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ADAPTATION STRATEGIES TO COPE WITH THE EFFECTS OF CLIMATE VARIABILITY IN THE CENTRAL PLATEAU REGION OF BURKINA FASO

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ABSTRACT

Climate variability presents major challenges across Africa, particularly in Burkina Faso. This article analyses the adaptation strategies implemented by local populations and development actors to cope with this phenomenon in the Central Plateau region. Conducted in October 2023 in three villages in the region, the research combines field observations, semi-structured interviews and documentary research. The results reveal a range of coping strategies adopted by local people. In agriculture, these include the use of short-cycle varieties, the planting of trees to counter the high heat, and soil conservation techniques to combat drought. Livestock farmers have also developed strategies such as transhumance and the construction of shelters adapted to the climate. In market gardening, the use of compost and innovative irrigation techniques is widespread. Development players, particularly technical services and NGOs, are supporting these initiatives by promoting sustainable agricultural practices and encouraging the construction of resilient infrastructure. This article thus highlights the importance of local adaptation to climate change and the crucial role of development players in strengthening community resilience to climate variability.

Keywords: Climate variability, adaptation strategies, Central Plateau region, Burkina Faso.

INTRODUCTION

Climate variability, characterised by short- and long-term fluctuations in weather and climate conditions, represents a major challenge for contemporary societies. The effects of this variability manifest themselves in a series of impacts on natural and human systems, including an increase in the frequency and intensity of extreme events such as heat waves, floods and droughts. These events disrupt ecosystems, agriculture, the economy and public health, requiring robust adaptation strategies to mitigate their effects and promote resilience. In this context, strategies for adapting to climate variability are measures taken to anticipate and reduce the negative impacts of this phenomenon while taking advantage of the opportunities they may offer.

Climate variability poses significant challenges throughout the world, and particularly in Africa. Because of its economic dependence on agriculture, its vulnerable infrastructure and the diversity of its ecosystems, the African continent is particularly sensitive to the effects of this variability. Therefore, adaptation strategies are crucial for mitigating the negative impacts and strengthening the resilience of African populations. In-

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deed, agriculture is the sector most affected by climate variability in Africa, with direct impacts on food security (Mbow et al., 2019). Regarding adaptation in urban areas, these areas in Africa face unique challenges due to their rapid growth and often inadequate infrastructure (Taylor and Ziervogel, 2017, Simon and Parnell, 2019). In this context, effective governance and appropriate public policies are essential for the successful implementation of adaptation strategies (Tindyebwa and Mulwal., 2021). Furthermore, Mungai and Gachene (2017) highlight that innovative technologies offer new opportunities to improve climate resilience in Africa. In addition, Chanza and Nhapi (2016) show that adaptation strategies must also include social and community dimensions to be fully effective on the continent. Similarly, Nyasimi and Amwata (2019) highlight the role of women in adaptation efforts. Women play a crucial role in natural resource management and food security, and their involvement in decision-making processes can lead to more sustainable and equitable solutions in Africa.

In Burkina Faso, the consequences of climate variability threaten to slow down socio-economic progress, wipe out years of development efforts and jeopardise livelihood support systems, particularly at the local level (Zoma and Tarama, 2022). Given this reality, the need to adapt to the effects of this recurring phenomenon has become apparent for Burkina Faso as a whole, and in particular for its territorial entities such as regions and communes (Zoma and Tarama, 2021). This study therefore examines the adaptation strategies of local populations and development stakeholders in response to climate variability in the Central Plateau region of Burkina Faso.

RESEARCH METHODOLOGY

The study was carried out in October 2023 in the Central Plateau region of Burkina Faso in West Africa (Figure 1), specifically in three villages: Kouila and Monebtenga in the municipality of Ziniaré and Goundry in the municipality of Loumbila.

The climate in this region is mainly Sudano-Sahelian, characterised by a long dry season from October to May, followed by a rainy season from June to September.

In view of the research theme of climate variability, these villages were chosen because they are mainly inhabited by farmers in Kouila, livestock breeders in Monebtenga and market gardeners in Goundry. Primary data collection in these three villages involved field observations, using a camera for documentation, as well as semi-structured interviews guided by interview questionnaires. A total of thirty-five (35) people were interviewed, including fifteen (15) in Goundry, nine (09) in Kouila and eleven (11) in Monebtenga. The selection of participants was based on a reasoned selection to ensure that the interviewees could provide relevant accounts of their perceptions of the adverse effects of climate variability on key activities in the region.

Interviews were conducted with local development stakeholders, in particular representatives of decentralised state structures such as the Ministry of Agriculture, Animal Resources and Fisheries, the Ministry of the Environment, Water and Sanitation, and the NGO APIL, which supports rural communities in Burkina Faso. Interview questionnaires were also distributed to households engaged in agriculture, livestock breeding and/or market gardening, with the aim of gathering their perceptions of climate variability and its impacts in the Central Plateau region. The purpose of these interviews was to explore the adaptation strategies implemented by local populations in the farming, livestock-raising and market-gardening sectors in response to climate fluctuations. Additionally, the interviews aimed to identify the adaptation mechanisms adopted by other development players in the region.

The data from the interviews were transcribed and supplemented by documentary research, in order to gain a better understanding of the perceptions and impacts of climate variability in these three villages in the Central Plateau region of Burkina Faso.

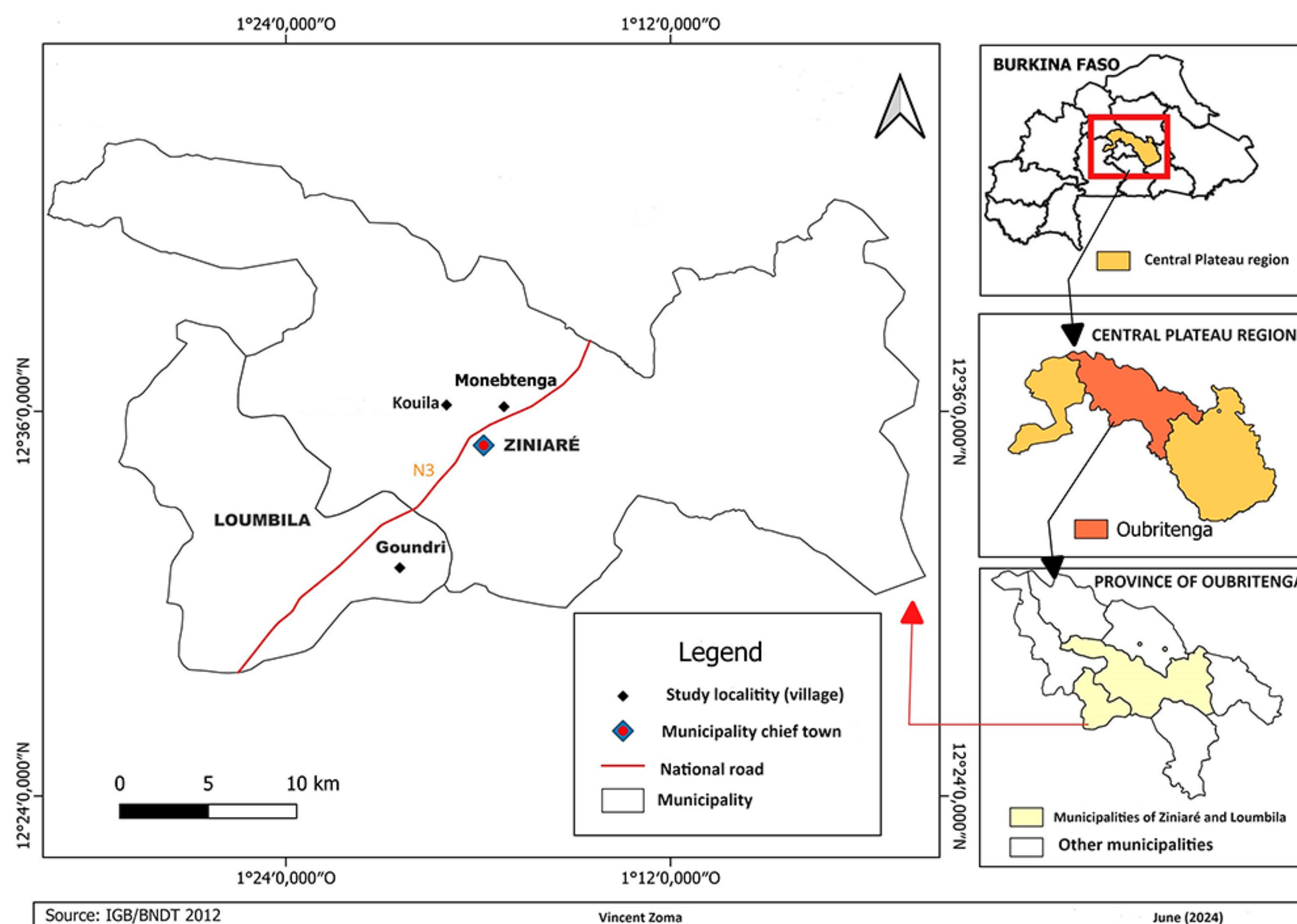


Figure 1. Location of the study area in the Central Plateau region

RESULTS

Adaptation strategies emanate on the one hand from local populations and, on the other, are mainly the result of contributions from development actors in the region, intending to benefit the communities.

Local Communities' Adaptation Strategies

Communities of farmers, herders and market gardeners have developed various strategies to counter the adverse effects of climate variability in the Central Plateau region of Burkina Faso.

In agriculture, farmers have adopted a number of farming practices to cope with climate hazards. Interviews with farmers show that they have abandoned certain crops that have proved incapable of withstanding climatic variations. Similarly, long-cycle varieties have been replaced by short-cycle varieties due to recurrent droughts, reduced rainfall and the impoverishment of fertile soils. For example, a group of farmers in Kouila report that they have *'abandoned crops such as the old maize, nebié (beans), white sorghum and red sorghum, which require 80, 70 and 90 days respectively for their growth cycles'*. This transition is motivated by the delay in the onset of the rains and their early cessation, encouraging the adoption of varieties with shorter growing times, often improved varieties. In this context, the use of these varieties remains a preferred option for farmers to compensate for the late start to the rainy season. In addition, some communities have planted trees to cope with the hot weather, although this practice is still not widespread.

In addition, according to the technical services in charge of agriculture and livestock in the region, as well as the households interviewed in the three villages, water and soil conservation techniques, such as the use of manure and compost, are widespread in the region. These techniques are aimed at coping with periods of drought, fluctuations in rainfall, flooding of fields and the late start and early end of the rainy seasons. Livestock farming is also increasingly integrated into agriculture, notably through the use of compost (Figure 2).



Figure 2. A compost heap

Source: Gouvernorat du Plateau Central (2023)

Figure 2 shows a pile of compost made from grass and animal waste. The organic manure is obtained by fermentation after watering. Animal droppings and household waste are used to produce this organic manure.

In the livestock sector, farmers are forced to adopt new approaches in the face of climatic hazards. According to interviews conducted with livestock farmers in the three villages, their resilience strategies vary according to their means of subsistence. For example, these farmers retain crop residues after harvesting to feed their livestock (Figure 3).

The maize residues, collected in piles and illustrated in Figure 3, are placed on a tree to provide food for the animals during the dry season.

In this region, transhumance is also emerging as a strategy for adapting to the effects of climatic variability. This practice involves the seasonal movement of herds to reach areas where they can feed or bring the same herd back to its original location when environmental conditions are favourable for livestock rearing.

Farmers in the region turn to veterinary services for expert advice on reducing animal morbidity. They also use available resources to build shelters to protect their animals from damage caused by heavy rain, particularly when raising pigeons (Figure 4).



Figure 3. Conservation of maize crop residues in Monebtenga

Source: Author (2023)



Figure 4. Pigeon shelters on a tree in Monebtenga

Source: author (2023)

These shelters, made from cans, offer domestic pigeons shelter from heavy rain. As shown in Figure 4, these cans have to be carefully positioned to prevent them from falling due to the wind and heavy rain.

In addition, in the field of market gardening, local people are implementing strategies to continue their activities despite the challenges posed by climate variability. They are using compost as a technique for soil and water conservation. Faced with water shortages, some people are using machines to draw water from the Loumbila dam. In addition, to mitigate the damage caused by strong winds that can break or uproot plants, they sow other large crops, such as maize or millet, among vegetable plants such as tomatoes (*Solanum lycopersicum* L.), aubergines (*Solanum melongena* L.) and spinach (*Spinacia oleracea*), as shown in Figure 5.

Figure 5 shows an aubergine crop grown alongside maize. The maize plants are not yet as developed as the aubergine plants. By diversifying into market gardening, this approach not only protects crops but also enables local people to increase their food production.

Overall, faced with the effects of climate variability, local communities in the region are implementing a number of resilience strategies. These include the use of adapted varieties, the application of soil and water conservation techniques (CES/DRS) and the planting of trees in the agricultural sector. They also include the use of crop residues, the construction of adapted shelters, the practice of transhumance and the use of veterinary services in livestock farming, as well as the adoption of CES/DRS techniques, crop diversification and the use of water supply machinery in market gardening.



Figure 5. Aubergine cultivation mixed with maize at Goundry

Source: author (2023)

In addition to these strategies put in place by the local populations, the decentralised services of the State (in particular the technical services) and non-governmental organisations such as the NGO APIL, which operates in the rural sector, provide support to help these communities address the challenges posed by climate variability.

Development Actors' Adaptation Strategies

In the agricultural sector, faced with pockets of drought, flooding, heavy rainfall, irregular rainfall and the late start and early end to the season that characterise climate variability, and to complement the strategies adopted by local populations, the agricultural technical services and the NGO APIL provide support to communities by introducing them to other methods of adaptation. These technical services explain various strategies to local people, including the use of adapted varieties, the practice of off-season cultivation, the deployment of drip irrigation systems, in-line sowing techniques, the introduction of micro-irrigation, the construction of small drainage channels, reseeding, sowing in bunches, etc., which they explain in detail.

Furthermore, in the region, strategies such as natural compost, zaï, half-moon, stone cordons and 300m³ boulis are introduced to the local population by NGOs such as APIL. Natural compost is a process for producing organic matter that involves digging a hole, up to 2 to 4 metres deep, in which harvest residues (millet, sorghum or maize stalks) are buried and mixed with manure (cow dung, pig or donkey droppings). This mixture is periodically watered to speed up the decomposition of the residues. Compost improves the soil's water-holding capacity, helping to alleviate water stress in crops, which is particularly exacerbated by climate variability. It also helps to increase yields and reduce food insecurity caused by climatic fluctuations.

In addition to compost, the zaï technique is an adaptation strategy in the agricultural sector, promoted by the NGO APIL in the region (Figure 6).

The zaï method, shown in Figure 6, is a means of preventing soil degradation. It is a traditional system for restoring the fertility of compacted arid land, involving the creation of pits to concentrate run-off water and organic matter. In this way, zaï represents an approach to recovering altered land and a response to climate variability by mitigating the effects of drought on soil productivity.

The half-moon method, illustrated in the figure, involves clearing the earth to form basins a few metres high, creating mounds in the shape of half-moons.

The half-moon method is used to collect water and sediment for the benefit of crops, identify sources of fertilising organic matter and water, and preserve and optimise these resources.



Figure 6. Zaï technique

Source: Gouvernorat du Plateau central (2023)



Figure 7. Half-moon technique

Source: Gouvernorat du Plateau central (2023)



Figure 8. Stone cordon technique

Source: Gouvernorat du Plateau central (2023)

On the other hand, the stone cordon technique (Figure 8) is mainly used to reduce the damage caused to the soil by rainwater.

The stone cordon technique consists of creating a linear structure made up of a stack of stones. It enables plants to withstand pockets of drought caused by climatic variability and prevents water erosion of the soil.

The boulis technique (water retention in Mooré) in Figure 9 is a technique used to collect run-off water.

In the field of agriculture, in response to pockets of drought, flooding, heavy rainfall, irregular rainfall and the late start and early end to the seasons that are characteristic of climate variability, local people are advised and supported by the technical agricultural services and the NGO APIL in adopting various adaptation strategies. These strategies include the use of adapted crop varieties, off-season cultivation, the development of drip irrigation systems, sowing in rows, the creation of small gullies, reseeding, and sowing in bunches, among others. These methods are explained to the local people by these services.

In the same vein, the NGO APIL explains to local people practices such as the use of natural compost, the zaï method, half-moons, stone cordons and 300 m³ boulis. Natural compost, for example, consists of producing organic matter from the decomposition of crop residues and manure, helping to retain water and increase agricultural yields, thereby contributing to food security in the face of climate variability.

The zaï method, illustrated in Figure 6, aims to limit soil degradation by concentrating run-off water and organic matter in holes. Similarly, the half-moon technique, illustrated in Figure 7, captures water and sediment for crops, while preserving fertilising organic matter and water resources.



Figure 9. Bouli technique

Source: Gouvernorat du Plateau central (2023)

On the other hand, the stone cordon method, shown in Figure 8, is mainly used to mitigate the damage to the soil caused by rainwater.

Another strategy put forward, as shown in Figure 9, consists of digging ponds to increase their water storage capacity, thus facilitating the irrigation of market garden crops around these basins.

The interviews revealed that in the livestock sector, advice from regional technical services agents encourages the use of agro-industrial by-products as essential supplements to livestock feed, as well as the conservation of fodder for periods of need. Livestock farmers are also encouraged to build suitable shelters for their livestock and to set up effective drainage systems to prevent damage caused by heavy rains.

Also, according to the interviews, with regard to water resources, the technical services recommend the use of groundwater (wells) as a solution for adapting to climatic hazards. In addition, reforestation of riverbanks is encouraged to protect dams and prevent pockets of drought.

In addition, in the environmental field, the regional technical services promote the application of good agro-ecological practices and sustainable resource management. These practices include the planting of adapted species, the use of rubble stones to limit erosion, and the assisted natural regeneration approach to stimulate the growth of woody species.

Moreover, in the housing and infrastructure sector, the technical services recommend using local building materials to reduce temperature differences and improve the thermal comfort of homes, thereby helping to reduce energy requirements and the risks associated with power cuts. Projects such as the ‘Village Opéra’ in Ziniaré illustrate these initiatives (Figure 10).

The commune of Ziniaré, located in the Central Plateau region, is home to the housing estate shown in Figure 10. This urban complex is characterised by buildings surrounded by stone and granite, comprising



Figure 10. Village Opéra in Ziniaré built with adapted local materials

Source: Diallo (2023)

around twenty bioclimatic buildings. These structures are designed to withstand the heat, so that when it is hot inside, the temperature remains pleasant without the need for excessive ventilation.

In this region, various regional development players are supporting the adoption of numerous strategies to cope with the effects of climate variability. In agriculture, these strategies include the use of water and soil conservation techniques (CES/DRS), adapted crop varieties, out-of-season crops, drip irrigation systems, in-line sowing techniques, and the construction of drainage infrastructure such as small gullies and drainage channels. In the livestock sector, strategies include the use of agro-industrial by-products, rational fodder management, the construction of suitable enclosures and shelters for livestock, animal health monitoring, as well as the promotion of fodder production and the construction of pastoral boreholes.

With regard to water resources, based on direct observations in the field, the regional councils are focusing on the use of groundwater, reforestation of riverbanks, the adoption of good integrated water management practices, the setting up of water management committees, the construction of drinking water supply infrastructures, as well as the cleaning of gutters and the opening of sluice gates for water drainage. In terms of the environment, efforts are focused on the application of good agro-ecological practices, the creation of run-off water collection basins, reforestation, limiting erosion through the use of rubble, reforestation and assisted natural regeneration.

In the field of housing and infrastructure, regional recommendations focus on the use of cover slabs for gutters, construction in non-flood-prone areas, the use of heat-resistant materials for infrastructure, and the provision of drainage and flood protection infrastructure.

All these strategies are encouraged and supported by the decentralised structures of the State and the non-governmental organisations operating in the region.

DISCUSSION

The adaptation strategies deployed by local populations and development stakeholders in the Central Plateau region of Burkina Faso in the face of climate variability are varied and meet the specific needs of the agricultural, livestock and market gardening sectors. This diversity of strategies illustrates not only the ingenuity and resilience of local populations, but also the importance of external intervention to reinforce these efforts.

In agriculture, farmers have adopted a number of practices to cope with climatic hazards. Replacing long-cycle varieties with short-cycle varieties is a direct response to the variability of rainy seasons. As Béné and al. (2014) point out, adapting crop cycles is crucial in regions where climatic conditions are uncertain and increasingly unpredictable. In addition, water and soil conservation practices, such as the use of manure and compost, are commonly used to improve soil fertility and water retention, enabling crops to better withstand droughts and heavy rainfall. Efforts to integrate agriculture and livestock farming, such as the use of compost, demonstrate an integrated approach to natural resource management. Farmers in the Central Plateau region thus illustrate the importance of agroecological solutions, which, according to Pretty et al. (2018), can improve the resilience of farming systems to climate change while increasing their productivity. Agro-ecological practices, such as reforestation and assisted natural regeneration, are encouraged to preserve biodiversity and combat soil erosion (Ouédraogo et al., 2018).

Breeders are also adopting strategies such as conserving crop residues to feed livestock during the dry season and practising transhumance to find new pastures (Yameogo et al., 2018). The construction of animal shelters, particularly for pigeons, is a measure taken to protect livestock from heavy rain and strong winds.

In market gardening, the use of compost and crop diversification to mitigate the impact of strong winds illustrates the adaptability of market gardeners. Growing taller plants to protect more vulnerable plants, such as tomatoes and aubergines, is a clever technique that demonstrates a deep understanding of the interactions between different crops and climatic conditions. These local practices align with the recommendations of the Food and Agriculture Organization of the United Nations (FAO, 2019) for sustainable agriculture that is resilient to climate shocks.

Development stakeholders, in particular government technical services and NGOs such as APIL, play a vital role in promoting advanced adaptation strategies. Support for techniques such as *zaï*, half-moon and stone cordons demonstrates the integration of improved traditional practices and innovations to meet current climate challenges. These techniques have proven effective in improving soil productivity and managing water resources, as highlighted by Kaboré and Reij (2004) in their work on the rehabilitation of degraded land in West Africa. In addition to agricultural techniques, initiatives such as fodder production and the organisation of competitions for the best fodder producers show a proactive approach to encouraging sustainable practices. These efforts not only support the resilience of farming systems, but also contribute to the food security of rural communities (Lal, 2016).

In addition, integrated water resource management, including riverbank reforestation and groundwater use, is crucial for the sustainability of local systems in the face of climate variation. Sustainable land management practices, such as assisted natural regeneration and the establishment of local water committees, demonstrate a systems approach to natural resource management (Rockström et al., 2010). Efforts to improve the thermal comfort of homes using locally adapted materials also demonstrate a holistic approach to climate adaptation, integrating socio-economic and cultural aspects for greater resilience (Satterthwaite and al., 2020). The use of local materials adapted to heat, such as compressed earth bricks, helps to improve the thermal comfort of buildings while reducing energy requirements (Zongo et al., 2022).

The strategies for adapting to climate variability in the Central Plateau region of Burkina Faso illustrate a combination of traditional knowledge and modern innovations supported by local and external stakeholders.

CONCLUSION

In the Central Plateau region of Burkina Faso, climate variability is putting considerable pressure on the livelihoods of local people, particularly in the farming, livestock breeding and market gardening sectors.

Faced with these challenges, local communities have developed a series of resilient adaptation strategies. In agriculture, farmers have adjusted their practices by abandoning less resistant crops and adopting short-cycle varieties that are better adapted to changing climatic conditions. They have also implemented soil and water conservation techniques such as composting and building small water reservoirs to cope with droughts and floods. The integration of livestock farming with agriculture through practices such as composting demonstrates their holistic approach to agricultural resilience. Livestock farmers have also developed intelligent strategies, notably by conserving crop residues for cattle feed during the dry season. Seasonal transhumance is another common practice, enabling herds to find suitable pastures depending on weather conditions. Farmers also benefit from the advice and health monitoring provided by the local veterinary services to keep their livestock healthy in the face of climatic challenges. In market gardening, local people use soil and water conservation techniques similar to those used in agriculture, while diversifying their crops to mitigate the risks associated with climate variability. The use of machinery to supply water and the combination of fast-growing crops with more wind-resistant ones illustrate their adaptability and creativity.

In addition to the strategies developed by local populations, development stakeholders such as technical agricultural services and NGOs play a crucial role in providing additional support and advice. Innovative techniques such as *zaï*, half-moon and stone cordons are being promoted to improve agricultural resilience, while initiatives such as the construction of water towers and integrated water resource management aim to strengthen water security in the region.

Overall, these adaptation strategies demonstrate the resilience and determination of local communities to face the challenges of climate variability. By combining traditional knowledge with innovative practices promoted by development players, the Central Plateau region is showing the way towards effective and sustainable adaptation to climate change. However, to ensure their long-term success, it is essential that these efforts are supported by appropriate policies and investments at all levels, from local to national.

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