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The Renovation of Farming Systems to Reduce the Pressures of Climate-Related Damage

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Abstract

The analysis in this article is based on the observation that several measures are being implemented to reduce the pressure exerted by climate-related damage on family agriculture. These measures include the incorporation of leguminous plants such as *Mucuna sp*, *Cajanus cajan* and *Gyricidia sepum* into farms. This article studies the mechanisms and processes that facilitate the emergence of new agricultural production systems based on agro-ecology. To achieve this, semi-structured interviews were conducted among thirty-two family farmers in three villages of the commune of Agbangnizoun in central Benin. The interview guide used focused on three points: a description of experience in using leguminous plants, how new production systems based on agroecology have been set up, and future prospects. The interviews were supplemented by participant observations carried out on ten farms, the drawing up of plot plans, and analysis of forty-two documents. The results show that the mechanisms challenged on farms are not only adaptive, as several previous studies have emphasized. Other mechanisms, namely substitution and correction, help us understand the changes at work, thus extending the repertoire of categories of farm resilience measures to climate events. Findings show that these mechanisms, supported by local beliefs and knowledge, allow farmers to regenerate soil fertility and maintain production despite climatic pressures. The analysis highlights the importance of incorporating these mechanisms into policy development to mitigate the impacts of damage caused by climate change in Benin, and other parts of the world.

Keywords

Farming Systems, Renovation, Local Knowledge, Agro-Ecology, Benin

1. Introduction

Climate change remains a significant challenge for small-scale family agriculture, agricultural development policies and global food systems [1]-[3]. Resource-poor farmers, decision makers, and Technical and Financial Partners (PTF) all express concerns about the negative effects of delayed onset and shortening of the rainy season, crops drying on ridges due to pockets of drought, extreme heat, and the destruction of fields and granaries by strong winds and flooding. These events reduce crop yields, impact revenue, question the security of family farming, and *ultimately* hinder rural populations' ability to adapt and well-being [4] [5]. Several studies have shown disruptions caused by pressures on the allocation of productive resources including land, labor and capital [6]-[8]. These studies have indicated total yield losses of up to half the harvest, leading to economic speculation in markets for main food crops in sub-Saharan Africa in general and Benin in particular.

To address food sustainability, various agroecological initiatives designed by government organizations and supported by PTF are being implemented in Benin [9]-[11]. Similar initiatives are also being promoted in other African countries [12] [13], Europe [14]-[16] and America [17]-[19]. At the core of agro-ecological initiatives in Benin are four leguminous plants: *Mucuna utilis var. pruriens*, *Cajanus cajan*, *Acacia auriculiformis* and *Gliricidia sepium*. These are grown alone, in combination and in rotation with food crops particularly maize (*Zea mays L.*) and cassava (*Manihot esculenta* Crantz). The initiatives contrast with *productivist* models by promoting the use of organic matter and bio-fertilizers, as well as the valorization of local knowledge and capacities [20] [21]. Many see these initiatives as a challenge to conventional agriculture, which, they believe relies on expensive agricultural inputs such as chemical fertilizers, pesticides, herbicides and seeds, requiring more financial resources from farmers' budgets [22] [23].

In the past, agroecology based on leguminous plants was introduced in Benin in the 1980s and 1990s by extension services. It was later refined by Research and Development (R&D), and integrated into agricultural production systems [24] [25]. Initially conflicting with local values and norms governing family agriculture such as non-consumable *Mucuna* seeds and competition with food crops, these leguminous plants have become appealing due to the severity of damage caused by climatic hazards. Observations indicate that integrating leguminous plants into farms has resulted in new cropping systems that, in social representations, alleviate the pressures of climate events.

This article does not aim to assess the dissemination potential of emerging agricultural production systems and their positive effects on food crop yields and agro-food regimes as these evaluations are well documented elsewhere [11] [26] [27]. Based on surveys conducted in Benin, where small-scale family agriculture still prevails, this article provides insights into the integration of leguminous plants in farming systems. Particular emphasis is placed on changes made to cropping systems including crop rotations and combinations, which are key to improving land yields, and adapting knowledge to the new conditions imposed by the adverse effects of climatic hazards. Given the pressure of damage caused by climate change on farming systems, the integration of leguminous plants into farms is seen as a way to renovate agricultural systems.

The term renovation is used in literature to describe ecosystems that are improved to enhance the living conditions and environment of residents. It refers to a series of operations designed to treat damaged parts, utilizing new knowledge to bring about significant changes. Renovation includes two processes: restoration, which involves complete reconstruction of a degraded or destroyed ecosystem [28]-[30]; and rehabilitation, which consists of actions and modifications that allow parts of an ecosystem altered by disturbance to be refurbished [31]-[33]. In this perspective, renovation is chosen over the more standard "climate change adaptation" and its established frameworks to highlight proactive, comprehensive transformation of agricultural production systems for resilience. This goes beyond minor adjustments to involve a critical redesign, utilizing nature in managing inevitable changes. The focus shifts from restoring a previous state to creating a new, sustainable future in altered conditions. Renovation entails holistic improvements in farming system effectiveness and efficiency to reduce pressures on productive resources. It is a tangible, action-oriented concept that encompasses more than just "adapting" to threats [34] [35].

Integrating leguminous plants into farms represents a transformation of agricultural production systems. Resource-poor farmers are incorporating new knowledge as well as reorganizing productive resources in order to mitigate the impacts of climate events. This renovation involves adjustments to farming practices such as changes to agricultural calendars, crop combinations and rotations that optimize the use of leguminous plants. Technical packages, which include farming operations and techniques implemented in a specific manner, are also modified. This shift offers opportunity to compare the new agroecology-based agricultural production systems with traditional slash-and-burn shifting agriculture. The effectiveness of leguminous plants on farms underscores the importance of identifying key attributes and decision-making that should be prioritized and structured accordingly.

Renovation is a concept that has enabled us to examine agricultural production systems based on agroecology from multiple perspectives. These perspectives include the productive resources mobilized by farmers, the research findings incorporated into decision-making and the constraints imposed by local institutions. Renovation also allows us to track who is renovating and what is being renovated. This article highlights the diversity of mechanisms that have facilitated the emergence of new crop systems based on agro-ecology. These mechanisms are viewed as intentions in soil regeneration following key motivational dimensions addressed by [36] and [37]. Therefore, the integration of leguminous plants into farming systems is considered planned behavior in response to constraints such as climate change-related pressures. On farms, choosing between various agroecological practices, taking into account opportunity costs, shared beliefs and alignment with local institutions are all forms of intentions in soil regeneration.

These elements anticipate decision making and the level of commitment of resource-poor farmers in promoting agro-ecology-based agricultural systems.

The first part of the article outlines the methodological approach used, providing a brief description of the natural conditions of the surveyed farms. It also discusses the methods and tools used for data collection and analysis. The results are then presented and discussed, leading to the presentation of the conclusions.

2. Methodological Approach

2.1. Research Design and Study Area

The research was conducted in the municipality of Agbangnizoun in the Zou department of Benin (Figure 1). Agbangnizoun is one of the three municipalities involved in diagnostic studies aimed at identifying the impacts of climate events on the family farming. It is representative of the three agro-ecological zones in South and Central Benin. The climate is sub-equatorial, with two rainy seasons (March to July and September to November) and two dry seasons. Annual rainfall is bimodal ranging from 1200 to 1900 mm. Family farming is significant, accounting for over 34.30% of the working population [38]. Agbangnizoun has 16763 family farms distributed across three agro-ecological units [39] [40]. The research involved farms in three villages located in three agro-ecological units identified in collaboration with the Agency for Agricultural Development (ATDA-7) based on the dominant production systems.

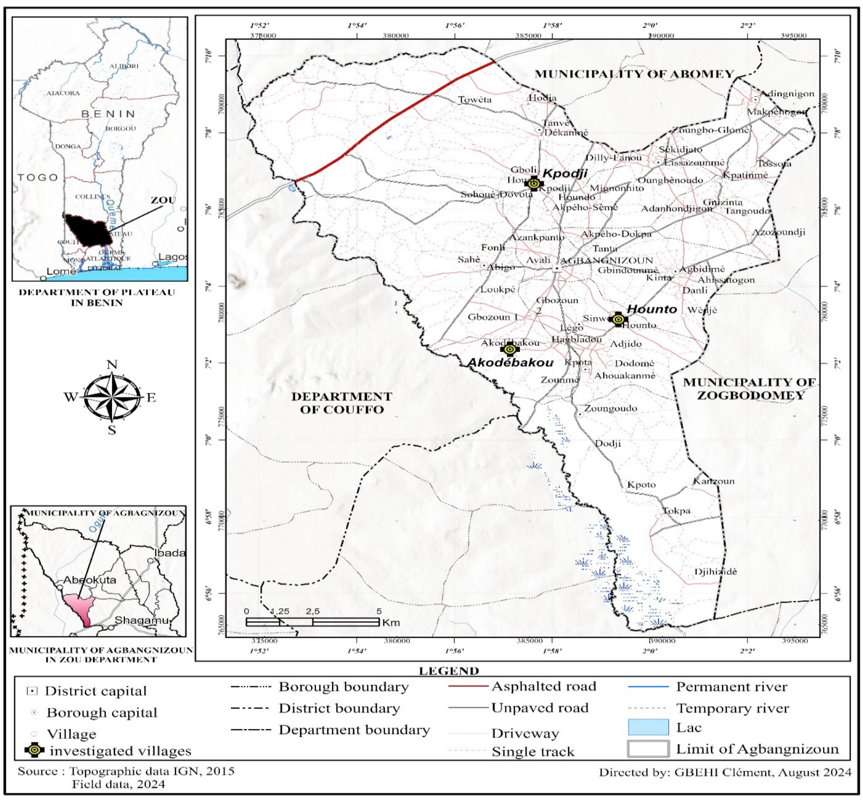

Figure 1. Location of Agbangnizoun and investigated villages.

- *Akodébakou* is located in lowland, area dominated by silty-clay soils along the slopes of the Couffo River. The cultivated plots have a high water retention capacity and are often flooded during the rainy season. However, they benefit from the plant and animal detritus drained by run-off water. The dominant crops include maize and cassava.
- *Hounto* is situated on moderately sloping land that becomes silty-clayey as you approach the *Siwé-houn* River. The cultivated plots are less fertile than those in the village of *Akodébakou*. They suffer from the adverse effects of delayed rainfall and pockets of drought. The main crops grown are maize, cowpeas and groundnuts.
- *Kpodji* is positioned on the plateau, less than 5 km from Abomey town centre, with a relatively flat topography. The farms, which are confined to degraded land, are subject to constraints associated with the vagaries of rainfall. The vegetation is dominated by palm groves and citrus orchards (mango and orange trees). Degraded soils are highly infested by parasitic weeds (*Striga hermonthica* and *Striga gesnerioides*). Between the plantations, there are plots of maize, cowpeas, cassava and groundnuts.

These villages were chosen because resource-poor farmers were facing similar opportunities and constraints, and because the arms are relatively close to the economic centers of Abomey and Bohicon. Family farming remains the primary activity for farmers, often combined with small-scale animal farming (sheep, goats and poultry) and agri-food processing (palm oil, *gari*, mustard). These products are mainly sold in the markets of Abomey and Bohicon. However, farms are often threatened by the adverse effects of climate events, which hinder farming activities. As a result, shifting cultivation, which was practiced in the past, is no longer used today. Instead, leguminous plants are being increasingly grown on farms to mitigate the damage caused by climate change.

2.2. Data Collection and Analysis Methods

The data collected and analyzed in this article were developed through three methods. The first method involved documentary analysis. The reading grid used made it possible to collect data on the geographical and agro-ecological units of the municipality of Agbangnizoun and the identified villages, past and present cropping systems, damage linked to climatic hazards and initiatives promoted by resource-poor farmers. The corpus analyzed included twenty-two scientific articles and ten diagnostic and evaluation reports obtained from project documentation center of Non-Governmental Organizations (NGOs) that disseminated new knowledge related to agroecological systems.

The second method involved conducting semi-structured interviews with three officers from local NGOs, two farmers' organizations, two agricultural extension agencies (ATDA-7), and thirty-two resource-poor farmers. To gain a better understanding of the mechanisms that facilitated the emergence of cropping systems based on agroecology, we utilized the approach for analyzing farms in relation to changes in production structure, developed by [41]. The interview guide consisted of three main points: the description of experiences in promoting new agro-ecological systems, changes compared to conventional agriculture (productive resources mobilized, cropping systems and production methods, and transformation of the production structure) and future prospects.

The sampling strategy also involved the use of the repertory grid approach [42]-[44]. In this process, respondents initially identify ten resource-poor farmers who advocate changes in agricultural production systems based on agroecology. They were then grouped in threes and compared two by two. This approach not only helped in selecting the sample but also gathered insights into the shared meanings that resource-poor farmers associate to the promotion of agroecology. Respondents highlighted the importance of access to productive resources, opportunity costs and social representations, drawing comparisons to shifting cultivation. Similar discussions are conducted with resource-poor farmers who are available and willing to be interviewed. The interviews were recorded in separate reports to facilitate statistical analysis. A total of ninety-two resource-poor farmers were listed, out of which thirty-two were interviewed (refer to **Table 1**). This sample is determined according to the principle of saturation, which highlights that data collection is ended once the interviews no longer provide any additional relevant information [45] [46].

Table 1. Statistics of investigations.

Villages	Number of resource-poor farmers		Observation	Drawing up plot plans
	Listed	Interviewed		
Akodébakou	24	8	3	3
Hounto	36	11	4	4
Kpodji	32	13	3	3
Total	92	32	10	10

The third method involved participant observations and creating plot plans. A total of ten farms were visited using a grid that covered the cultivated fields and the treatments applied to mitigate the adverse effects of climate change. Ten plot plans were also developed with the help of resource-poor farmers. These plans provide information on the dispersion of cultivated plots, distances from habitats, estimated areas, and the number of fields of crops as well as those combined with leguminous plants and natural fallow.

The data collected was processed through qualitative content analysis of the explanations provided by key resource persons and the resource-poor farmers surveyed. The goal was to understand shifts in farming practices, major changes and differentiation mechanisms that have influenced the promotion of agro-ecological systems. In this case, we first consider the explanations derived from the repertory grid approach which suggest indicators to guide the integration of leguminous plants. The information is then reassessed in light of the source and method of implementation. Finally, the emerging themes are grouped to allow for the structuring of shared meanings. To achieve this, documentary analysis (scientific articles, diagnostic and evaluation reports, maps, photos and plot plans), semi-structured interviews and participant observations were re-examined and triangulated.

3. Research Findings

3.1. Changes Mentioned as Important in Farming Systems

Observations of the agrarian landscape in the surveyed villages indicated that farms are characterized by fields of maize, cowpeas, groundnuts and cassava. There are also patches of leguminous plants, specifically *Mucuna*, *Cajanus cajan* and *Glyricidia* promoted to cover the diversity of the farming systems. This is because farmers have different expectations and capacities when it comes to mobilizing resources. These leguminous plants are grown either alone or in combination with food crops, especially maize and cassava. The historical analysis of how farm plots are organized revealed two significant series of changes. The first series mentioned are qualified as structural adjustments to weather conditions and related to changes in agricultural calendars, technical itineraries (e.g. late sowing and sowing of early varieties, short-cycle and drought-tolerant varieties), cultivation operations and cropping systems, particularly combinations and rotations with leguminous plans.

In the village of Akodébakou, these changes are only implemented in cases of prolonged delay in the onset of the rains and severe pockets of drought, as most cultivated fields are prone to flooding. Resource-poor farmers in Kpodji and Hounton, however, are compelled to make these adjustments, with the exception for plots owned in *Dodji* and *Sahè*, two villages near the Couffo River. In the latter scenario, reported land tenure includes purchase (8%), borrowing (42%) and sharecropping (12%). The farmers involved are typically under 50 years of age, and often engage part-time in other economic activities, such as driving *zémi-djan* motorbike taxis, trading in manufactured goods and processing wine and oil palm fruits.

The second series of major changes involve the abandonment of shifting cultivation by resource-poor farmers. Statistics show that 84% of resource-poor farmers were cultivating leguminous plants which were increasingly visible in the agrarian landscape of the three villages. Resource-poor farmers reported that shifting cultivation based on moving plots of land with clearing fires is less common nowadays due to the scarcity of natural long-term fallow. The negative effects of clearing fires on soil fertility, such as the destruction of organic matter and micro-organisms, are cited as the main reason for this shift. All admitted that shifting cultivation is no longer economically justifiable today, as it is becoming ineffective in maintaining sustainable food crop production due to the damage caused by climate events.

These changes are evidence of behaviors aimed at reducing or mitigating the impact of climate-related damage. They also reflect Fishbein's theory of reasoned action, which highlights the importance of attitude. According to [47] and [48], attitude is shaped by beliefs, which are evaluations of reality based on knowledge and experience. Contrary to the insights provided by [47] and [48], resource-poor farmers assess the integration of new knowledge based on agroecology as "essential care" or "treatment" for their cultivated fields. They view this as a crucial factor in enhancing crop yields. The enthusiasm for new production systems involving leguminous plants considers the combined effects of the benefits and opportunity costs. However, this enthusiasm is often undermined by the destruction caused by transhumant herds that graze on fields with only leguminous plants or those associated with crops. As one resource-poor farmer in the village of Akodébakou explains, "leguminous plants are appealing to oxen and goats. These animals, driven by the *Fulani*, cause significant damage to the fields. The transhumant herds traverse the crop fields and attack the men and women who oppose the grazing of oxen in the crop fields and leguminous fallows."

Despite resentment towards transhumant herders, the farms visited have similar landscape features, with plots of crops and leguminous plants in rotation or combination. The number of plots planted with leguminous plants is statistically higher in the villages of Kpodji and Hounton. *Mucuna* and *Cajanus cajan* are grown regularly either alone or in combination with maize crops, while *Glyricidia* is cultivated as *intercrops* (*alley-cropping*) with maize and cassava. Akodébakou, on the other hand, has fewer fields planted with leguminous plants, mainly because the soil benefits from the organic matter and fertilizers drained by run-off.

3.2. Mechanisms for Renovating Agricultural Production Systems

The resource-poor farmers' explanations point to three mechanisms for renovating production systems: substitutive, adaptive and corrective. These were developed by 46%, 62% and 41% of the farmers surveyed respectively. However, the observation reveals that some farmers develop only one mechanism while others employ two or three simultaneously in the same year. Two leguminous plants are used for substitution: *Mucuna* and *Cajanus cajan*. According to the estimates declared when the plot plans were drawn up, 6.5 hectares of fields are involved, including 1.3 hectares cultivated with *Mucuna* fallow and 5.2 hectares sown with *Cajanus cajan*. Substitution differs from adaptive and corrective mechanisms in that it involves replacing the natural fallow with a cultivated fallow *of Mucuna* or *Cajanus cajan*. Many resource-poor farmers, however, mentioned that, in contrast to *Mucuna, Cajanus cajan* provides both substitutive and adaptive mechanisms. They explained that it provides organic matter to fertilize the soil and maintains moisture, allowing maize to adapt and improve its drought tolerance, thereby enhancing the farming system's resilience. Substitution is most prevalent in the villages of Hounto (64%) and Kpodji (54%) (**Figure 2**), where farms have to cope with pockets of drought and excessive heat every year. It is less prevalent in Akodébakou (12.5%) because of the hydromorphic nature of the soil and the relatively high fertility of the plots.

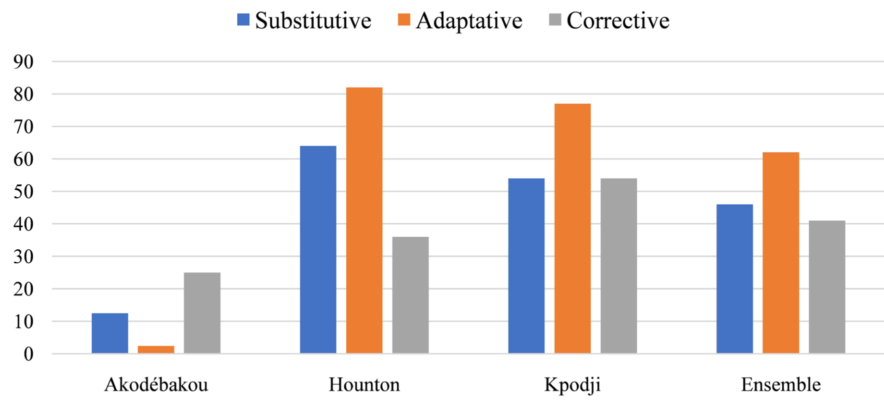

Figure 2. Importance of mechanisms for renovating the farming systems.

Substitution with *Cajanus cajan* is preferred by 87% of resource-poor farmers. This is primary due to two reason: the technical benefits it offers, such as soil coverage, erosion and weed reduction, and the addition of organic matter; as well as the financial advantages compared to *Mucuna*, since the harvested seeds can be sold for profit. Resource-poor farmers mentioned that both leguminous plants are grown from seeds planted in the ground. According to social beliefs, "a planted seed yields crops for consumption and/or sale". Unlike *Mucuna*, which is primary used for soil fertility restoration, moisture retention, and control of speargrass (*Imperata cylindrica*), *Cajanus cajan* has the added benefit of being integrated into the diets of people in southern and central Benin.

In the adaptive and corrective mechanisms, the components of the cropping systems remain unchanged. These two mechanisms are similar because they both involve planting maize or cassava in rows or alternating strips. Adaptation is achieved by planting *Cajanus cajan* (or *Mucuna*), while correction mainly involves *Glyricidia*. These mechanisms result in adjustments in agricultural production, partially due to the combination of productive resources allocated. For example, adaptation does not require any additional investment, unlike correction, which requires mobilizing family or paid labor to prune *Glyricidia* branches to reduce competition for light with crops. Additionally, the correction process requires careful decision about which plots to treat due to land constraints, as several fields are under sharecropping and borrowing arrangements. These two methods of accessing land provide little security, as no trees (*Glyricidia* or *Acacia*) can be planted, and the owner can withdraw the tenant's use at any time.

The adaptive mechanism is prevalent in the villages of Hounton and Kpodji, but is less prominent in Akodébakou. In Akodébakou, a half-hectare plot of maize was treated with *Cajanus cajan*. Resource-poor farmers justified this decision based on the location of the plot on the sloping part of the village, which is often affected by pockets of drought. Participant observations revealed two cropping patterns. The first, referred to as a "*closed combination*", involves planting maize and *Cajanus cajan* seeds in the same pocket. This type of association is deemed interesting by 63% of farmers because it helps conserve soil moisture for the plants, unlike pure stand maize cultivation. In the second system, known as "*open combination*", *Cajanus cajan* or *Mucuna* is alternated with maize on the same ridge.

According to many resource-poor farmers who have learned from agricultural advisers and researchers, *Cajanus cajan* is typically planted two to three weeks after maize sowing; while *Mucuna* is grown as a relay crop 30 to 35 days after sowing maize. They did, however, mention constraints related to the duration of droughts and the labor required for sowing leguminous seeds a few week later. This does not mean that resource-poor farmers are disregarding research recommendations. On the contrary, this open combination is economically beneficial as it reduces labor costs and leads to better yields. One farmer attested to this, stating: "The mulch of Mucuna suppresses the speargrass, reducing the need for weeding to just one time instead of two or three, while the treated plot yields between 15 and 18 bags of 50 kg of maize compared to the control plot, which yields less than 10 bags."

The corrective mechanism is primarily observed at Kpodji and Hounton. However, for this system to be effective, access to land is necessary, as *Glyricidia* strips tale up a significant portion of cultivated plots. This system is similar with the distinction that *Glyricidia* is grown in strips, typical of alley cropping. Unlike *Cajanus cajan* and *Mucuna*, which are planted every agricultural season on the treated plots, *Glyricidia* remains in place for at least three consecutive years. Resource-poor farmers have observe that the best maize yield is achieved with two lines of *Glyricidia* for every one line of maize. Allocating 2/3 of the available area to *Glyricidia* is considered unsustainable due to land constraints. This method is not only beneficial for improving soil fertility by renewing biomass, but also for producing firewood, poles for house frames and formwork for reinforced concrete slabs. In this regard, *Glyricidia* stands out from the other leguminous plants due to its versatility in meals preparation and as an additional income source to offset planting and maintenance cost for young plants.

4. Discussion

The results presented above demonstrate that food crop production is facing challenges due to the impact of climate change on the allocation of productive resources. However, resource-poor farmers have not yet reached the problematic situation anticipated by several authors [49]-[51]. Two important aspects of the responses provided and reported above are synthesized and discussed: the expansion of the range of categories of resilience measures and the mediations of mechanisms that have moderated the pressures of climate change-related harm.

4.1. Expanding the Range of Categories for Resilience Measures

The analysis revealed a shift in family farming towards the promotion of agroecological systems, which have altered agricultural production systems. This change, also observed in other countries [52] [53], indicates that resource-poor farmers are concerned about the consequences of climate change on their living conditions and income. Changes in cropping practices are currently being implemented [2] [54]-[56]. Some promising results have been achieved, including real time harvests and a reduction in the length of the hunger gap. However, resource-poor farmers view these changes as ineffective and "temporary" since they must be renewed annually.

Evidence shows that resource-poor farmers continue to experience reduced yields of the main food crops year after year due to difficulties in accessing chemical fertilizers. This situation justifies the incorporation of leguminous plants in the farming systems as a way to mitigate the damage caused by climate events. As previously mentioned, leguminous plants have been promoted as soil fertility management technologies. Several arguments are presented here, particularly the logic that changes are not systematically promoted, but first adapted to local institutions. These observations are consistent with those of [57] who concludes that "adaptive strategies are implemented gradually, with the reliability of a practice being tested, leading to a survival process that becomes a new technology progressing until the entire group adopts it."

Beyond strengthening measures to alleviate the damage caused by climate disruption, the analysis concludes that the introduction of leguminous is facilitated by the implementation of three mechanisms: substitution, adaptation and correction. This conclusion is significant for several reasons.

- Firstly, adding value to leguminous plants involves changing the combinations of productive resources to which farms are accustomed. [58] describes these changes as alterations in the structure of agricultural production through the addition of new knowledge. In this process, resource-poor farmers have capitalized on the knowledge produced in situ by evaluating the potential and limitations of leguminous plants during the R&D trials in which they have participated [59]-[61], or during the reliability experiments conducted on farms outside the scrutiny of researchers. This knowledge is considered 'contextualized' due to the experiences associated with its use [62]-[64].
- Secondly, the emerging mechanisms are not only adaptive, as several previous studies have emphasized. Other mechanisms, namely substitution and correction, help to understand the changes at work, thus broadening the repertoire of categories of resilience measures to climate changes. In other words, resilience is also substitutive and corrective. The three mechanisms implemented to anticipate, reduce or reverse the pressures of damage caused by climate change, cover the diversity of farms as observed by [65] who conclude the existence of a wide range of meanings of good farming reflected in diverging trajectories.
- Finally, substitution, adaptation and correction contrast with the processes initially advocated for promoting changes in farming practices. These changes are not restrictive responses, and do not require resource-poor farmers to behave in any particular way. On the other hand, translating the mechanisms requires the availability and better management of productive resources, particularly land and labor. This has led several resource-poor farmers to resort

to direct (purchase) and indirect (loan and sharecropping) tenure of land in agro-ecological units near the Couffo River, due to the water conservation capacity and fertility of the soil. Retrospective testimonies have revealed the necessity to ensure sufficient crop to meet the family's food requirements.

4.2. Mediation of Emerging Mechanisms

As the results show, many resource-poor farmers have shifted their farming practices. Agricultural production systems now involve plots cultivated with leguminous plants, in association or in rotation with food crops. The scientific literature refers to this change as "agroecological transition" [66]-[69]. In this article, this change is seen as a renovation of farming systems, with resource-poor farmers adopting alternatives that differ from conventional agriculture. This renovation involves using new knowledge to anticipate and fix damage caused by climatic hazards.

From an anthropological perspective, the analysis reveals that resource-poor farmers are amazed by their transition to agro-ecology, which has helped alleviate the pressures of climate change on the allocation of productive resources. This concept is captured well by the term "*lɛvɔ dɔ̀*", in the local language of Central and Southern Benin, meaning "reborn again". Therefore, agro-ecology can be seen as "the rebirth of resource-poor farmers in nature", similar to the *syntropic* agriculture discussed by [70]: "a system that enriches the soil, build diversity and energy over time, and shift nature from being perceived as an enemy to an ally". These local beliefs are reflected in the information provided by several interviewed farmers who explained how this knowledge, collectively constructed and shared, influenced decision-making and behavior. Substitution, adaptation, and correction fit within the logic of *lɛvɔ dɔ̀* which governs the promotion of farming systems based on agroecology. In essence, agro-ecology poses a significant challenge to conventional agriculture [22] [23] [71].

The explanations provided by resource-poor farmers support the findings of various studies that emphasize the importance of innovative intentions [72]-[75]. According to farmers, intentions to regenerate the soil were the driving force behind the attitude (*djidɔ̀*) that ultimately led to the adoption of planned behaviors, such as incorporating leguminous plants into their farming systems. An illustrative example is found in the retrospective account of one of the first resource-poor farmers who experimented with the *Mucuna* fallow. He remembers that "some of his colleagues disapproved and even blamed the owners of plots planted with Mucuna for snake bites. These colleagues believed that these fields attracted snakes in search of fresh air". Furthermore, the analysis highlighted the challenges posed by transhumance, as *Mucuna* and *Glyricidia* are attractive to Fulani herds of cattle, sheep and goats.

As [76] [77] and [78] have shown, behavioral beliefs form the basis of attitudes and represent the consequences of action. Therefore, as in the literature on reasoned action or the improved version subtitled the "theory of planned behavior", the analysis of reported data highlighted the contribution of social representations, including norms, beliefs and social values widely shared within communities. These emerged as determinants in the promotion of agro-ecological practices [10] [47] [79]-[82]. The results revealed the importance of beliefs associated with religious meals made from maize and cowpea, which are offered to the ancestors responsible for food production. Additionally, annual ceremonies of thanks to the divinities who are the protectors of well-being mark the rituals for bringing out the new yam in central Benin.

In both cases, agricultural production not only provides food for family members but also offers to the *Vodoun* during ritual meals. These explanations are reminiscent of the ideas put forth by [69]: "rites create a framework for food crop production where beneficial combinations can occur and be integrated as agricultural practices". The three mechanisms linked to food crop production are no different. These mechanisms represent varying levels of *ritualization* where organic matter replaces chemical fertilizers to enhance crop yields. Several studies have shown fields cultivated using agroecological practices yields similar results to those using chemical fertilisers but with better soil resilience during climate-related challenges [83]-[86].

The model described as adaptive, involves sowing maize and *Cajanus cajan* seeds in the same pocket. This association is unfamiliar to most resource-poor farmers. The analysis reveals that monitoring the vegetative development of leguminous plants has helped in understanding and establishing the mechanisms by which leguminous plants are utilized on farms. Similar to the domesticated maize mentioned by [86], incorporating leguminous plants into cropping systems also necessitates considering encoded information.

5. Conclusions

The integration of leguminous plants into agricultural production systems helps enhance the resilience of family farms. Analysis of substitutive, adaptive and corrective models has enabled us to highlight the diversity of mechanisms and ongoing changes in cropping systems. Adaptations based on *Cajanus cajan* are recognized as more beneficial and widely applied than substitutive and corrective models. However, as more plots are being treated, the transformation of cropping systems anticipates widespread knowledge of agro-ecology. The development of models can be attributed to resource-poor farmers' motivation to learn about leguminous plants, which alleviate pressures from damage caused by climatic events. The analysis concludes that motivations are not solely linked to the absence of additional investment and labor costs or loss of income.

At a time when initiatives funded by the technical and financial partners are increasing in sub-Saharan African countries, analysing agroecological models allows for the consideration of advisory support that aligns with social representations. To achieve this, responsibilities must be shifted so that advisory support is provided directly by resource-poor farmers, who have informed knowledge of the local context where research results are applied. In the future, advisory services will need to promote preferential access policies for *Mucuna* and *Cajanus Cajan* seeds to improve farm resilience and ensure food production. The analysis highlights the importance of incorporating these mechanisms into policy development to mitigate the impacts of damage caused by climate change in Benin, and other parts of the world.

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Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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