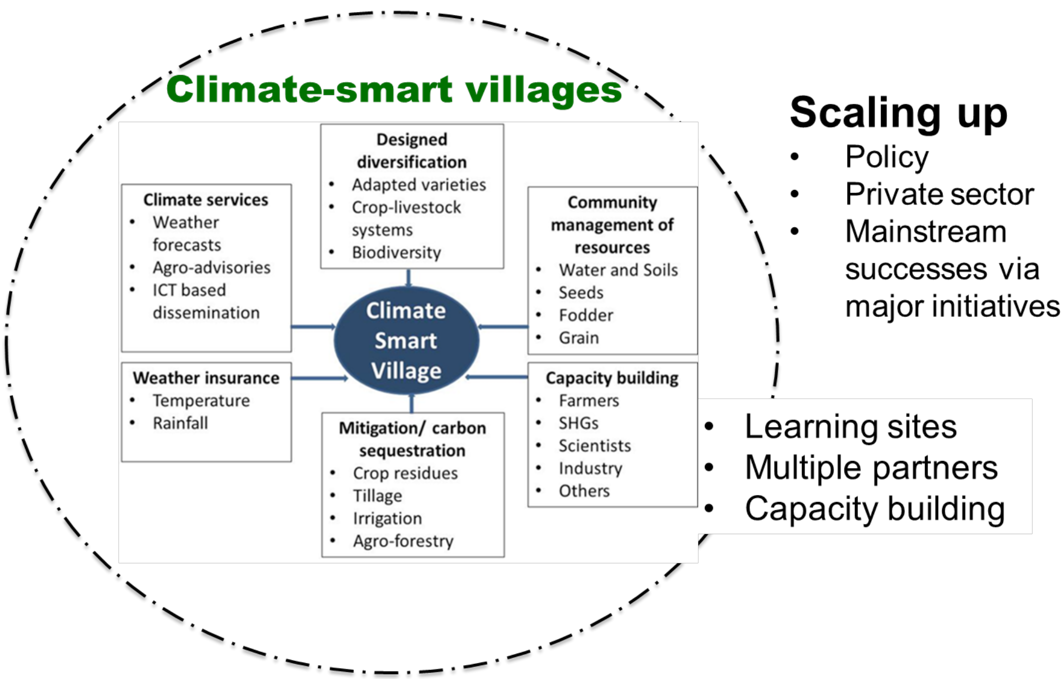


Figure 1: Model of climate-smart village being tested in the CCAFS West Africa region

Therefore, the main objective of the participatory action research on climate smart agriculture (PAR-CSA) in West Africa is to test and validate, in partnership with rural communities and other stakeholders, scalable climate-smart village models for agricultural development that integrate a range of innovative agricultural risk management strategies (Figure 1). The project also aims to enable farmers, developers and managers of agricultural adaptation and mitigation, and policy makers to develop cost-effective CSA options that support local sustainable development especially related to food security and climate change adaptation.

Four work packages and eleven activities as defined by a stakeholders' workshop held in 2012 at the start of the project were broadly described to help frame the domains of activities that each country team could contextualize to make the agricultural production systems in each site more resilient (Table 1). Therefore these activities have not been executed to the same extent as each country team (including all actors mentioned in the partnership section) has adopted a range of suitable agricultural technologies and practices to bring about the changes desired by the community at site level (Tables 2 and 3).

Table 1: Work packages and activities for participatory action research on climate smart agriculture as described in the project document (ICRAF-WCA, 2011) for West Africa

Work packages	Activities
Work package 1: Baseline studies	Activity 1: Baseline data on carbon stocks
	Activity 2: Baseline data of cultural and socioeconomic conditions
Work package 2: On farm testing of tree-based technologies to mitigate and adapt to climate change	Activity 3. Increase C sequestration through integrated biomass management in farmers' fields
	Activity 4. Carbon monitoring
	Activity 5. Assessment of soil quality
	Activity 6. Economic cost-benefits and reward scheme for environmental services
	Activity 7. Institutional analysis arrangements (forest laws and local regulations)
Work package 3: Development of sustainable biofuel production systems	Activity 8: Integrated biofuel production systems
	Activity 9: Adapting parkland agroforests to produce better wood in a changing climate
Work package 4: Greenhouse gas (GHG) fluxes from soils	Activity 10: Mitigation actions for GHG in production systems
	Activity 11: Monitoring of GHG from soils

Parallel to the mitigation actions, there was a plan to monitor the GHGs, particularly the carbon dioxide (CO_2) emitted from the various options tested. Further efforts were to be made to separate the components of this emitted amount of CO_2 (autotrophic and heterotrophic) as this has some implications on the management options of the farming systems. However, it did not materialize due to limited funding.

4. Sites of implementation

Research activities have been implemented in the following sites, known as climate-smart villages (CSV) (refer to Map 1 for details): Tibtenga (Yatenga), Burkina Faso; Doggoh (Jirapa) and Bompari (Lawra), Ghana; Ngakoro and Tongo (Cinzana), Mali; Kampa Zarma (Kollo), Niger; and Ngouye and Daga Birame (Kaffrine), Senegal. The altitude of all these sites ranges from 180m to 350m above sea level (asl), except the Senegal sites (15-50 masl) which are located at much lower altitude compared to the others. Förch et al (2013) have provided more details on the farming and livelihood systems of each site.

The climate is of Guinean type in the Ghana sites and Sudano-Sahelian or Sahelian type in the remaining four country sites. The lowest rainfall (300mm) is registered in the Niger site, and the highest rainfall is in Ghana (1,200mm) showing a strong latitudinal rainfall gradient that determines the cropping systems. Indeed, if extensive small-scale mixed crop-livestock farming systems are common in all sites, tuber crops (yam and potatoes) as well as crops with higher water requirements (cotton and maize) are more developed in the south in Ghana sites. Despites these differences, the rainfall of all the West African CCAFS sites is characterized by dramatic fluctuations and substantial year-to-year variability. Other challenges include high population pressure on natural resources, land degradation, poor soil fertility (sandy with low soil organic carbon content), high poverty levels with low access to capital, and food insecurity. These challenges are threatening the livelihood of more than 80 percent of the populations of these sites who are making their living from subsistence rain-fed agriculture (Förch et al 2013).

Map 1: Location of the implementation sites (climate-smart villages) of the participatory action research on climate smart agriculture in West Africa

To address these constraints, several initiatives have been developed by actors of the rural development sector. Despite these initiatives, the degradation of ecosystems and food insecurity continue and are even increasing (McIntyre et al 2009; Munang et al 2011). This situation can be attributed to the multiplicity of sectoral non-concerted interventions that very often ignore the local knowledge of the communities (World Bank 2004). In an attempt to reverse this, CSV models were tested with the following components: climate information services, agro-sylvo-pastoral product diversification, mitigation and carbon sequestration, community management of the resources and capacity development (Figure 1).

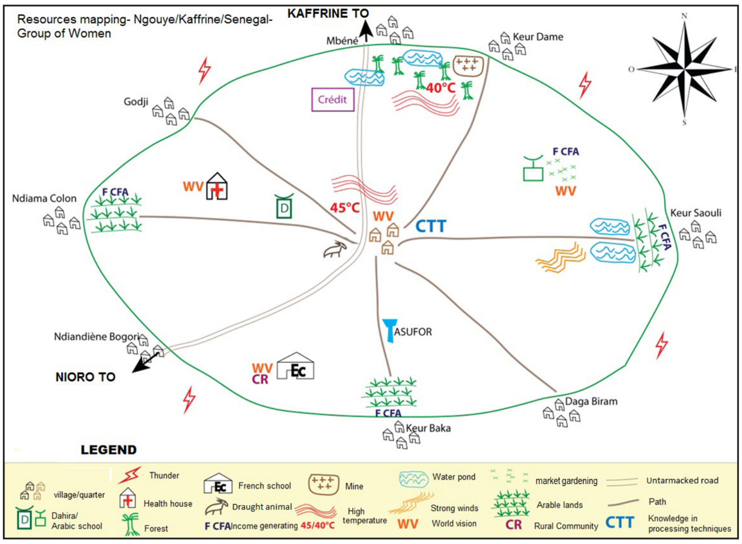
5. Methodological approach and implementation

5.1 Participatory planning of the activities

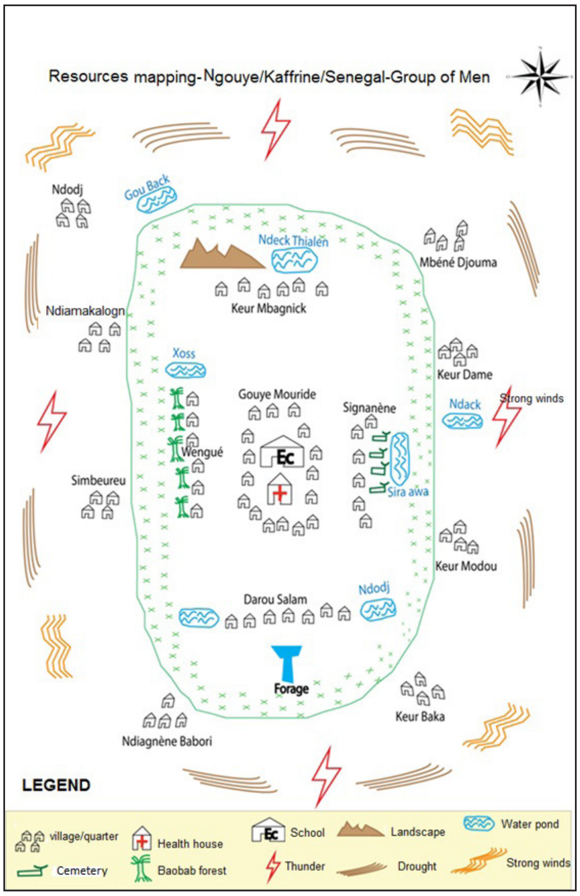
The main goal of the project is to find ways to improve crop production while sustaining the diverse ecosystem services provided by agricultural landscapes in response to present climate variability and future climate change. Based on the use of the TOP-SECAC toolkit (Somda et al 2014), the approach consisted of first identifying, in collaboration with rural communities, the type of desired CSV in order to deal with the effects of climate change and hazards. The desired future was then shared with stakeholders of rural development in the region to fine tune the consensual model and identify strategic actors likely to support rural communities in achieving their objectives (Appendix 1). This process resulted in a partnership comprising a dozen strategic actors from different complementary areas of research, extension services, NGOs, private sector, policy makers and communities. The partnership was then built around developing integrated agricultural systems promoting the restoration of vegetation cover and land while using several options for sustainable intensification.

The process involves the following steps:

1. Establishing a platform for PAR-CSA actors or where a similar forum existed building upon it;
2. Quantitative and qualitative mapping of the most important livelihood resources and climate hazards (Figure 2) conducted by the local population;
3. Mapping vulnerability of gender-differentiated groups to set a baseline to track changes in living conditions induced by the project activities;
4. Visioning the desired future of living conditions with the community's members and their stakeholders, given the plausible future climate;
5. Defining the CSV model to achieve the desired future of each community;
6. Defining and developing partnerships needed (technical support units, village committees);
7. Identifying climate adaptation technological options for on-farm testing and demonstration;
8. Organizing a planning workshop with key partners (research staff, project leaders, local NGOs, development agents, sectorial policy makers, etc);
9. Periodically evaluating, with the participation of all actors, (during and at the end of each cropping campaign), the results achieved on physical, economic and social aspects.



A: Women mapping



B: Men mapping

Figure 2: Village resources and hazards mapping using the ToP-MECCA (Toolkit for Planning, Monitoring and Evaluation of Climate Change Adaptation of the International Union for Conservation of Nature (IUCN)) in Kaffrine, Senegal

The mapping process helped in translating the common objectives of the project into contextualized actions in each of the five countries (Tables 2 and 3) with some commonalities such as:

- Establishing strong partnerships to develop agricultural systems that improve the resilience of ecosystems and people;
- Strengthening the capacity of key stakeholders (farmers, students and development agents) through vocational and academic training, awareness raising and information dissemination;
- Identifying and testing, in a participatory manner, the best agricultural practices addressing climate change issues both at community and landscape levels;
- Assessing the impact of the project activities on biophysical and social changes, and;
- Ground testing following the participatory planning exercise as described in section 5.2.

Table 2: Country-specific objectives for the participatory action research on climate-smart agriculture in West Africa

Country	Specific objectives
Burkina Faso	• Identify the constraints and local coping strategies to address climate change in the target villages; • Develop participatory action plans to mitigate the effects of climate variability for the target villages taking into account the gender differentiation; • Build a broad and strong partnership to develop agricultural systems that improve the resilience of the agro-ecosystems and people; and • Assess the impact of the project on the biophysical and social changes and dissemination of good practices.
Ghana	• Strengthen the capacity of farmers to cope with climate change and variability; • Identify the best agricultural coping strategies to climate change; and • Assess the impact of the project on the biophysical and social changes.
Mali	• Identify activities related to adaptation or mitigation of climate change in Mali; • Identify the best agricultural practices to address climate change issues (water conservation techniques, improved crop varieties, micro-fertilization, agronomy of *Jatropha curcas*); • Share seasonal forecasting with farmers in collaboration with the national meteorological services; • Build the capacity of students and other stakeholders on adaptation and mitigation options to climate change in partnership with non-governmental organizations (NGOs) and extension services.
Niger	• Improve climate seasonal forecast information; • Analyse the vulnerability of the local communities to climate hazards and monitor the changes in behaviour; • Develop options (Integrated Soil Fertility Management {ISFM}); and • Rehabilitate the vegetation cover, crop varieties and cultivars to address the effects of climate change and variability.
Senegal	• Identify the resources, constraints and opportunities to cope with climate change; • Analyse the vulnerability of the local communities to climate hazards and monitor changes in the behaviour of the key actors; • Develop options (ISFM, rehabilitation of vegetation cover, crop varieties and cultivars) to address the effects of climate change and variability; and • Build a strong partnership for the dissemination of the technologies to cope with climate change issues.

Table 3: Planned activities for participatory action research on climate-smart agriculture implemented in each target country in West Africa

Country	Work package 1: Baseline studies	Work package 2: On-farm testing of a basket of technologies to adapt to and mitigate climate change	Work package 3: Development of sustainable biofuel and fuelwood production systems	Work package 4: Greenhouse gas fluxes from soils	Capacity building	M&E
Burkina Faso	Monitor tree growth	- Agro-meteorological information dissemination to farmers and development agents - On-farm trials and demonstration of management options to cope with climate change		- Production of tree seedlings in nursery in partnership with the forest service - Regeneration of woody species through seedling planting	- Strengthen partnerships and capacity-building - Farmer exchange visits - Video films and radio broadcasts	Monitor and evaluate the changes induced by the project using IUCN tool
Ghana	Monitor tree growth	- Evaluate ISFM options - Evaluate drought and heat-tolerant crop varieties (maize and vegetables)	Evaluate biofuel cropping systems (Jatropha-based agroforestry)	Establish tree nursery/wood lots and fruit tree plantations	- Sensitize farmers on proven mitigation and adaptation strategies - Train farmers (anti-bush fire, soil conservation, compost, ISFM, tree nursery and management, improved stoves) - Produce knowledge-based information supports - Video films and radio broadcasts	- Develop and implement knowledge and behavioural changes M&E plan using IUCN tool
Mali	- Monitor tree growth - Assess baseline biomass and carbon	- Seasonal forecast information sharing - On-farm testing of options to cope with climate change negative effects (soil water conservation techniques, improved varieties)	Jatropha-based agroforestry system	Tree planting in cropped lands (on-farms)	- Capacity building: vocational and academic - Farmer exchange visits - Video films and radio broadcasts	Train country team on knowledge and behavioural changes M&E

Niger	Monitor tree growth and carbon accumulation of naturally regenerated trees	- Share seasonal forecast information - Test on-farm options to attenuate climate change negative effects (soil water conservation techniques, improved varieties of agricultural crops, trees and vegetables, diversification)		Farmers' managed natural regeneration and tree planting, including fruit trees	- Build capacity through vocational and academic training - Farmer exchange visits - Video films and radio broadcasts	Monitor and evaluate changes induced by the project using both IUCN and Care International methods
Senegal	Monitor tree growth and carbon accumulated by naturally regenerated trees	- Share seasonal forecast information - Test on-farm options to attenuate negative effects of climate change (soil water conservation techniques, improved varieties of agricultural crops, trees and vegetables)		Farmers' managed natural regeneration and fruit tree planting	- Build capacity through vocational and academic training- Farmer exchange visits - Video films and radio broadcasts	Monitor and evaluate changes induced by the project using IUCN tool

5.2 Ground testing of climate-smart agriculture innovations with communities

The groundwork starts with the seasonal weather forecast information (provided by the national meteorology service) sharing that guides the planning of the cropping activities at the beginning of each rainy season (Photo 1). Based on this forecast, a range/combination of activities were tested to contribute to food security, promote adaptation and build resilience to climatic stresses in the pilot sites with the hope that the proven approach could be scaled up to similar contexts and locally modified to fit within the system at new locations.

Biophysical baseline qualitative and quantitative data were required to track the changes in the production and the sustainability of the agro-ecosystems. The tested technologies or practices comprised some combinations of minimum tillage-crop rotations, organic and inorganic fertilizers (micro-dosing), land reclamation and water conservation techniques (zaï, half-moons, earth or stone bunds), vegetation cover restoration and species diversification (assisted natural tree regeneration also known as Farmers-managed Natural Regeneration {FMNR}), protected area/plot to regenerate the vegetation cover, tree planting for different purposes (wood, fruits, nuts, vegetables, and fertilization), crop diversification (sesame, cowpea, sorghum, hibiscus, okra), short cycle and drought-tolerant varieties (sorghum, millet, cowpea and groundnut), and new energy options through the development of *Jatropha curcas*-based farming systems in association with cereal crops (Table 4). All these activities were evaluated at mid- and at the end of the cropping season in a participatory manner with all involved actors (Photo 2).

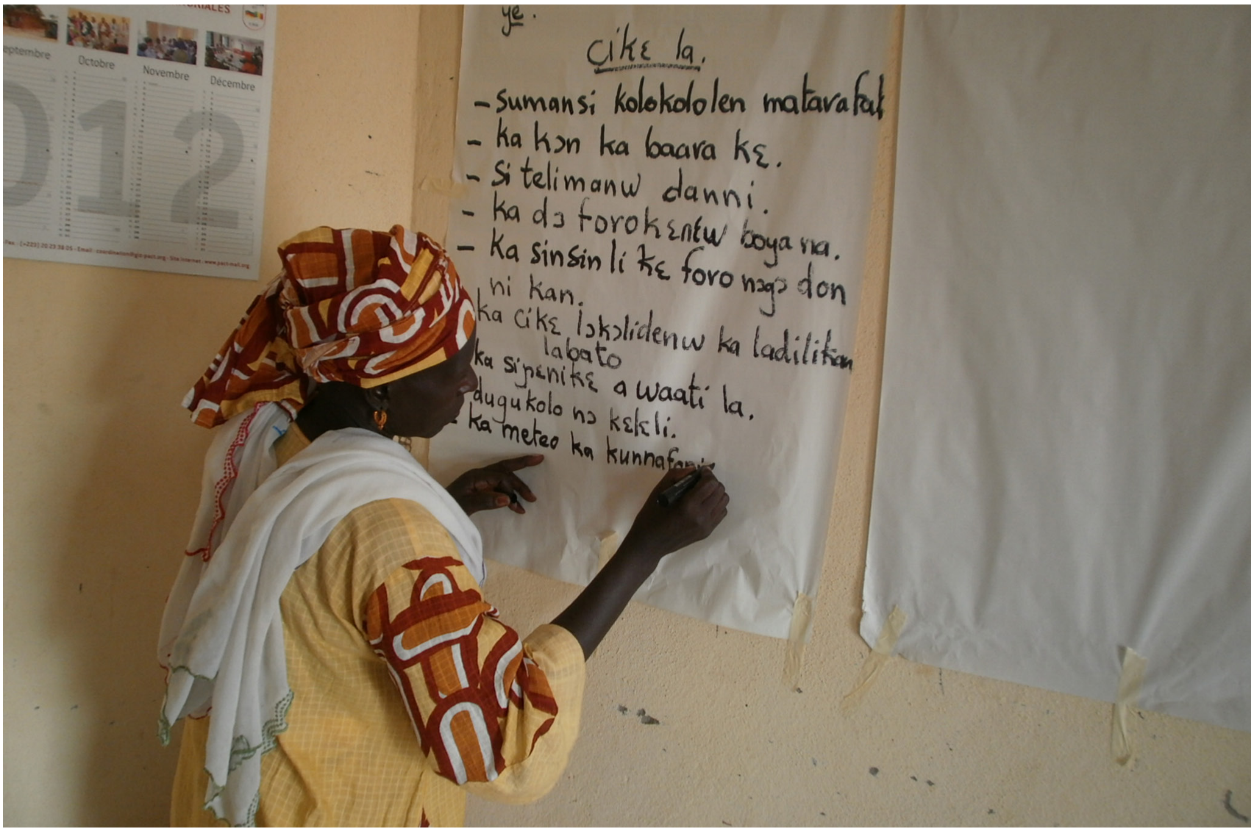


Photo 1: Planning of seasonal cropping activities using climate information in Cinzana, Mali (©Traoré K/IER)

Photo 2: Mid-season evaluation of the tested options by farmers in Tibtenga village, Burkina Faso (©Sanou J/ INERA)

In addition, changes in behaviour induced by participation in this project were monitored at farmer and community levels using the Most Significant Changes technique (Davies and Dart 2005) integrated into a step-by-step toolkit for planning, monitoring and evaluation of climate change adaptation (Somda et al 2011). Through storytelling, significant changes enacted by individual farmers and by gender-differentiated groups were gathered and analysed. The selected most significant changes were substantiated and used to learn the newly initiated behaviours, and additional constraints farmers face to maintain the new behaviour. As the lead actor of the monitoring and evaluation (M&E), IUCN has been very active through the CCAFS-funded Project Harvesting Adaptation Outcomes of Climate Change, Agriculture and Food Security (PHAO-CCAFS) in West Africa to strengthen the adaptive capacity to climate change of farmers and institutions. Such partnership aimed at ensuring that activities were adequately planned to address the impact or effects of climate change and the behavioural changes needed for effective adaptation. To contribute to the social learning process from the PAR, the M&E was therefore designed and implemented in a participatory manner.

The rationale behind developing participatory M&E for behavioural changes is that climate change adaptation and mitigation activities are expected to be sustained by adequate “adaptive behaviour” leading to increased food security, and that stakeholders must have the capacity to plan, monitor and evaluate these behaviours (Somda et al 2014).

Table 4: Summary of the country specific set ups for the participatory action research on climate-smart agriculture in the five benchmark sites of CCAFS in West Africa

Activities	Burkina Faso	Ghana	Mali	Niger	Senegal
Partnerships	- Farmers' community - INERA - Extension services (forestry, agriculture and livestock) - Meteorological services - Decentralized authorities (mayors, prefects, high commissioners) - Local non-governmental organization (NGO): FNGN - Local radio: voice of farmers - AGRHYMET - IUCN - ICRAF - International Crops Research Institute for Semi-Arid Tropics (ICRISAT)	- Farmers' community - SARI - Extension services (forestry, agriculture and livestock) - Ghana Meteorological Agency - Decentralized authorities (districts) - Local NGO: Langmaal centre - Local radio: West Link Radio - AGRHYMET - IUCN - ICRAF - ICRISAT	- Farmers' community - IER - Extension services (forestry, agriculture and livestock) - Meteorological services - Decentralized authorities (mayors, prefects) - Local NGO: ARCAD - Local radio: ORTM-Segou - AGRHYMET - IUCN - ICRAF	- Farmers' community - INRAN - Extension services (forestry, agriculture and livestock) - Meteorological services - Decentralized authorities (mayors) - International NGO: Care International - Local radio: Fakara Djinda - AGRHYMET - IUCN - ICRAF - ICRISAT	- Farmers' community - ISRA - Extension services (forestry, agriculture and livestock) - Meteorological services - Decentralized authorities (mayors) - Local NGO: AGRECOL - Local radio: Radio Kaffrine - AGRHYMET - IUCN - ICRAF - ICRISAT
Climate information/ weather forecast	Climate information delivery (workshop and local radio)	Climate information delivery (workshop, local radio and mobile phone)	Climate information delivery (workshop and local radio)	Climate information delivery (workshop and local radio)	Climate information delivery (workshop, local radio and mobile phone)

Baseline studies (including socioeconomic)	- Soil carbon stocks on some trial plots (soil sampling) - Carbon accumulation of FMNR and tree planting trials	- Soil carbon stocks on some trial plots (soil sampling) - Carbon accumulation of tree planting trials	- Soil carbon stocks on some trial plots (soil sampling) - Carbon accumulation of FMNR and tree planting trials	- Soil carbon stocks on some trial plots (soil sampling) - Carbon accumulation of FMNR and tree planting trials - Vulnerability analysis (wealth classes)	- Soil carbon stocks on some trial plots (soil sampling) - Carbon accumulation of FMNR and tree planting trials
Water harvesting and land reclamation	Zaï-FMNR Half-moons Stone bunds Manure/Micro-dosing Compost	Earth bunds Minimum tillage-Rotation-ISFM Compost Mulching Tie-ridges	Ridging Micro-dosing Compost	Zaï Half-moon FMNR	FMNR Localized application of fertilizers
Vegetation rehabilitation	Tree planting: wood, fruit (*Adansonia digitata, Ziziphus mauritiana*), medicinal (*Cassia senna*), soil fertility (*Piliostigma reticulatum*) and leafy vegetables (*Moringa oleifera*, *A. digitata*)	Tree planting: woodlots (*Senna siamea, Tectona grandis*), fruits (*Anacardium occidentale, Mangifera indica*), leafy vegetable (*Moringa oleifera*)	Tree planting: fertilizer (*Gliricidia sepium*), fruit (*Adansonia digitata*) and leafy vegetable (*Moringa oleifera*, *A. digitata*) trees	Tree planting: drought tolerant tree species (*Piliostigma reticulatum, Bauhinia rufescens, Ziziphus spina-christi, Balanites aegyptiaca, Leptadenia hastata*) for fodder, fruit and leaf vegetable	Tree planting: grafted and non-grafted fruit trees (*Adansonia digitata, Annona muricata, Psidium guajava, Tamarindus indica,* and *Ziziphus mauritiana*)
Gender specific activities (women)	Introduction of *Moringa oleifera*	Off season gardening Nutrition education Soybean recipes Village savings and loan scheme	Fonio Sesame	Vegetables	

Drought tolerant and short cycle varieties	Millet: SOSAT C88, IKMP5 Cowpea: KVX396-4-5-2D, KVX61.1 Sesame: SR42	Maize: Omankwa, Aburohemaa Cowpea: Songotra Non-shattering Soybean: Jenguma	Sorghum: Guindé (local), CSM 219, Séguifa, Sagatigui (stay green) Millet: Boboni (local), Toroniou C1, HKP, Soxat	Millet: Haini kirey Kampa, Zongo kwallo, local Damana, Local Ouallam, HKP, V3 (Tarmamoua), Zongo Dan arbaiin Sorghum: Mota Maradi, Hamo Kirey Ouallam, IRAT 204, Bagazan, Elbagazan, Hamo kirey Damana Groundnut: ICIARTBT1, Jan Guiada, TL24, JL24 blanche Cowpea: IT99, Dan Mallam Idi, TN5-78, TN25 6-87,IT90, Dan Louma, IT97 Sesame: SN103, SN203, SN303, SN5, SN7, Jan Ridi, SN8, SN6, and Local Kampa Bambara groundnut: Kwan zabie, El doua, Hawayin zaki, black variety, red variety, Da arna Okra: Gombo Agadez, Gombo Eltakude, RCA, and ElTakude Etc.	Maize: Thai Millet: Souna 3
Mitigation	FMNR Tree planting	Tree planting *Jatropha curcas* based farming system	Tree planting *Jatropha curcas* based farming system	FMNR Tree planting	FMNR Tree planting
Information dissemination	Farmers' field days Newspapers Local radio Study tour	Farmers' field days Local radio Esoko mobile phone company Study tour Exchange visits Local durbars – kobine festival	Farmers' field days Local radio	Farmers' field days Local radio Study tour	Farmers' field days Local radio
Capacity building	1 student from a professional school 3 MSc students	1 MSc student 3 staff trained on CLIMSOFT database management software	1 student IPR/IFRA 2 MSc students of University of Bobo-Dioulasso in Burkina Faso and AGRHYMET	3 MSc students	1 MSc student
Planning and M&E of change in behaviour	Toolkit for planning, monitoring and evaluation of climate change adaptation (ToP-MECCA)	Toolkit for planning, monitoring and evaluation of climate change adaptation (ToP-MECCA)	It was not possible to run the full Planning and M&E of change in behaviour process in Mali, except the theoretical training	Toolkit for planning, monitoring and evaluation of climate change adaptation (ToP-MECCA)	Toolkit for planning, monitoring and evaluation of climate change adaptation (ToP-MECCA)

5.3 Capacity development for up-scaling climate-smart village models

Training activities for researchers on approaches, methods, and tools have been conducted by the project's team to build their capacity for action research on developing climate smart technologies and practices. They have also been trained on the climate change "adaptive behaviours" monitoring and evaluation tools by IUCN. This allowed them to trace the changes in behaviour of farmers and the local communities as a result of their participation in the PAR activities. They have also benefited from participatory scenario planning by ProNet North (an NGO) in partnership with OXFAM and CARE International (under the West Africa Water Supply, Sanitation and Hygiene (WA-WASH) programme, Adaptation Learning Programme and Enhancing Livelihood Security through Climate Change Adaptation). They have also been trained by the 'Centre Régional de Formation et d'Application en Agro-météorologie et Hydrologie Opérationnelle (AGRHYMET)' on the climate analogue tool which has been used to identify analogue sites for the implementation of the farm of the future approach. AGRHYMET was key in the use of seasonal forecasts later shared with other actors with farmers as the ultimate beneficiaries. This helped tailor climate information to the needs of farmers to allow them to adjust their farming activities accordingly.

Technical support units (extension services, NGOs, and research technicians) have also benefited from training to ensure sound implementation (relevant advisory services in the face of changing climate), monitoring and reporting of the PAR results. Training has also helped them link national priority needs with sub-national level experiences and specific enabling conditions. This category has not only benefited from internships for fieldwork to academic degrees (professional schools and university students), but also from vocational training. A range of topics have been developed during the training including but not limited to: dissemination and evaluation of climate information impacts on farming activities, participatory planning of farming activities, land and vegetation restoration, integrated soil fertility management, use of information and communication technology (ICT) for extension and advisory services.

Farmers have benefited from practical training (including exchange visits, Photo 3) on a range of topics: climate information use in planning seasonal farming activities, participatory monitoring and evaluation of the use of the climate information and its impact on their resilience to the effects of climate variability and change, ways of combining existing technologies to adapt and mitigate climate change effects by farming in a sustainable way (combining composting, FMNR, water harvesting techniques, and integrated soil fertility management). For mitigation, themes on improved stoves to reduce the quantity of wood used for cooking, techniques for bushfire control, and techniques to restore the vegetation cover have been developed. For more effective dissemination, training on the use of telephones in scaling up activities and participatory video filming to document key findings has been delivered. Support tools used in these training activities of the farmers include: demonstration plot, farm of the future, farmers' school fields, farmers' field day for a farmer-to-farmer learning, traditional annual farming festival, local radio programmes and mobile phones. Mobilization activities have also been conducted towards national platforms (scientists and policy makers) for exchanging and mainstreaming climate-smart agriculture into agricultural policies while linking national adaptation needs with sub-national level experiences and specific enabling conditions.

Photo 3: Practical training during an exchange visit in Burkina Faso (©Sanou J/INERA)

The capacity of national meteorological services has been built to generate more accurate climate information based on historical records (Photo 4). This activity started with Ghana and is to be expanded to other countries with the support of the University of Reading in the United Kingdom. This is done parallel with academic training in various fields of climate change related issues. The ultimate goal is to make available a new generation of climate experts in agriculture for the region.

Photo 4: National meteorology staff of four countries (Burkina Faso, Mali, Niger and Senegal) being trained on how to analyse historical climate records to generate localized and context-specific climate information (©Dembele C/ ICRAF)

5.4 PAR approach up-/out-scaled to new villages

Linking up with existing projects and programmes has been considered one of the best ways to up/out scale successfully tested and validated climate smart approaches (use of climate information to plan cropping activities), technologies and practices (restoring the vegetation, diversification of crops, drought tolerant varieties, etc.). Examples of potential collaborative projects are the BMZ-funded project on the Ecosystems Protecting Infrastructure and Communities (EPIC) and the World Food Programme in the Burkina Faso funded project on Cash for Work. Both projects are implemented by IUCN, using the partnership framework developed around the PAR activities in Burkina Faso. With support from IUCN's projects, the team was able to increase the number of intervention villages from one to six. The same projects have also funded the fencing of communal plantations in the same villages using the approach of food/cash for work.

These scaling out activities contributed to building social capital and cohesion within the communities in the CCAFS's Tougou block in Burkina Faso. FMNR is one of the promising climate-smart agricultural technologies being promoted by PAR. This promising innovation of naturally assisted regeneration has been taken up by EPIC and scaled out to other communities in the northern region of Burkina Faso. Similar examples of out scaling activities have also been initiated in Senegal with the project "Strengthening the capacity of resilience and adaptation to climate change through integrated management of land, water and nutrients in the semi-arid areas of West Africa or ENRACCA-WA". New United States Agency for International Development and the Department for International Development funded programmes in various Sahelian countries are willing to use the approach developed by the PAR-CSA.

5.5 Impact pathways

The impact pathways of the PAR-CSA in West Africa are illustrated in Figure 3. Even though PAR-CSA is still at the infancy stage, an increasing number of farmers in pilot villages and outside have been exposed to potential tactical and strategic options to cope with climate variability using climate information/forecast as an entry point for planning their cropping activities.

This has triggered attitudinal changes in the farmers towards the climate forecast that was previously received in a passive manner. Farmers portrayed awareness of the climate change issues and the need for adaptation in all countries (knowledge and understanding of CSA concepts related to meteorology, climate, climate change and the adaptation process). The consortium of actors has also learned how participatory action research can help in addressing complex development problems like the ones related to climate change. However, the enabling policy aspect is still lagging behind. Indeed, local authorities have been involved but the high-level policy makers have not been sufficiently informed. Another aspect worth monitoring is the return flow from the eventual change in behaviour of participating actors to trigger (mostly farmers) the change of non-participating actors in the most efficient way.

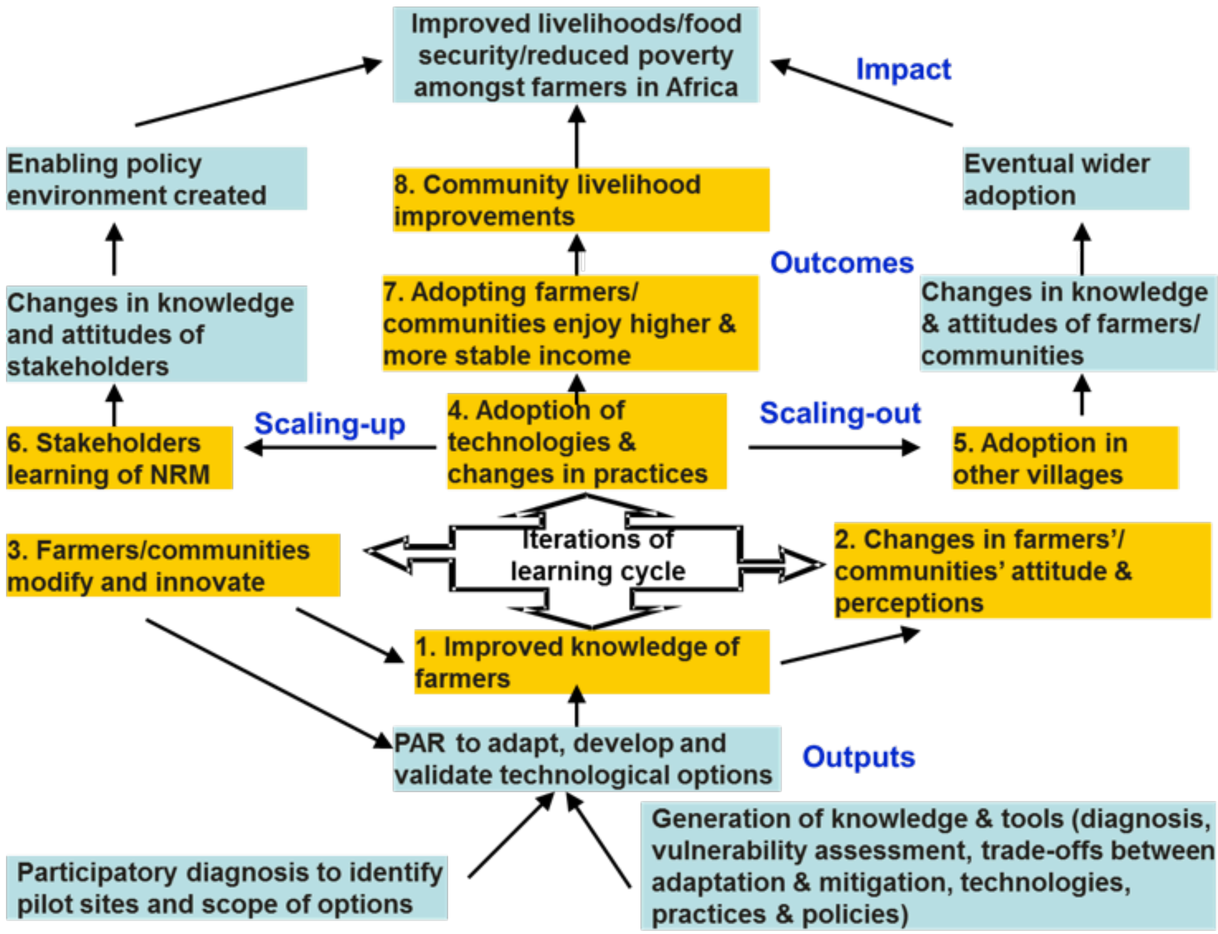


Figure 3: Impact pathway of the PAR on climate smart agriculture in West Africa

5.6 Partnerships

The partnership developed to conduct the PAR CSA activities goes from the regional level with ICRAF and RPL-WA (ICRISAT) providing scientific leadership and coordination, then to country teams coordinating the activities on the ground at site level and finally to the IUCN and AGRHYMET as international/regional structures to lead specific activities.

To implement such a model, the PAR project has identified the following boundary partners depending on the country:

1. Local communities (including traditional leaders), providing the operationalization set up, are in charge of implementation on the ground of their preferred and selected innovations to address climate change impacts in their production activities;
2. National research institutions are in charge of coordinating activities at country level and conducting the research (co-developing protocols, establishing trials, monitoring and reporting);
3. National extension services (forestry, animal husbandry and agriculture) are providing the agricultural advisory services and following up the proper use of the skills acquired during the training;
4. NGOs have a similar role as the national extension services but are expected to expand

these activities to other areas and beyond the lifespan of the project;

5. Decentralized authorities are providing the political support, channelling concerns to higher levels in the administration and helping in streamlining key findings into policies. Points 4 and 5 are yet to be developed;
6. National meteorological services are key partners with regard to climate information (forecast and projections). They also participate in evaluating the impact of using the climate information;
7. Local radios are supporting the dissemination of the technical information and raise awareness by airing important messages. In Ghana these include mobile companies;
8. International research centres provide scientific leadership and coordination at the regional level in close collaboration with the national research teams and regional/international development institutions (AGRHYMET and IUCN);
9. IUCN is in charge of the harmonized monitoring and evaluation component of the project activities at the regional level, and;
10. AGRHYMET is helping in strengthening the capacity of national actors in generating relevant and tailored climate information for the farming activities at site level.

In bringing together all these actors to work on a problem of common interest, the expectations were to induce some changes in the behaviour of all in the areas of knowledge, practices, relationships, collaboration and access to resources. More effort is needed to bring in more diverse private sector actors even though this has started (a mobile company in Ghana, micro-finance institution in Niger, etc.).

5.7 PAR-CSA project contributions to behavioural changes in West Africa

Adaptation occurs in physical, ecological, and human systems and changes in social and environmental processes, perceptions of climate risk, practices and functions to reduce risk and exploration of new opportunities to cope with the changed environment (IPCC, 2004).

Learning from changes in social processes, perceptions of climate risks and the related practices constitute an important way to improve and accelerate the adoption of the proposed climate smart agricultural options in the PAR project. This was done through monitoring and evaluation of behavioural changes in the intervention sites as an integral part of PAR-CSA. The Central and West Africa programme of the IUCN led the monitoring and evaluation process in close collaboration with the PAR-CSA teams in four countries, namely Burkina Faso, Ghana, Niger and Senegal.

5.7.1 Developing monitoring and evaluation plans for behavioural changes

The framework for monitoring and evaluating behavioural changes was developed based on the theory of planned behaviour by Ajzen (1991). This theory has been applied because technological and behavioural options are subjected to a certain level of adaptation in line with the sustainable livelihood framework (Scoones 1998; Solesbury 2003).

Technological options can help communities to realize the adaptation vision in terms of improved livelihood resources in the context of climate change if appropriate behaviour and actions are put in place by the members of communities and their partners. For the proposed technologies to effectively deliver the intended biophysical outcomes, there is a need to ensure that all stakeholders, particularly the communities, enact the supportive behavioural options.

Prior to the development of the M&E plan, vulnerability assessments were conducted and adaptation actions planned in a participatory action research framework (Somda et al 2014). In all target countries, the vulnerability assessment clearly identified adaptation needs and the future desired situation by the communities and their stakeholders. Following this, monitoring and evaluation plans were developed with all stakeholders to collect data on the changes developed by men and women participating in the PAR-CSA activities. Table 5 summarizes the elements of the validated pilot M&E plans that were applied in the four countries.

Table 5: Pilot monitoring and evaluation plan for behavioural changes induced by PAR on climate smart agriculture in four benchmark sites of CCAFS in West Africa

Criteria for outcome harvesting	Niger	Burkina Faso	Ghana	Senegal
Domains influenced by PAR	Partnership Knowledge Food security	Partnership Knowledge Behaviour Organization	Partnership Knowledge Food security Behaviour Organization	Partnership Knowledge Behaviour
Periodicity of outcome harvesting	Once in two years	Once in two years	Once in two years	Once in two years
Outcome harvesting methods at community level	Focus group discussion; Individual interviews	Focus group discussion; Individual interviews	Focus group discussion; Individual interviews	Focus group discussion; Individual interviews
Choice of outcomes stories tellers	Men and women groups Individual women and men	Men and women groups Individual women and men	Men and women groups Individual women and men	Men and women groups Individual women and men
Participants for the selection of the most significant changes	One representative from each group of PAR-CSA partners (Research, extension services, local authorities, IUCN, communities – man and woman)	One representative from each group of PAR-CSA partners (Research, extension services, local authorities, IUCN, communities – man and woman)	One representative from each group of PAR-CSA partners (Research, extension services, local authorities, IUCN, communities – man and woman)	One representative from each group of PAR-CSA partners (Research, extension services, local authorities, IUCN, communities – man and woman)
Selection technique	Iterative voting	Iterative voting	Iterative voting	Iterative voting
Feedback from the most significant changes	All partners of the PAR-CSA in the selected communities and during workshop	All partners of the PAR-CSA in the selected communities and during workshop	All partners of the PAR-CSA in the selected communities and during workshop	All partners of the PAR-CSA in the selected communities and during workshop

From the PAR-CSA partners' perspective, participation in the proposed activities could induce changes in several domains of the community life. Domains of changes that were expected in all target countries include **knowledge** in climate change and appropriate technologies to address its effects, and **partnership** to address climate change effects. Changes in **behaviour** and **organizational** aspects were expected from a successful implementation of the PAR-CSA project in Burkina Faso and Ghana. For PAR-CSA partners in Niger and Ghana, participating in the project could induce changes in **food security**. It is worth noting that these domains of changes in community life are not meant to be exhaustive, but to guide the collection of the stories of change. In practice, some collected behavioural changes might fall outside the pre-set domains of changes.

The above M&E plans were applied from 2013 to 2014 in the four benchmark sites of CCAFS in West Africa to gather information on the changes that are being put in place by men and women farmers through their participation in PAR-CSA. The 'Most Significant Changes' technique was used to collect significant stories of changes told by communities.

The collected stories of changes were selected for the most significant changes enacted by men and women farmers because of their participation in the project. The sample size was intentionally kept small, because this type of M&E was new to the country teams, thus requiring field-testing before it could be extended to a larger sample size.

5.7.2 PAR-CSA induced behavioural changes in the communities

The PAR-CSA project ran from 2011 to 2014 and the results presented here show the initiation of behavioural changes that the project contributed to. The results are mainly meant to show cases of feasibility and usefulness of monitoring behavioural changes alongside the implementation of the PAR-CSA project. Finally, they demonstrate that significant change stories can be used to derive attributes in each domain of change, and estimate the extent to which changes are taking place within a farmer community or a group of farmers. Table 6 summarizes the attributes of occurred behavioural changes derived from the stories of change gathered in 2013 and 2014.

It should be noted that men and women demonstrated capacities to enact changes in various domains of their life. As compared to the M&E plans, a new domain of change has been identified from the collected change stories: access to productive resources (on-farm trees, land, governance for natural resources, etc.). This kind of information can be used by the PAR-CSA teams to improve future interventions as it shows domains where more effort will be needed to boost the adaptation process. In fact, for climate smart agriculture to be successful in a community, there is a need to increase the percentage of women and men with adaptation-relevant behaviours.

Table 6: Attributes of the occurred behavioural changes in four benchmark sites of CCAFS in West Africa (% of respondents)

Domains of changes/attributes	Burkina Faso		Ghana		Niger		Senegal	
	Men	Women	Men	Women	Men	Women	Men	Women
1. Changes in knowledge								
Knowledge about agricultural techniques (relationship between climate change and improved varieties, flat ploughing and row planting, compost preparation, etc.)	84	60	100	100	100	100	50	67
Knowledge on how to implement on-farm assisted natural regeneration techniques	58	47	0	0	100	100	69	11
Knowledge on tree (planting and utilization) management	37	63	33	33	10	17	0	0
Knowledge on poultry husbandry (feeding, maintenance, etc.)	0	0	0	0	0	0	31	56
Knowledge about the importance of meteorological information	0	0	0	0	0	0	81	56
2. Changes in farming behaviour								
Agricultural practices (use of improved seeds, row planting, compost application, fertilizers use, etc.)	58	73	100	100	100	83	81	44
Practicing on-farm assisted natural regeneration of trees (associated with anti-erosion structures)	5	13	33	33	100	83	75	11
Tree planting	26	40	0	0	0	0	0	0
Use of meteorological information	0	0	0	0	0	0	86	33
Poultry husbandry	0	0	0	0	0	0	31	56
3. Organizational changes								
Relationships among farmers	37	7	17	17	0	0	94	44
4. Changes in partnering								
In-community collaboration (exchange of information, services and goods)	58	67	67	67	60	33	63	22
5. Access to productive resources (on-farm trees, etc.)								
Access to on-farm and to medicinal trees	32	80	0	0	0	17	13	0
6. Change in food security								
Diversification of diets and early harvesting from early maturing crops	0	13	50	0	0	83	19	44
Total pilot sample size	**19**	**15**	**6**	**6**	**10**	**6**	16	9

6. Lessons learnt

Independent consultants conducted two evaluations of the project (Akponikpe 2014; Whiteside 2015). The criteria considered were: design, relevance, efficiency and effectiveness, changes towards impact, sustainability, gender issues, innovations, partnership and cooperation. In link with these criteria, the information collected from key actors is summarized in Table 7. The content of this section is largely pulled out from the conclusions and from the data obtained from the project implemented by the teams composed of actors listed in 5.6 during a workshop conducted at the end of phase 1.

Table 7: Evaluation criteria of PAR on climate smart agriculture in West Africa

Evaluation criteria	Information data	Source of information
Design and Relevance	Project background, objectives, approach and strategy	Proposal, work plans, meeting with local teams and discussion with communities
Efficiency and Effectiveness	Planned versus achieved outputs/activities *versus* resources used	Regional and national reports; meeting with local teams; field visits and discussion with communities
Impact	Outcomes, outputs	Field visits and discussion with communities
Sustainability	Outcomes, outputs	Field visits and discussion with communities
Gender issues	Gender consideration in project planning, approach and strategy, planned *versus* achieved outputs/activities	Discussion with communities (women group discussion)
Innovations	Planned *versus* achieved goals/activities	Regional and national reports; meeting with local teams; field visits and discussion with communities
Partnership and Cooperation	Project approach and strategy	Regional and national reports; meeting with local teams; field visits and discussion with communities

6.1 Design and relevance

The project was found to be well designed and very relevant to address the issues related to climate change. The approach of capitalizing on the successes, achievements and lessons learnt from previous experiences was a good decision. In most cases, the promoted technologies were predominantly developed and thoroughly tested at national/regional levels by previous projects to deal with similar constraints caused by climate change. Therefore the main issue was on how to combine them; and the “participatory action research” used was adequate in co-designing the potential solutions with farmer communities who tested them later. In addressing such complex issues, having different and complementary disciplines in the national teams was found to be very relevant.

For such a project a good monitoring system is required, and the use of the toolkit planning, monitoring and evaluation of climate change adaptation (ToP-MECCA) of IUCN across case studies was appropriate. But its efficiency was weakened by the lack of baseline study on the project performance indicators (different from

the CCAFS household baselines in the countries) against which progress was to be measured; making it difficult to trace changes related to the project in the intervention communities through monitoring and evaluation. The new starting point for the M&E in the second phase will be an inventory and prioritization of the most promising technologies/practices through village workshops gathering all key stakeholders as described throughout this document. The main criteria of the prioritization of the technologies/innovations to be tested in this second phase comprise the ability of each practice to improve agricultural productivity, generate income, show viability as an adaptation strategy, show potential for reducing GHG emission (mitigation), show potential for up-scaling, show economic viability (cost and benefit), and show restoring potential impact on ecosystem services (Appendix 2). This will be implemented together with the Participatory Integrated Climate Service for Agriculture (PICSA) to produce more accurate climate information (Dorward et al 2015). The PICSA goes beyond climate information and considers possible options to be tried for which the criteria presented above can be used for final selection (Appendix 2).

For the planning process, project activities have been well planned and summarized as country work plans at national level (Burkina Faso, Ghana, Mali, Niger and Senegal). However, no clear link was provided between project activities at national level (in work plans) and work packages in the project document – Table 1 (ICRAF-WCA 2011). These linkages should have been clearly stated and justified. Activities at the regional level have been neglected or not considered in any of the participating countries and that is valid particularly for the GHG fluxes (Table 3). There has not been any systematic carbon measurement or a cost analysis. Such a situation does not allow elaborating much on the cost-effectiveness of the tested options for agricultural mitigation. As a consequence, climate-smart villages are rather partial in comparison with the items illustrated in Figure 1. This partial model for climate-smart agricultural development focuses on certain aspects of adaptation. It is not entirely clear how widespread an area the model is applicable to. Despite these weaknesses, the project design and implementation include many innovations as specified in Tables 3 and 4:

- Use of participatory approach in village level agricultural development;
- Provision and appreciation of seasonal weather forecasting information on radio;
- Village level planning and very early stages of fragile implementation;
- Participatory and common approach for monitoring and evaluation (ToP-MECCA);
- Development and training of in-field methods of soil conservation and fertility management including better management of trees within the fields;
- Sharing the findings with local extension, government and NGO agents or during farmers' days help to better spread the findings of the project;
- Use of video technology (all countries mainly Niger which made a compilation through the communication division of INRAN) to keep track of the project memory. Success and failures could be synthesized and extended to other communities through this innovative dissemination tool. Meanwhile the quality of video has not been standardized and coordinated at a regional scale, and so compiling them in one document may be difficult;
- Farmers' in Burkina Faso greatly appreciated their participation in demonstration plots and outputs evaluation. Farmers mentioned that previous projects taught them the "best practices" but they were never been involved in the selection of the appropriate technologies;
- Academic training of students involved in research was very relevant in building the capacity of young rural development practitioners in their awareness of climate change issues;
- The project was built upon a strong partnership from all levels – international (IUCN), regional

(AGRHYMET) and national (agriculture and forestry sub-sectors with local technical groups, NARS, NGOs, and public extension services);

- A strong collaboration/partnership has been implemented with PHAO-IUCN with a regional facilitation action plan that endeavours to standardize the research-action intervention approaches through participation and monitoring-evaluation across countries. Regional projects often lack this kind of uniform strategy of action, which leads to serious problems in many multi-partners projects. Partnering with other projects was also positive in Burkina Faso (e.g., EPIC) and Senegal with ENRACCA-WA to scale out the actions in several villages contrary to the other four case studies where actions were limited to one or two communities.

Since testing operates in real conditions that are variable, there is a need for better understanding of such complexity for multiple recommendations for farmers in different environments. To be able to do that, there is a need to involve a large number of farmers (replicates) in each trial to sample as much as possible various situations. Specific attention should be given to ensure that the number of replicates is appropriate for each type of trial (Figure 4). For trials that are conducted on-farm, the position of the red star (on the left hand top corner) should be avoided. The ideal situation is the green star (on right hand bottom corner) position but that entails a very high cost, therefore everyone should try to position their trial on the blue diagonal line for the number of replicates to be used.

Working in different sites and in different countries/contexts is ideal for planned comparisons in such a way that regional conclusions can be drawn while still answering context-specific local questions. For that to happen, the trial protocols must be harmonized for a minimum data set to be collected in a systematic way by all participants. In these types of comparisons, there must be some room to collect additional and specific data for each site if deemed appropriate.

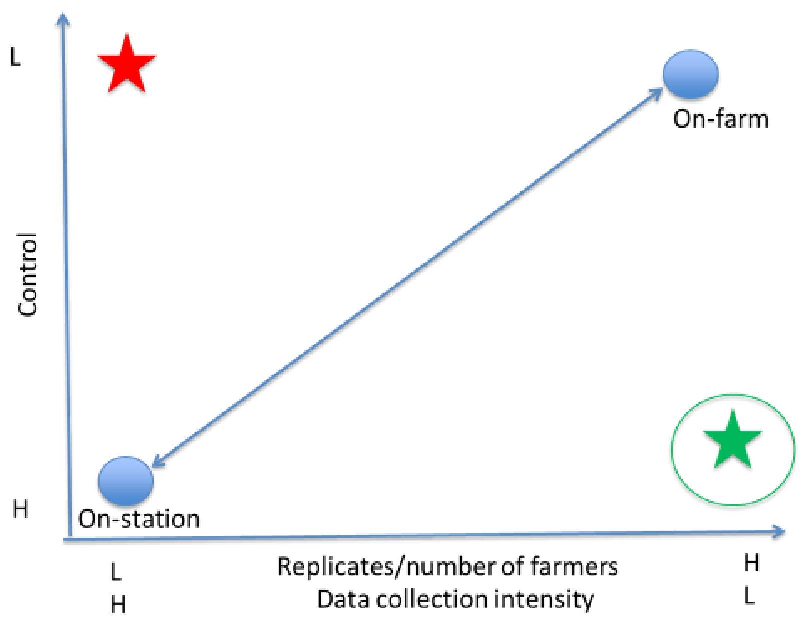


Figure 4: Considerations for determining the number of replicates for trials of the participatory action research on climate smart agriculture in West Africa (H=High, L= Low)

6.2 Efficiency and effectiveness

Analysing the activities, the following observations can be made about their efficiency and effectiveness:

- **Individual *versus* collective:** Collective activities, although successful in some countries, were constrained by low farmer participation, e.g. in Burkina Faso (Photo 5) as farmers tend to execute their individual activities on their farms before joining the common plots. This might also explain why the common area treated with half-moons in Niger was not used. This low participation in collective activities is due to time constraints and lack of perceived direct benefit goals, which impeded the capacity building and knowledge sharing expected from this type of activities. It is also linked to governance issues, for instance land and tree tenures. This calls for more (and thus a low capacity building as expected) consideration for the farmers' own schedules and governance at both household and community level. Despite this situation, collective actions are needed as they help build up the social capital of the communities which is required for landscape interventions. There is a need to improve the selection process of the collective activities with low competition with individual ones while openly discussing and addressing governance issues of natural resources at community and landscape scales.

Photo 5: Planting on communal land with few participants in Tibtenga village in Burkina Faso (©Bationo BA/ INERA)

- **Local *versus* introduced practices:** In Burkina Faso, most of the activities are about improving the existing techniques/innovations. Such an approach has the potential of increasing the efficiency of these techniques and their adoption (even sustainability). Land reclamation techniques have been tried for a long-time in Burkina Faso as opposed to Ghana where the issue is just emerging. In Ghana, most of the technologies being tried out are new to the communities. There is therefore a tendency to screen a large number of techniques: new soil fertility management (crop rotation, manure and inorganic fertilizer application), new soil and water conservation practices (ridges and tied ridges, stone lines, etc.), and new crop varieties (maize, soybean, and cowpea). Promising and potentially sustainable practices/technologies include zaï, FMNR, agroforestry through tree planting for fuelwood, fruits, vegetables, etc. It has been found that successful activities were those in line with the project objectives but grounded in local practices. The introduction of several new technologies at a time may confuse farmers as they probably may not have enough time to understand and be convinced (many things to learn); and make the adoption decision before the end of the project.

- **Introduced varieties**: Adoption problems of new crop varieties, including trees, have been observed because of food habits and organoleptic quality reasons, but also because the seeds/plants of these varieties are not easily accessible to poor rural farmers (physically and financially); their products (grains in most cases) deteriorate quickly when stored and their market is yet to be developed. Will the approaches being used in this project help change the attitudes about improved varieties? This question needs to be critically investigated in an attempt to address the climate change stresses.

- **Diversification**: In Niger, the vegetable diversity trial conducted by women raises some questions in terms of its efficiency (and sustainability). Contrary to the usual women practices, the trial plot was collective and far from homesteads. Women are used to growing vegetables individually and close or around homesteads because vegetable farming is labour-intensive with high inputs demand. Vegetables are very valuable crops and risk being stolen when remotely located.

- **Baseline**: Although the ToP-MECCA approach is being implemented, it may prove difficult to trace changes in the intervention communities as no specific baseline on the project performance indicators (different from the global CCAFS baselines in the countries) was established in a systematic way before launching the testing activities. It is necessary to conduct such baseline with the measurement of clearly defined indicators, e.g. from ToP-MECCA methodology (Pramova et al 2013) both for biophysical and socioeconomic changes taking into consideration yearly time scale objectives in line with the funding scheme.

- **Up/Out scaling**: Although it is still at the early stage, if additional work is carried out based on the first phase of PAR, biophysical impacts on farmland and communities livelihood as a whole will be observable for a long period. Furthermore, the adoption of climate-smart agricultural technologies will not be effective without multi-institutional partnerships contributing to a clearly identified vision that goes beyond the CCAFS scope of work. Synergistic actions with other projects (e.g. the EPIC project in Burkina Faso from the first year and ENRACCA-WA in Senegal) made it possible to increase the number of communities and villages where the project intervenes. From one village (planned by the CCAFS-PAR project) the project was able to extend its actions to five more villages in 2013 and was expecting to reach 11 villages in 2014 in Burkina Faso due to the collaboration with the EPIC project. Scaling up/out should focus on the dissemination of proven and successful technologies/innovations

that include individual activities, low cost (time, labour, financial, etc.), and grounded in local practices. Some examples are: zaï, FMNR, tree planting (fruit and vegetable trees), crop diversification (e.g. garden vegetables) of well-evaluated species.

- PAR-CSA is extremely relevant with the potential to engender adaptation and mitigation learning and guidance on a significant landscape that has been the subject of intense academic and NGO activity for the last 40 years in West Africa. By running 'its own small three-year project', even if well executed and the results shared, it has mainly replicated what many have tried before.

  The up scaling and out scaling is planned through connections to local government and agricultural extension, but largely based on limited experience from two-three cropping seasons of PAR (e.g. too early for the long-term outcomes from agroforestry to become apparent). Instead of running its own small and short-term project, PAR-CSA must bring a number of new insights to climate-smart land use through:

  i. Evaluation of some of the agroforestry interventions over the last 30 years, backed by productivity, economic and GHG measurement;
  ii. Partnership with some existing long-established development interventions to conduct action research around some specific agroforestry value addition and action research (i.e. not stand-alone PAR projects but building on existing interventions pre-PAR and within a framework of continued implementation and monitoring post-PAR);
  iii. Strategic use of the CCAFS 30km x 30km pilot site to monitor change with participation from multiple partners should include bio-physical changes, carbon stocks, and behavioural changes, and;
  iv. Support for clear in-country multi-partner dissemination and learning strategy for all the above constitutes a very good aspect to pursue.

- **Concepts**: In terms of climate change and adaptation knowledge, the climate change concepts were not clearly defined by farmers in all countries. In Niger (contrary to Ghana, and Burkina Faso) the concept of climate change was not mastered by farmers. Moreover the link of the project activities with climate change or farmers' awareness of project activities as climate change adaptation/mitigation was unclear based on their perception. When possible, farmers defined climate change by its impact on soil, vegetation and agriculture. Therefore, the big challenge is how to get them linked with the meteorological, climate and human activities causing the changes. In the absence of such understanding, the efforts of the CSA project will not be perceived as climate-smart oriented compared to previous and ordinary environmental degradation projects. The initiated changes in attitude of stakeholders particularly at the smallholder farmers' level with respect to climate change, the need to change the way they are implementing farming activities, and the relationships with climate hazards and changes appear as one important outcome with a lasting impact. Therefore, there is need to develop a linguistic corpus of climate change concepts in local languages, which is understandable by farmers, to make sure scientists, development actors and farmers talk the same language and are consciously tackling the same climate change hazards.

- **Capacity building**: Although some of the technologies have been promoted for a long period in Burkina Faso, the PAR-CSA approach in collaboration with IUCN-led projects have allowed (a) identifying linkages between climate hazards and the specific technologies, (b) actions that community members can put in place by themselves and

actions that require external support (from PAR-CSA or other partners), (c) the behavioural changes associated with participation in PAR activities, (d) bringing different stakeholders (administration, extension services, research, NGOs and farmers) to support the development of climate-smart agriculture and associated behaviour, and (e) the introduction of the first climate change adaptation day in Yatenga that allowed farmers and their partners to share achievements on adaptation processes. Farmer capacity building in terms of meteorology and climate information is required as it will positively influence the planning activities.

- **Funding:** The funding of the project, which is on a yearly basis, may affect its sustainability as climate change issues which require long-term investment and commitment. Linking with the current short-term planning perspective of the project, the objectives may appear ambitious as there is no guarantee for funding for the next season. Adoption of climate-smart agricultural innovations may also be associated with new challenges in terms of resources to acquiring new inputs (equipment, knowledge, etc.). If these challenges are not properly dealt with, the maintenance of the new behaviours will be difficult for smallholder farmers. EPIC has already considered dealing with equipment constraints with an additional small grant provided by the World Food Programme in Burkina Faso.

6.3 Impact and sustainability

It is still too early to fully assess these aspects of the project but it appeared that the scales in time and space of the good participatory work have been limited. However, the types of behavioural changes portrayed by farmers suggest that an approach that combines field level innovations, community plans, and weather forecasting has high potential to deliver longer-term benefits and to be sustained by the local community.

The maintenance of the new behaviour will be achieved during the second phase of CCAFS programme. Although a baseline study has not been done in a systematic way for socioeconomic and biophysical indicators, the main potential impact from PAR-CSA could be a menu of new (e.g. different from existing practices) climate-smart livelihood recommendations that have been rigorously tested on-site and analysed (e.g. for production, cost-benefit, carbon sequestration and for resilience) for a statistically representative scale. Yet it has been possible to observe some elements that may lead to significant changes in the future:

- FMNR and the zaï technology in Niger and Burkina Faso have revealed high adoption potential because they are simple and affordable (Garrity et al 2010; Bayala et al 2011; 2012). In addition they provide immediate and diversified benefits. For instance, FMNR improves soil fertility, protects young crop plants from strong winds (Photo 6), and provides fodder and wood for construction and energy. The zaï technique helps to conserve water, improve the efficiency of fertilizer due its strategic placement in the sowing pit at crop root and has impact on tree and pasture regeneration (Photo 7). Higher benefits are obtained when these two techniques (zaï and FMNR) are combined as tested in Burkina Faso and Niger;

- Tree planting within homestead compounds (e.g. *Moringa oleifera* gardens by women in Burkina Faso), on-farms (live fences) and fruit trees (mango and cashew in Ghana; tamarind, baobab and jujube/ber in Mali and Senegal) have attracted strong community commitment and that can lead to the sustainability of such activities. The remaining question is how to take this beyond the limits of the pilot sites.

Photo 6: Farmer-managed natural regeneration helping protect young crop plants from strong winds in Niger (©Tougiani A/INRAN)

Photo 7: Zai technique conserving rainwater for young crop plants in Niger (©Tougiani A/INRAN)

6.4 Gender

On the gender front, it is clear that men, women, youth and migrants have varying abilities to adapt to climate shocks and longer-term climate change because of differentiated access to entitlements, assets, and decision-making. This ability to adapt is further complicated by gender and social differences. Therefore, gender has been considered in all countries, even though with some differences.

In all countries, meetings, training and fieldwork have involved some women and youth (Photo 8). In addition, gender sensitive activities like diversification in the fields of garden vegetables and planting of *Moringa oleifera* in Burkina Faso, plantation of fruit trees for women in Senegal, vegetable diversification in Niger, fonio and sesame farming in Mali have been conducted. Women-headed households were involved in conducting the field trials in Mali. In Ghana, the Gender Climate-Smart women groups have been trained on the use of stone lining, compost, stone bounding for soil and water conservation and they have adopted these practices for rice and maize production on fields that are prone to gully erosion. Emphasis has also been placed on interventions that are likely to be more beneficial to women including nutritional education (training on soybeans utilization, village savings and loans groups).

All country teams have used different men and women focus groups for discussions as well as attempted to have women involved in the project activities. In order to overcome resource constraints and maximize the participation of the resource-poor women, the project also introduced interventions designed to provide immediate short-term income and food benefits, allowing farmers to plant trees that would generate other substantial benefits in the longer-run. Additional interventions included training on soybean utilization in a variety of local dishes, introduction of early maturing drought-tolerant maize and cowpea varieties as well as low shattering and promiscuous soybean varieties which require no inoculation or little mineral fertilizers to produce high grain yields, and emphasis on sustainable agricultural practices.

It is recognized that local level institutions are central to the scaling up and sustainability of the project in the long-term. The project has been trying to address this issue by working with chiefs and elders to recognize that women and youth are also entitled to own assets. Men and women are encouraged to come together and engage in decision-making so as to open up opportunities for collaboration and cooperation. This involves supporting continued dialogue at both household and community levels about the roles of women and youth in supporting agricultural innovation, while working to reduce structural deficits (access to resources) and encouraging more male support.

Photo 8: Awareness creation on climate change with a women's group meeting in Doggoh in Ghana (©Buah SS/SARI)

6.5 Policy issues and communication

Policy and asset barriers to the adoption of the assisted natural regeneration have been identified, particularly under the current rules (be granted an authorization from the forestry services) for the utilization of the native trees on farmlands. If these barriers are not addressed, achievements in the promotion of tree-based technologies/practices will remain localized. Addressing these barriers includes working towards local conventions that will grant smallholder farmers the right to sustainably use the on-farm trees they have regenerated (this will represent an incentive to naturally assisted regeneration techniques). Attention should also be paid to access to some assets (land, finance, inputs, etc.) that can help farmers to expand the application of the on-farm technologies. There is a need to continue supporting women and youth access to on-farm natural resources like planted and regenerated trees. Finally, there is a need to strengthen collaboration with the local governments to help introduce adequate agricultural services within the decentralized administrative entities.

Communication strategy is also to be improved through the following actions: (1) strengthen the capacity of project national teams; (2) make more use of communication technologies to disseminate project information and outputs (radio, video, ICT, etc.), (3) identify and make use, depending on the context, of local communication channels. For instance, the successes of the first phase may be capitalized as a documentary (based on the five case studies) to be shared as a dissemination tool and increase the number of farmers' radio debates on CSA successful practices.

7. Conclusion

This methodological evaluation report was not only meant to present the methods, but also provide information on the main strengths and weaknesses for future actions for the CCAFS-ICRAF PAR on climate-smart agriculture in West Africa and beyond. It was found that the project was well designed and was very relevant in the context of climate change as its objectives are in line and fit with local needs, especially national research/development goals. At the end of a three-year first phase, the most promising and sustainable outputs are the individual, low cost and locally grounded technologies/innovations. These include soil and water conservation techniques (e.g. zaï), agroforestry practices (e.g. the FMNR, fodder banks and fruit tree planting) and crop diversification (leafy vegetables). The fact that farmers were found to prefer individual action may appear to be a weakness but having all farmers implementing an individual technology will result in widespread adoption and landscape impact. Of course, efforts should be pursued to also have collective activities as they help in building the social capital which is critical in natural resource management. Indeed, some of the issues (erosion, vegetation degradation, etc.) can only be addressed at community and landscape levels.

For the development of the CSV models, the findings from the three-year period revealed the importance of partnership. However, the project has not been well connected to the national policy dialogue platform of CCAFS which exists in each of the five countries. This missing link needs to be established if the findings are to be mainstreamed into national policies. Other areas requiring specific attention to improve the performance of the CSV models are clear baseline, community resource management (governance issues for community and landscape actions), mitigation and locally accepted vocabulary in local languages of key climate change concepts.

The following specific recommendations have been formulated for future action:

- Conduct a project specific baseline study;
- Scale up proven technologies/innovations through strategic partnerships;
- Undertake some activities on the component of GHG fluxes from the soil;
- Strengthen the component of farmers' capacity building on meteorological and climate knowledge and information;
- Develop a linguistic corpus of climate-change concepts for each site, promote and encourage synergistic actions between projects and improve the project communication strategy.

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Appendices

Appendix 1: Workplan framework for defining activities

Climate change constraint targeted	Desired change	Activities	Expected outputs	Expected outcomes	Actors/partners & roles	Deliverables	Timeline	Academic training

Appendix 2: Prioritization of promising climate smart agricultural practices

Technology	**Criteria** (score from 0 (none/not at all) to 10 (excellent/highly suitable)							
	Food security		Adaptation[1]	Mitigation	Others			Total score
	Productivity	Income	Adaptation	Mitigation	Up-scaling	Economic viability	Ecosystem services	
1.								
2.								
3.								
4.								
5.								
6.								
7.								
8.								
9.								
10.								

Adapted from: Checklist for the inventory and prioritization of promising climate-smart crop-livestock agroforestry practices of the FP1 project "Building resilient agro-sylvo-pastoral systems in West Africa through participatory action research (BRAS-PAR)". Use the mode for final selection instead of the mean of the scores

[1] Adaptation refers to "adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities" (IPCC, 2007).

Mitigation refers to human interventions to reduce the sources or enhance the sinks of greenhouse gases (IPCC, 2007)

Ecosystem services according to MEA (2005) are: provisioning services (food, fuelwood, fibre, biochemical, and genetic resources), regulating services (climate, diseases, water regulation and purification), supporting services (soil formation, nutrient cycling, primary production and provision of habitat), and cultural (spiritual, recreation, education, medicine, etc.). MEA, 2005. Millennium Ecosystem Assessment. Ecosystems and Human Well-Being, Synthesis. Washington, D.C.

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