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Research Article

Agriculture and Climate Change: A Socio-Economic Dynamics of Climate-Smart Practices in Oubritenga Province, Burkina Faso

Constantin Gueswindé Compaoré[1, *], Evadine Marie Fulbert Windinmi Compaoré[2], Mathieu Ouédraogo[1, 2, 3], Boundia Alexandre Thiombiano[1], Patrice Toé[1]

[1]Laboratory of Rural Studies on Environment and the Economic and Social Development (LRSE/ESD), Nazi BONI University, Bobo-Dioulasso, Burkina Faso

[2]Institute of Environment and Agricultural Research, National Centre for Scientific and Technological Research, Ouagadougou, Burkina Faso

[3]Alliance of Bioversity International and CIAT, Dakar, Senegal

Abstract

The issue of farmers' resilience to climate and natural resource degradation remains a major concern in Sahelian countries, including Burkina Faso. The aim of this study is to analyze the dynamics of farming practices in the province of Oubritenga in Burkina Faso, highlighting similarities and differences in climate-smart practices. To do this, a mixed method (qualitative and quantitative) was used, combining surveys, individual interviews and focus groups. The results indicate that these practices were disseminated and adopted in Oubritenga province well before the 1980s, and that they have evolved in terms of adoption rates and improvements in recent years through research. The practices mentioned include sustainable land management (SLM), water and soil conservation practices/soil defense and restoration (WSC/SDR). Rural households are responding by adopting and reinforcing climate-smart farming practices that are considered more sustainable in the face of climate shock, soil degradation and greenhouse gas mitigation. It should be noted that other agricultural practices and techniques have been disseminated and adopted over time, in connection with mechanization and the promotion of technical production itineraries. This is a body of endogenous knowledge that coexists with technical production itineraries aimed at respecting the balance between nature and the well-being of living beings by integrating a sustainable land and environmental management system.

Keywords

Climate Change, Climate-Smart Agriculture, Oubritenga

1. Introduction

Climate change represents an increasingly perceptible threat to the viability of rural households in sub-Saharan Africa, where communities live mainly from the exploitation of natural resources [13]. Indeed, climatic constraints and vari-

*Corresponding author: tintincomp@yahoo.com (Constantin Gueswindé Compaoré)

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ability, soil degradation and poverty due to human pressures are deteriorating the environment and ecosystems. This vulnerability of natural and environmental resources affects the living conditions of local communities, whose main source of income is the exploitation of natural resources, and exposes them to food insecurity and poverty. As a result, they are faced with the need to increase agricultural production on ever-smaller cultivated areas, in view of demographic growth. This situation has led many producers to favor so-called conventional agriculture, which has further impoverished arable land, lowered agricultural productivity and made the economies of rural households more precarious. Consequently, there is an urgent need to strengthen resilience and adaptation to climate change in this agricultural sector, in order to improve living conditions for rural farmers. In response to these consequences, developing the agricultural sector remains a major challenge in the face of climate variability and natural resource management. Community and international organizations are helping farmers to adopt and promote (disseminate) innovative farming practices, the most widespread of which are climate-smart agricultural practices (CSA). Today, this agro-ecological transition is presented as a response to the climatic, socio-economic and environmental challenges to which agriculture must respond [14]. The aim is to reconcile productivity and sustainability, by taking ecological phenomena into account while limiting the degradation of environmental resources. Under the aegis of technical, financial and state partners, some farmers in Burkina Faso have benefited from the support and implementation of agricultural projects and programs in recent decades. In the province of Oubritenga, agricultural activities are undergoing major transformations to cope with climatic hazards and soil poverty, while preserving environmental resources and combating food insecurity. It is therefore a sustainable and reasoned agriculture whose agricultural production activities are associated with techniques and practices for the sustainable management of the environment: land and natural resources [12]. Thus, some villages in this province have benefited from intervention by stakeholders and projects promoting climate-smart agricultural practices. This is the context of this research, whose main objective is to analyze the dynamics of endogenous agricultural practices in the province of Oubritenga in Burkina Faso by highlighting the similarities and differences of climate-smart practices.

2. Theoretical and Methodological Framework

2.1. Theoretical Framework

2.1.1. The Concept of Climate-Smart Agriculture

Different terminologies of the concept; climate-smart farming practices is a notion derived from climate-smart agriculture. The concept of Climate-Smart Agriculture (CSA) was first used in 2009. It was presented by the FAO at the first global conference on agriculture, food security and climate change in The Hague in 2010. It is defined as an agriculture that sustainably increases productivity and resilience (adaptation), reduces/eliminates Greenhouse Gases (GHGs) (mitigation) where possible, and enhances the achievement of national food security and development goals [6]. Still according to the same source, CSA is an approach aimed at identifying the most suitable strategies for achieving the three objectives of productivity, adaptation and mitigation, based on national and local priorities and conditions. It integrates the three dimensions of sustainable development (economic, social and environmental), targeting the challenges of food security, ecosystem management and climate change. Thus, food security and development are the main objectives of CSA, while productivity, adaptation and mitigation are identified as the three interdependent pillars needed to achieve this goal.

Productivity: CSA aims to sustainably increase agricultural productivity in order to support equitable increases in farm incomes, improve food security, and promote development without harming the environment.

Adaptation: one of CSA's objectives is to reduce farmers' exposure to the risks of short-term climate change, and strengthen the resilience of agricultural systems by enhancing their ability to adapt and thrive in the face of long-term shocks. The emphasis is on protecting the ecological services that ecosystems provide to farmers.

Mitigation: According to the Intergovernmental Panel on Climate Change [8]; special report on Climate Change and Land, agri-food systems currently contribute over 30% of global greenhouse gas emissions, taking into account agricultural production, land-use change and energy consumption. According to the same report, the agriculture, forestry and other land use sector accounted for around 23% of all anthropogenic greenhouse gas emissions between 2007 and 2016. Wherever possible, CSA should contribute to reducing and/or eliminating these GHG emissions. This implies avoiding deforestation due to agriculture, reclaiming soils and maintaining trees in such a way as to optimize their potential to act as carbon sinks.

Nevertheless, there are several terminologies used in the literature to designate these practices, such as: climate-smart agriculture, climate-intelligent agricultural practices and agroecology.

In January 2005, the Economic Community of West African States (ECOWAS) adopted a common agricultural policy (ECOWAP/CAADP). It pursued three (03) objectives: sustainable intensification of agricultural production, market regulation and improved access to food for vulnerable populations. To achieve these objectives in a context of increasing climate change, ECOWAS has integrated an instrument to support the agricultural sector, in order to address the paradox between maximizing agricultural productivity, increasing the

resilience of agricultural systems to climate change, and mitigating greenhouse gas (GHG) emissions from the agricultural sector.

In Burkina Faso, several tools and approaches have been used to implement CSA, including the climate-smart village (CSV) approach. It was developed by the Consultative Group on International Agricultural Research (CGIAR) through its Climate Change, Agriculture and Food Security (CCAFS) program, in collaboration with its partners (ICRISAT, ICRAF, IUCN, INERA and the national weather service), whose main objective is to improve the climate literacy of farmers and local stakeholders, and to develop a resilient agricultural system to climatic hazards. The CCAFS program aimed at promoting a number of CSA practices with a focus on inputs, water, energy, nutrients and risk prevention tools that help farmers reduce climate risks in agricultural production [1]. For them, it's a model of local action for climate risk management in farming communities that includes the selection of locally adapted practices, technologies, climate information services, insurance, institutions, policies and financing options. These interventions are expected to sustainably increase crop yields and farmer incomes, improve input efficiency and reduce GHGs, thereby minimizing climate risks in agricultural production systems. Thus, there are no fixed packages of CSA, with options differing from site to site depending on local governance, agroecological characteristics and level of development.

To cope with the adverse effects of climate variability, Burkina Faso has implemented strategies and policies to disseminate and promote climate-smart agricultural practices.

The aim is to reconcile production and sustainability, by taking environmental and ecosystem factors into account. According to a study carried out in Burkina Faso in the southern Sudan zone on the comparative effects of good agricultural practices for soil fertility management on soil properties and crop yields, these practices make it possible to adapt to climate variability in order to meet current needs, improve livelihoods and preserve the environment in a sustainable manner [17]. Generally speaking, good practices are defined on the basis of FAO criteria. These include sustainable land management practices, soil erosion control, water and soil restoration and conservation.

Thus, in order to mitigate the impacts of climate change, in 2015 Burkina Faso adopted a National Adaptation Plan (NAP) to climate change, the vision of which is to enable the country to effectively manage its economic and social development through the implementation of planning mechanisms and measures that take into account resilience and adaptation to climate change by 2050 [16]. Since then, NGOs, associations and projects have become involved in promoting these climate-resilient agricultural practices and combating land degradation. Today, this commitment has led to the existence of important land management techniques in rural areas. Agricultural activity is carried out through a diversity of cultivation methods determined by farming practices. Agricultural practices are the set of processes and means by which producers carry out their farming activities. According to Clemence VANNIER [23], the choice and implementation of farming practices depend on various local factors such as farmers' production logics, the size of the farm and the organization of work within it, local agricultural orientation policies and national and international regulations such as agricultural market policies. According to the study by Valerie HAUCHART [10], the definition of agricultural practices includes the means and equipment used by farmers. The definition of agricultural practices in this study takes into account the nature of the equipment used, its direct implications on agricultural production and the environment, as well as the implementation processes and the means of application. There are several types of practices, organized into 4 groups according to the nature and effect of the tools used: mechanical practices, agroecological practices, socio-cultural/economic practices and use of technological packages. These practices are summarized in the table below.

Table 1. *Summary of agricultural practices and their description.*

Types of practices	Practices	Description of practices
Mechanical practices	Ploughing, ridging, mowing and weeding	According to the study on the dynamics of the mechanisation of agricultural production and processing in West Africa, [11], mechanical agricultural practices include the use of mechanical tools such as the hoe, the plough, machinery and energy sources of animal, human and mechanical origin, as well as all the services linked to mechanisation, such as financing, the manufacture and maintenance of agricultural equipment, training, advice and agronomic research. These practices aim to improve agricultural efficiency and productivity, while reducing the cost of manual labour and facilitating the management of natural resources.
Agro-ecological practices	Rotation and mixed crops, agro-forestry/tree farming, SWC/SRD, Improved early varieties	According to the study conducted to promote agroecology through organic certification in Burkina Faso [15], agroecology is a set of farming methods that aim to improve the environment and the ecosystem. These practices include techniques that incorporate an environmental management system,

Types of practices	Practices	Description of practices
		maintaining a balance between nature and the well-being of organisms.
Socioeconomic/cultural	Breeding, Early sowing, Association groups, Sacrifices/Prayers	They constitute the set of practices by which populations alleviate their financial or social problems, with or without direct or indirect integration of environmental management, depending on habits and even cultures.
Technology packages	Use of chemical inputs (fertilizers and pesticides)	Technology packages include all chemical fertilizers and pesticides.

2.1.2. Agricultural Policies and Interventions on the Adoption of Farming Practices

Agricultural policies generally contribute to reorienting and helping rural households and farmers to implement agricultural practices. It should first be noted that, according to [20], an agricultural policy can be defined as a set of institutional arrangements aimed at increasing farmers' production and income, and which contributes to the general progress of a society. The article stresses the importance of these actions in ensuring the sustainable management of natural and environmental resources in the region. With the aim of ensuring sustainable management of natural and environmental resources, Burkina Faso has put in place strategies and actions to combat land degradation and desertification. This has led to the implementation of numerous initiatives, at both national and local level, aimed at restoring and sustainably managing land. In West Africa, the [22] report states that the countries of sub-Saharan Africa have many assets and strengths in the face of land degradation and climate variability. In this thematic report on West Africa, the UNCCD highlighted the net loss of forests in Africa between 2010 and 2020, mainly due to the conversion of forest land to agricultural land and climate change. Natural resources in Africa, including land, water and mineral resources, are abundant, but the exploitation of these resources does not always benefit local populations, and the rush for land can have harmful consequences. These initiatives include soil restoration through fertilization, erosion reduction through techniques such as stone barriers, grass strips, bunds, agroforestry practices, water retention techniques such as za ï and half-moons, and the promotion of adapted and resistant varieties of improved seeds that can increase agricultural productivity in a sustainable manner.

Burkina Faso has focused its development on a strong, sustainable agricultural economy. To this end, it has set up research, supervision and technical support structures. These include technical services in charge of agriculture, agronomic research structures, non-governmental organizations (national and international), development associations and producers' unions working in the agro-sylvopastoral sector (agriculture, environment, livestock and agroforestry) in conjunction with producers to promote sustainable agriculture such as agroecology and CSA. The practices disseminated relate to sustainable land management, soil restoration and water conservation strategies using agroecological technologies adapted to the province of Oubritenga. Several factors influence the adoption of agricultural techniques and practices, such as socio-economic characteristics, production conditions and technology characteristics. According to the study on the adoption of agricultural technology: a guide to survey design [2], various groups of factors can influence the adoption of agricultural practices and techniques. In particular, access to extension services and contact with technical services facilitate access to information and encourage the adoption of innovations. According to D. P FOLEFACK and al [7], the technical support provided to farmers by extension services has a positive influence on the adoption of certain conservation farming practices and on soil fertility. In addition, technical and economic factors such as extension, government support, agricultural materials and equipment, and the accessibility of chemical and organic inputs favor the adoption of sustainable agriculture technologies and the dissemination of good agricultural practices [21].

2.2. Research Methodological Framework

2.2.1. Study Area

The province of Oubritenga is located at 12° 35′ 00″ north latitude and 1° 25′ 00″ west longitude. It covers an area of 2,778 km², representing 1.014% of the national territory and 32.28% of the regional territory. It lies within the area of influence of Ouagadougou, the capital. Ziniaré, its capital, is 35 km from Ouagadougou. Created by law n°041/98/an of August 06, 1998 on the organization of territorial administration in Burkina Faso as a territorial collectivity. The province of Oubritenga comprises a total of seven (07) communes and 216 villages. (See figure 1).

The province of Oubritenga was chosen because of its enormous potential, which should be properly exploited to transform it into a genuine agricultural development hub. It is located in transition between the Sudanian (humid) and Sahelian (dry) zones. In addition to its potential, agriculture is the main activity that occupies the majority of the province's population. Indeed, land pressure, soil poverty, the advancing desert and increasingly recurrent climatic constraints expose the province's agricultural sector. However, efforts have been

made to develop good farming practices. In this province, there is a great deal of interest and action on the part of stakeholders for a resilient, sustainable agriculture that can contribute to the mitigation of greenhouse gases and adaptation to the effects of climate variability in agriculture. The research involved four (04) of the seven (07) communes in the province of Oubritenga in Burkina Faso. Ten (10) villages were divided into two (02) types of zones, namely climate-smart zones and non-climate-smart zones. The climate-sensitive villages comprise five (05) villages, including two (2) in the commune of Ziniaré (Koassanga and Napamboubou) and three (03) in the commune of Dapélogo (Gademtenga, Guiè and Soglozi). There are five (05) villages that are not climate-smart, including three (3) villages in the commune of Zitenga (Bissiga, Lelèxé and Tanlili) and two (02) villages in the commune of Nagréongo (Nagréongo-koudgo and Tanvoussé). These results come from a survey of producers in the province and are not directly linked to the climate-smart village projects mentioned in the research sources. The figure below shows the location of the province of Oubritenga.

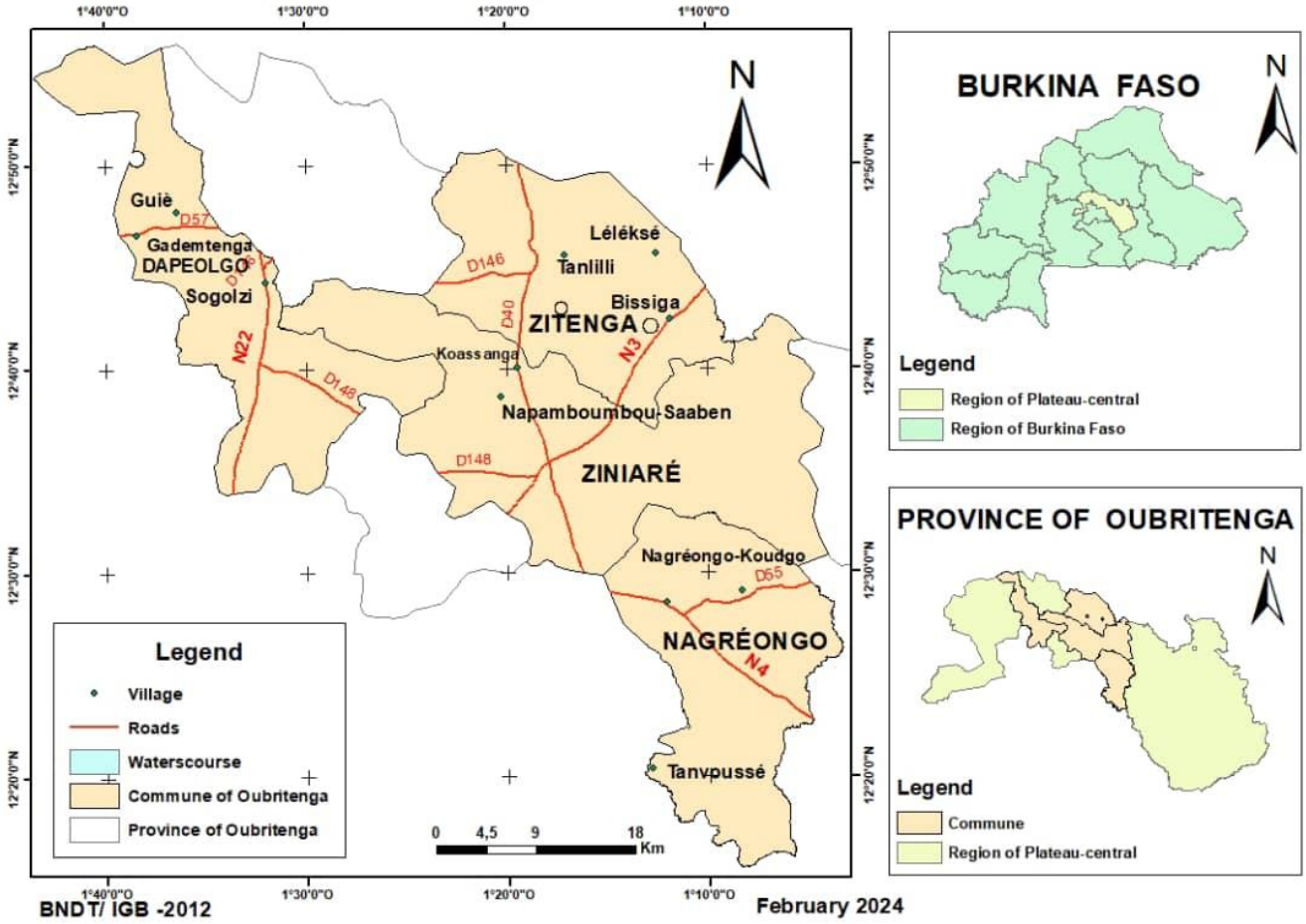


Figure 1. *Location and situation map of the study area.*

2.2.2. Methodology and Sampling Technique

The study is based on a mixed methodology that combines quantitative and qualitative methods to collect and analyze data. This approach makes it possible to combine the advantages of both methods to obtain a more complete and in-depth understanding of the phenomenon under study. Quantitative methods are used to collect statistical and measurable data, while qualitative methods are used to inventory and understand smart farming practices and the attitudes and behaviors of participants. For the quantitative method, the sampling of individuals surveyed was carried out in a simple random fashion. Households in each village were selected on a semi-reasoned basis and by neighborhood, using the odd-numbered rule. The 1st household is systematically taken and the 2nd is skipped for the 3rd, then the 4th is skipped for the 5th if the 3rd is not available and the 4th systematically becomes the 3rd. For the qualitative method, the reasoned technique is used. A total of 502 heads of farmer households were interviewed in the course of the study. Households in each village were selected using the odd-number rule. For qualitative data, a sample of 22 institutional players were consulted through individual semi-direct interviews. In addition, direct discussion and exchange groups

of around ten farmers were organized in each village.

Table 2. Sample distribution.

Techniques	Actors	Sample
Questionnaire survey	Farmers/households	502
Individual interview	Institutional	22
Focus group	Social groups	10

2.2.3. Data Collection Methodology

Quantitative method: We used a questionnaire-based survey. The questionnaire was administered individually, with both closed-ended and open-ended questions. The form was digitized in XSLS form and deployed on a Kobo Toolbox server to serve as a platform (hosting, storage, retention of collected data). The Kobo Collect mobile application was used to collect data using Smartphones.

Qualitative method: We opted for interview techniques, focus groups and documentary reviews to take stock of farming practices and understand the factors behind the adoption of smart farming practices. We used interview guides through oral discussions. Verbatim discussions were recorded using a dictaphone for a verbatim transcription of what was said in an audio document.

2.2.4. Data Analysis Method

Statistical Package for the Social Sciences (SPSS 20) and EXCEL software were used for the descriptive analysis of the data collected. They were used to analyze the data obtained from the households surveyed in different zones in order to inventory and characterize the cropping practices adopted by the households. Typical steps in descriptive analysis with SPSS include generating descriptive statistics such as mean, standard deviation, median, minimum and maximum for the variables, and creating tables and graphs to summaries the characteristics of the data. Excel is used in particular for calculating descriptive statistics and creating graphs and comparison tables.

3. Results of the Survey

The section below presents the results of the survey and in-depth interviews on the dynamics of CSA practices in the province of Oubritenga, in the Central Plateau region of Burkina Faso.To cope with the effects of climate variability, initiatives have been developed and adopted by farmers. In this province, initiatives have contributed to the adoption of sustainable land management practices, water and soil conservation, soil defense and restoration, and environmental resources.

3.1. Dynamics of Agricultural Input Use

The dynamics of agricultural practices show the evolution of land use, sustainable land management and the use of agricultural inputs. The adoption of agricultural inputs can contribute significantly to adapting to and improving the resilience of populations in the face of climatic constraints, mitigating GHG emissions and soil impoverishment. The figure below shows the proportions of input use by farmers in the study area.

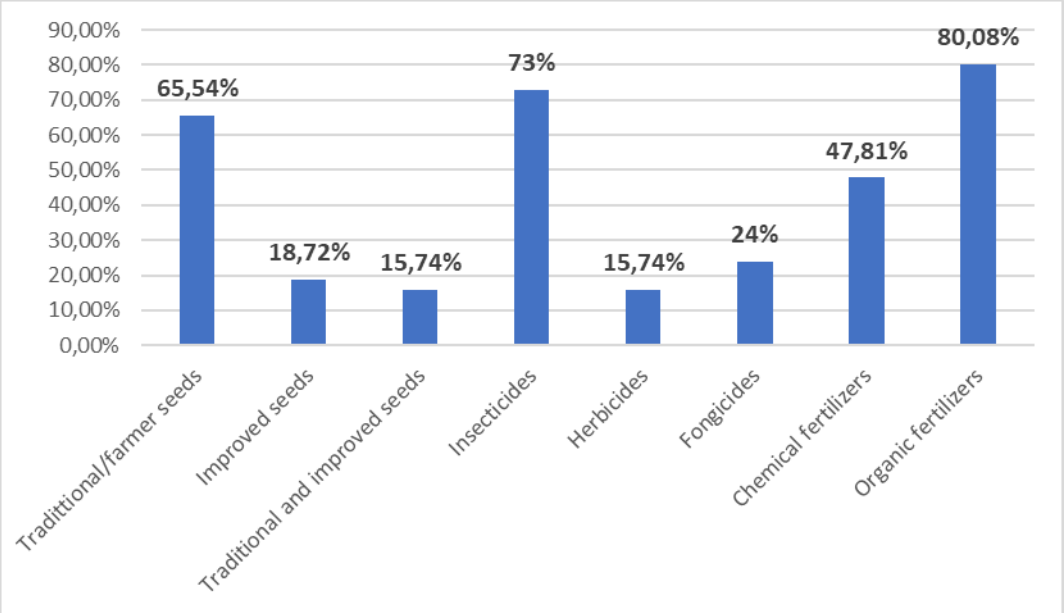


Figure 2. Input use by producers in Oubritenga province.

The graph above illustrates the results of a survey of 502 producers, showing that 47.81% of them use chemical fertilizers such as nitrogen, phosphorus, potassium and urea as inputs in their agricultural production. The survey results also revealed that 73% of respondents use insecticides, 24% fungicides and 15.74% herbicides. As far as seeds are concerned, 65.54% of respondents use farmers' seeds and 18.72% use improved varieties, while 15.74% use both types of seed (farmers' and improved). The use of chemical inputs such as chemical fertilizers, insecticides and herbicides is actually more prevalent in the villages of Tanvoussé (Nagrégogo), Lelékié (Zitenga) and Koassanga (Ziniaré), all villages where market garden produce is more dominant. Indeed, in these localities, growers explain that the use of chemical fertilizers is due to difficulties in accessing organic inputs (compost and organic manure). However, despite these constraints, growers in Dapélogo, Ziniaré and Zitenga (Tanlili and Bissiga) are taking steps to acquire and apply organic fertilizer. In the Tanlili commune of Zitenga, the majority of producers are adopting farmer seeds, supported by the NGO DIOBASS through their farmer seed producers' group (group of producers of passpaongo seeds) in the massal selection of Sorghum and Millet varieties.

3.2. Inventory of CSA Practices and Techniques Adopted

All the direct players (involved in the production, processing and marketing of agricultural products as peasant farmers or farm households) and indirect players (providers of financing, advisory and technical support services to direct players such as NGOs, government departments, technical services, agricultural development organizations and professional representatives) interviewed consider that agriculture is undeniably linked to climatic and rainfall conditions. This favors the adoption and dissemination of a number of more resilient practices that adapt to these climatic constraints. The figure 3 below shows the intensity of adoption of so-called climate-smart practices.

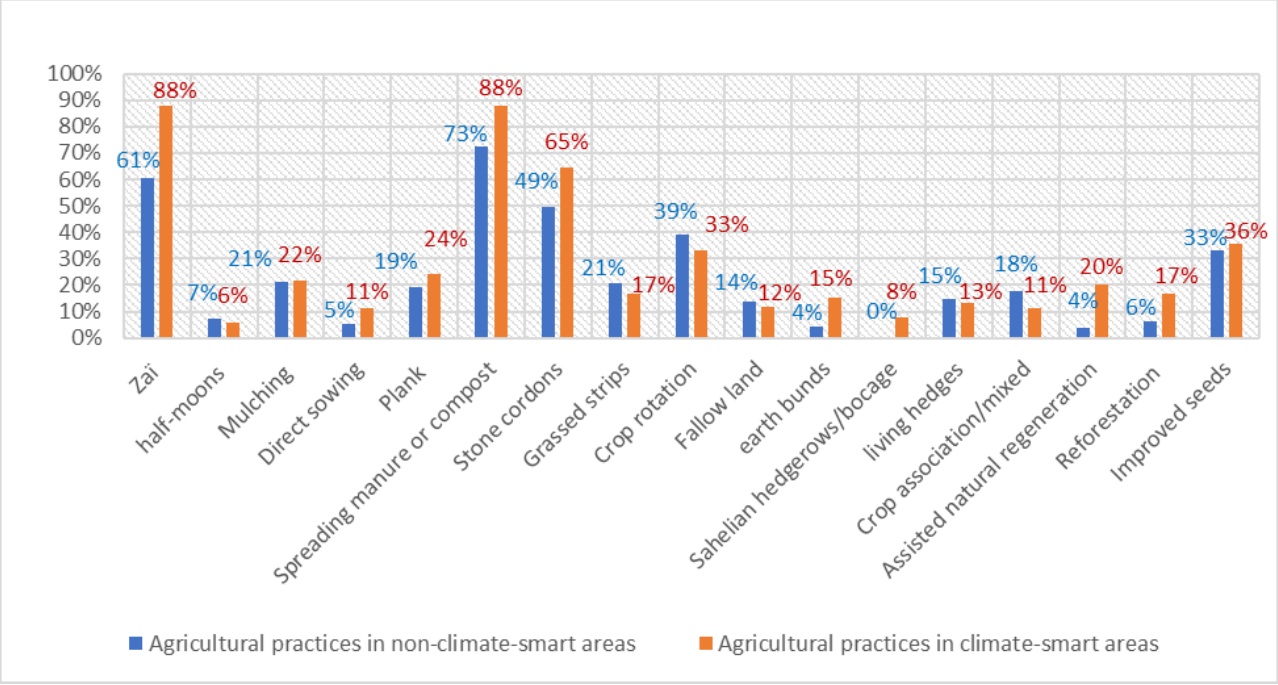


Figure 3. *Climate-smart agricultural practices adopted by producers.*

The graph shows that certain practices are adopted by the majority of respondents. These include spreading organic manure (80.08%), Za ï(74.11%) and stone cordons (56.97%). Other practices are not widely adopted, such as crop rotation (36.06%), use of improved seeds (34,5%), planking or terrace cultivation (21.71%), mulching (21.35%), grass strips (18.73%), crop association (14.56%) and RNA with tree pruning (12.16%); fallow land (12.55%), hedgerows (13.94%), reforestation or agroforestry (11.55%), earthen bunds (9.26%), half-moons (6.57%) and bocage or Sahelian bocage (3.78%). Lack of means is the main constraint to the adoption of certain practices, such as access to compost, the adoption of half-moons, stone cordons, reforestation and Za ï On the other hand, in certain localities such as Bissiga and Taonvoussé, the soil texture does not allow or facilitate the use of Za ï Also, the practice of Sahelian bocage is non-existent and unknown in Zitenga, Nagrégogo and Ziniaré During focus group discussions, farmers felt that spreading

manure and compost, and adopting za ï and stone cordons contributed to sustainable soil management. *" Nowadays, if you don't use za ï you can't hope to harvest, and you can't use za ïwithout compost, animal manure or household compost"*[1]. Some practices are Non-climate-smart practices are unsustainable practices that do not contribute to environmental protection and soil restoration. Some farming practices are unsustainable and no smart because they can have a negative impact on the environment and human health. These include practices such as the excessive use of fertilizers and pesticides, which contribute to soil impoverishment, soil and groundwater contamination, and loss of biodiversity. Deforestation and slash-and-burn farming techniques lead to the loss of natural habitats, soil degradation and the release of greenhouse gases. Finally, the excessive use of soil (deep ploughing, ridging) by heavy agricultural machinery, which can damage the soil and contribute to the emission of greenhouse gases. These unsustainable farming practices can have negative consequences for the environment, human health and long-term profitability. The figure below shows some of the non-climate-smart practices adopted in the province of Oubritenga.

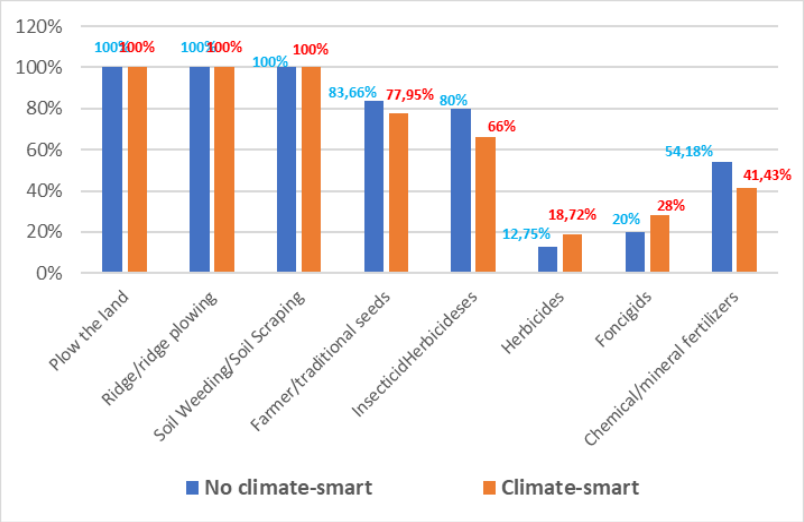
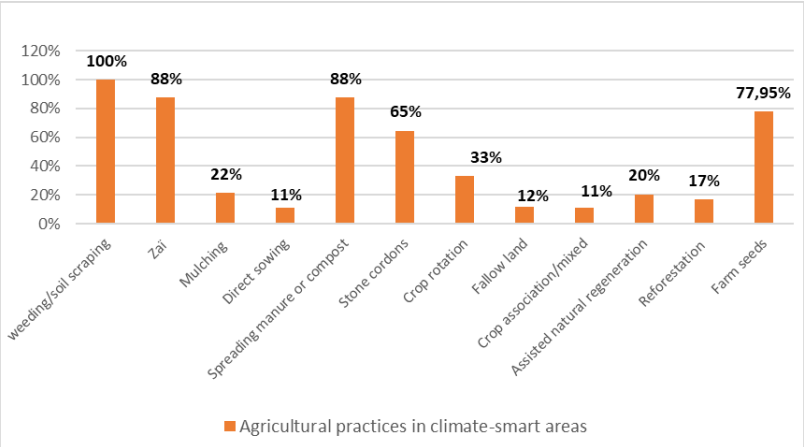


Figure 4. *Non-climate-smart agricultural practices adopted by farmers.*

The data show that some farming practices are considered non-climate-smart. All respondents (100%) adopt ploughing, ridging and weeding practices. In terms of input use, the majority (65.54%) still use farmers' varieties, 15.74% use farmers' and improved seeds, 73% use insecticides, 47.81% use chemical fertilizers, 24% use fungicides and 15.74% use herbicides. "*We are aware that ploughing and ridging impoverish soils and land, as these practices contribute to erosion and degradation. Rainwater carries soil and sand along watercourses, and we are the ones who transport this sand to the city of Ouaga for construction purposes*"[2]. The graph below compares the endogenous practices adopted in the study area.



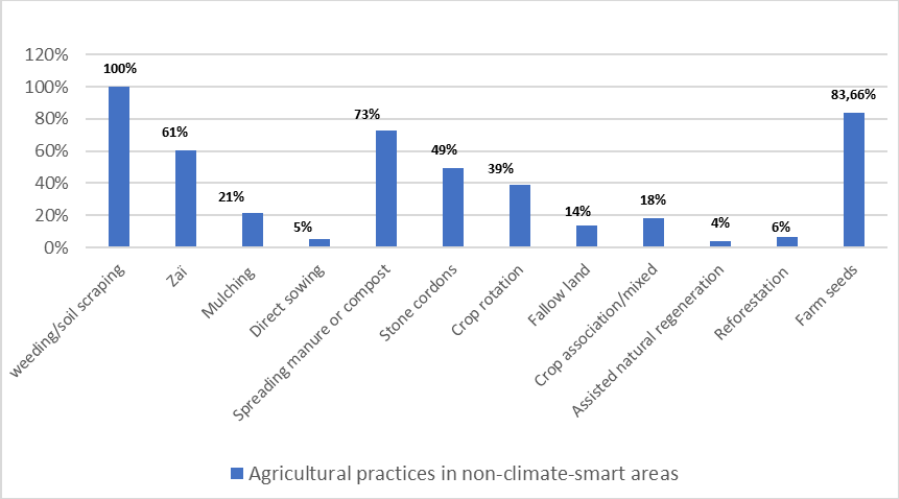


Figure 5. *Endogenous farming practices adopted in the two study areas.*

The graphs show a comparison in terms of the proportion of endogenous farming practices adopted. Among these endogenous practices, weeding is adopted and practiced by all respondents, i.e. 100%. This operation consists in removing harmful vegetation and loosening the soil surface to conserve moisture. All the so-called endogenous practices are more widely adopted in climate-smart zones, except for crop rotation (33%) and fallowing (12%), which are slightly more widely adopted in non-climate-smart zones (39% and 14% respectively). "We used to make earthen bunds to combat runoff and water erosion, before we benefited from training to replace this method of combating water runoff (ko koaka, meaning water blockage) with pebbles called stone cordon (koug koaka), which has also evolved into simple cordons, which has improved through training and capacity building"[3]. With regard to mulching practices, we have seen mulching practiced on arid, poor and degraded soils to recover and restore the soil in order to increase agricultural productivity in this area"[4]. It is important to note that alongside these endogenous practices coexist other agricultural practices that have been disseminated and adopted over time with mechanization and the promotion of technical production itineraries. Those endogenous practices that have stood the test of time have in fact proved their worth through results. With the advent of scientific research, a number of practices have been scientifically explained, enabling producers to strengthen their capacity. The graph below compares the non-endogenous practices adopted in the study area.

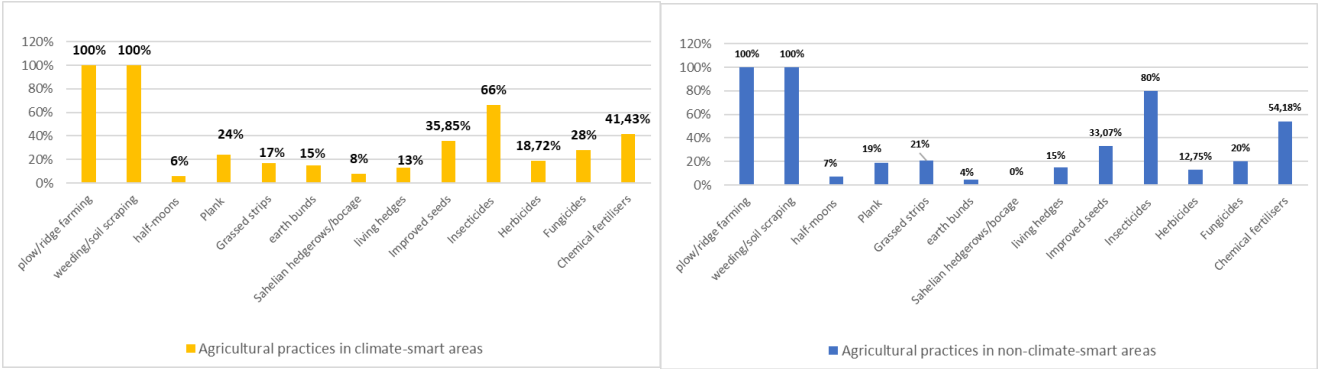


Figure 6. *Non-endogenous farming practices adopted in the two study areas.*

The graphs show the proportions of adoption of non-endogenous agricultural practices that coexist with endogenous practices. These are practices taught by agricultural development stakeholders (institutions, research, associations). They include soil preparation techniques such as ploughing and ridging, as well as fertilization techniques and phytosanitary treatments. These practices are more widely adopted in non-climate-smart zones. On the other hand, in climate-smart zones, the intensification of cowpea, maize and market garden crops requires the adoption of technical production itineraries and the use of chemical products for the treatment and maintenance of these crops, hence the use of insecticides and chemical fertilizers in the different zones.

3.3. Effect of Stakeholder Intervention on the Adoption of CSA Practices

The various sustainable land management practices, erosion control practices, water and soil conservation techniques, soil defense and restoration techniques, and agricultural mechanization are priority programs for the development of the agricultural sector in Burkina Faso [18]. Actors such as technical and financial partners, NGOs, associations and producer groups are committed to combating land degradation and restoration and adapting to the effects of climate change through the implementation of agricultural projects and programs. This commitment has led to the implementation, dissemination, promotion and adoption of various sustainable agricultural production practices and techniques aimed at preserving and improving environmental and natural resources in a sustainable way. The interventions of public authorities and agricultural development NGOs have been made necessary by the importance and strategic value of this sector in the national economy. The practices disseminated relate to the strategy of soil restoration and water conservation using agroecological techniques adapted to the province. The Figure 7 below shows some of the projects and their achievements in terms of sustainable land management in the province of Oubritenga.

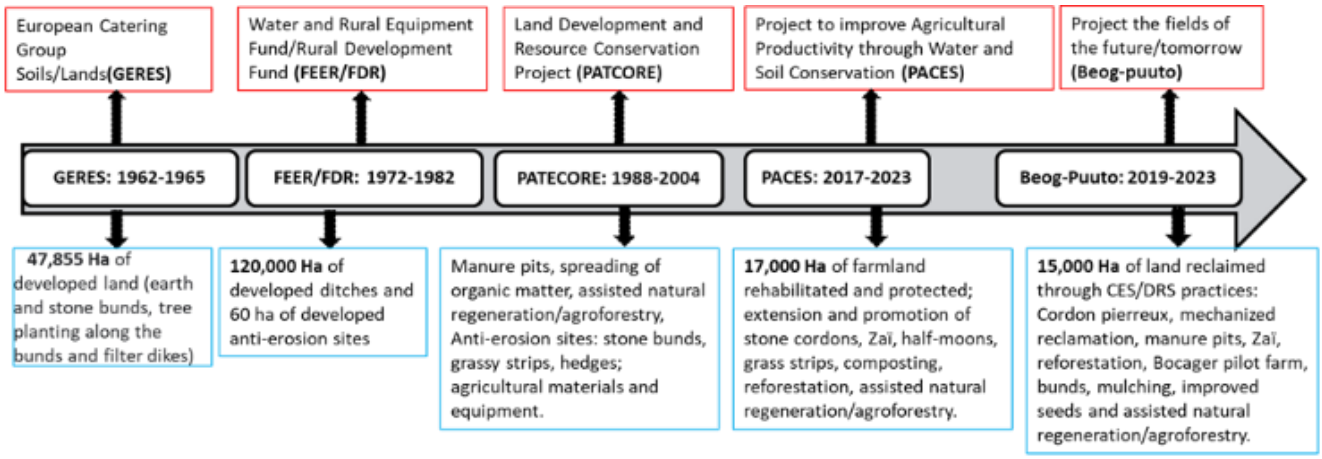


Figure 7. *Projects and their activities and achievements.*

The data in the graph illustrate the evolution and milestones in the promotion, dissemination and adoption of agricultural practices and techniques in relation to the various projects and programs that have structured them. Key projects and programs have contributed to the intensification of current agricultural practices and techniques in the Oubritenga province. Projects such as the European Soil Restoration Group (GERES) project, the Water and Rural Equipment Fund/Rural Development Fund (FEER/FDR) project, the Land Management and Resource Conservation Project (PATCORE), the Project to improve agricultural productivity through water and soil conservation (PACES) and recently the B éog-puuto project have been implemented by NGOs and development associations in conjunction with their partners to promote sustainable agricultural resilience through sustainable land management techniques (SWC/SRD) and agroforestry. These organizations include the FAO, SOS Sahel, GIZ, the Great Green Wall, the NGO Terre verte, the NGO Action for the Promotion of Local Initiatives (APIL), the Tiipalga association, decentralized state institutions and farmers' groups. "*In truth, some farming practices are very old, but it is the technical and financial support of the association Terre Verte and the projects that have enabled the intensification of the stone cordons in our fields, the creation of manure pits to produce organic fertilizer; others are new practices such as the Sahelian bocage. The same dynamic is being pursued with the Za ï raaga initiative, which rewards the best Za ïfarmer. It is now a major event, encouraging households to step up the adoption of Za ïin the commune of Dap éogo*"[5].

4. Discussion

Local and endogenous knowledge has always been useful for the survival of a group. In the province of Oubritenga, a dozen climate-smart agricultural techniques are practiced. They form part of the practices used to combat erosion and improve soil fertility. A set of endogenous agricultural practices that appeared long before the CSA concept. Sustainable agricultural practices that respond to sustainable land management, environmental protection and safeguarding, as well as resilient practices for adaptation to increased climate change. According to Dialla B. E [3], this is knowledge that has been developed, practiced, transmitted and learned from generation to generation. For the same author, these are practices that remain complementary to the modern knowledge system and can serve as a basis for sustainable development.

A study published in 1992 confirms that small farmers in

the north (Ranawa and Aorêm) of Burkina Faso preferred anti-erosion techniques based on traditional natural resource conservation systems to newly introduced ones [4]. This study confirms the hypothesis that smallholders or rural households preferred anti-erosion techniques designed on the basis of traditional natural resource conservation systems, to those newly introduced. For the author, designing anti-erosion techniques based on farmers' knowledge increases the rate of adoption of these techniques by farmers.

In the study of agricultural production systems in the Sissili province of Burkina Faso: Analysis of cropping systems among the Nouni, Mossi and Peulh in the village of Ba-gounsio [19], the author explained that crop rotation is a common practice. This technique consists of growing a succession of crops on the same plot year after year. According to the author, rotation is achieved by growing yam, sorghum, maize and millet in succession on the same field. Farmers believe that the succession of the same crops on the same field reduces its fertility and profitability and degrades the soil.

On the other hand, D GUILLAUD, in his study of the Sahelian agro-pastoral system in Arbinda, Burkina Faso [9], states that the technique of crop association and rotation are traditional practices adopted by farmers in the rural commune of Arbinda, in the Sahel region, to restore soil fertility. Farmers see crop rotation as a guarantee of food security for rural households in this region. If one crop fails, the other can at least produce good results. Farmers have developed survival strategies to combat food insecurity using their local and endogenous knowledge. This study has confirmed the continuity of crop association and rotation practices that have been used in the past to help conserve and preserve soil fertility.

The adoption of agricultural practices, particularly water and soil conservation and restoration, is favoured when they are in line with traditional methods and farmers' knowledge. According to a study by Dibouloni J. B [5] on the adoption of zaï and stone cordon techniques in the Centre and Centre-South regions of Burkina Faso, these methods have proved effective in preserving soils and combating erosion and crop instability in these regions. However, the adoption of these practices is influenced by several factors, such as the level of knowledge and skills of farmers, the availability of financial resources, the involvement of women and young people, land conflicts, and the dissemination and promotion of these techniques. So, to ensure the successful adoption of such practices, it is essential to integrate them harmoniously with traditional practices and promote them as part of initiatives to combat desertification and manage natural resources. Some of the institutional players we met refer to CSA as agroecology, and see no difference between agroecology and climate-smart practices. They believe that climate-smart practices are sustainable practices that advocate reduced tillage (less depletion and enrichment of the soil, then improved crop yields), and that sustainable agriculture like CSA means agroecology. If agroecological practices have been disseminated since the 80s, through Pierre Rami, it is important to consider the fact that these practices are still present. The majority of those interviewed were positive about these practices, despite the fact that they integrate social, environmental and economic dimensions. They consider that the majority of practices are not modern/new. For them, they are a set of endogenous practices innovated and improved by research, NGOs, associations, development actors and promoters of sustainable agricultural practices. These are practices that were used and adopted in the past with very few resources, tools and unsophisticated equipment. These practices made it possible to meet the needs of these producers, since the production system was mainly a subsistence system. They include the adoption and use of traditional or peasant seeds and varieties through massal selection (peasant and local knowledge), stone cordons, assisted natural regeneration, fallowing, agroforestry, zaï, crop association, rotation, selection of peasant/traditional seeds, mulching, spreading organic fertilizer/compost.

5. Conclusions

Experiences in adopting, promoting and disseminating farming practices and techniques in the province of Oubritenga show that rural populations put agricultural practices and techniques through the prism of their socio-economic knowledge and realities. Local knowledge, as well as the ability to link research and local activities, plays a key role in broadening the adoption of agricultural practices to strengthen the resilience of livelihoods. The presence, enthusiasm and evolution of social structures influence the intensity of large-scale adoption of farming techniques and innovations by rural households. Land degradation, climate variability and the search for adaptive and climate-resilient strategies will increase the relevance of the technological development process to local conditions and priorities. Adaptation and mitigation actions are proposed, disseminated and adopted to mitigate foreseeable climate shocks. At the individual level, the actions undertaken by farmers or local populations are sustainable land management techniques and climate-resilient agricultural practices for soil conservation, preservation and restoration. It's a body of endogenous knowledge that coexists with technical production itineraries that attempt to respect the balance between nature and the well-being of living beings by integrating a sustainable environmental and soil management system. This endogenous knowledge has been perfected and improved/innovated with the technical and financial support of research in recent years.

Abbreviations

CSA: Climate-Smart Agricultural

CCAFS: Climate Change, Agriculture and Food Security

CGIAR: Consultative Group on International Agricultural Research

CSV: climate-Smart Village

ECOWAS: Economic Community of West African States
FAO: Food and agriculture Organization
GHG: Greenhouse gas
GHGs: Greenhouse Gases
GreenGaDe: Greenhouse Gas Determination
ICRAF: International Centre for Research in Agroforestry
ICRISAT: International Crops Research Institute for Semi-Arid Tropics
INERA: Institute for the Environment and Agricultural Research
IUCN: International Union for Conservation of Nature
NAP: National Adaptation Plan
NGO: Non-Governmental Organization
NG0s: Non-Governmental Organizations
SLM: Sustainable Land Management
SPSS: Statistical Package for the Social Sciences
SRD: Soil Restoration Defenses
SWC: Soil and Water Conservation
SWC/SRD: Soil and Water Conservation/Soil Restoration Defenses
UNCCD: United Nation Convention to Combat Desertification
WASCAL: West African Science Service Centre on Climate Change and Adapted Land use

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Conflicts of Interest

The authors declare no conflicts of interest.

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1 Comments from a focus group participant at Soglozi in the commune of Dapélogo

2 Comments from a focus group participant in Nagréongo-koudgo in the commune of Nagréongo

3 Comments from a focus group participant in Tanlili in the commune of Zitenga

4 Comments from a focus group participant in Koanssanga in the commune of Ziniaré

5 Comments from a focus group participant in Gademtenga in the commune of Dapélogo