



Factors limiting the integration of agroecology into agricultural practices in Aquitania Boyacá, Colombia

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Abstract

At present, agricultural activities in the Municipality of Aquitania, Boyacá, have caused impacts on natural resources and biodiversity. Particularly, an adverse impact on soil quality, sources of water, and species of flora and fauna. This study seeks to establish criteria and recommendations for the incorporation of agroecology through environmental and sustainable agriculture. The study took a qualitative approach with a descriptive scope and action research design. Interviews were carried out with 120 farmers in the Municipality of Aquitania. Among the limitations to the implementation of agroecology included inadequate training, fear of change among producers, lack of institutional support, and lack of incentive to develop sustainable processes. It is established that guidelines should be developed in Aquitania for the implementation of sustainable production.

Keywords: Agroecology, Environment, Sustainability

Introduction

Agroecology has been proposed as a sustainable alternative to the conventional method of growing food in agriculture because it enables the creation of activities that support nature, biodiversity, and culture. In this regard, as argued by Gliessman (2020), agroecology entails incorporating different perspectives into the practice of agriculture, and this results in reducing dependency on external resources while increasing the resilience of the environment. This is especially true for Colombia because its agricultural practices have been very intensive, causing negative effects to the environment. One such practice can be observed in Aquitania in the department of Boyacá in Colombia, where the economy relies on the production of long onions.

Several studies have indicated that over-reliance on agrochemicals, monoculture, and mismanagement of environmental resources such as water and soil contribute to poor natural resource quality (Nisar, 2021). From the local perspective, some farmers in Aquitania have reported changes in biodiversity, for instance, the disappearance of pollinators and certain types of plants, and changes in soil fertility. Despite early attempts at integrating agroecology in agricultural practices through institutions and the community, these attempts are yet to be developed as an effective option in the region.

The key question that this research will try to answer is what the barriers that have impeded the incorporation of agroecology in the practice of agriculture in the Aquitania municipality are, since apart from the environmental impacts of current agricultural practices, there are unsustainability issues of production systems which are little adapted to climate change and economic instability among the population. In other words, the question here would be what the factors are that hinder the implementation of agroecology in Aquitania? What conditions should be changed for this implementation to be feasible?

Therefore, the study is relevant insofar as it contributes to generating reflection on the conditions that must be considered in order to move towards agriculture that is more environmentally friendly and more accessible to rural communities. By recognizing the limiting factors and perceptions of producers, it seeks to provide a basis for the formulation of educational, technical, and institutional strategies that will enable progress in the agroecological transition. According to Maughan and Anderson (2023), agroecology cannot be imposed, but must be generated through dialogue and the participation of rural actors.

Therefore, the aim of this study is to create principles which will make it possible to integrate agroecology into the agricultural sector of Aquitania, Boyacá. With regard to this, the following specific aims of this study are to explore barriers to integration, to examine the perception of farmers about agroecology, and to develop guidelines for integrating agroecology.

Literature review

This section aims to present key concepts surrounding the research in order to identify and analyze the determinants of the non-adoption of agroecology as an alternative agricultural practice in the municipality of Aquitania (Boyacá). Therefore, conceptual constructs of agroecology as a sustainable alternative for agricultural production are developed, along with the social, cultural, and institutional limitations of agroecology. The theoretical review responds to the need to interpret, from a critical perspective, the dynamics that shape the link between agroecological knowledge and its practical application in rural areas.

The current conceptual literature review will be based on three themes, which provide an understanding of how to structure some of the key theoretical contributions in relation to the topic at hand. For starters, the theme of agroecology is considered as a whole through the lens of environmental sustainability. Secondly, the theme addresses the reasons behind the poor adoption of agroecology practices by looking at the social and cultural aspects. Finally, the paper ends by considering the institutional environment and lack of motivation for successful agroecological transformation in Colombia.

Agroecology as an approach to environmental sustainability

Agroecology may be seen as using ecology to create effective agroecosystems. According to Wezel et al. (2020), agroecology can be understood as the scientific study of managing agricultural production systems in such a way that ensures the conservation of nature and minimizes the use of agrochemicals. On the other hand, from the viewpoint of Kerr et al. (2022), agroecology can be viewed as integration as a social movement.

Diversification is one of the key tools of resilience both in ecological and socio-economic terms according to the framework of the proposed theory. As demonstrated by modern researchers like Brillouin et al. (2021), diversification of agroecological systems results in higher incomes, greater diversity, and provision of more ecological services without decreasing productivity in the mid-term perspective. The results of López's (2022) study are consistent with the hypothesis concerning sustainable agroecosystems in the long term.

As Palomo et al. (2022) argue, agroecology relies on diversity, synergy, and nutrient cycling that foster stability and functioning of the system. In the view of the author, such approaches allow for efficient use of food resources while emphasizing the role of ecosystem services provided by biodiversity, such as water management and maintenance of soil fertility, which is not typical of intensive monoculture or use of fertilizers and other chemicals.

Moreover, agroecology is a concept that embraces a participatory and political approach. As noted by Frank et al. (2022), the transdisciplinary character of agroecology allows for the co-production of knowledge among researchers, producers, and social movements. As emphasized by Peña et al. (2022), in Latin American countries, this approach also includes the defense of food sovereignty, dialogues of knowledge, and resistance aimed at strengthening autonomous peasant agriculture.

Social and cultural factors that hinder the adoption of agroecology

Specific training, as well as the difficulty of accessing technical training, constitute a significant limitation when it comes to small producers implementing agroecological practices. In this regard, Cano et al. (2023) emphasize that the dissemination of sustainable agricultural innovation is slower when farmers lack training mechanisms or access to knowledge. In rural Colombia, the use of applications such as AgroTIC has also shown that, when there is no training process, useful digital resources are not fully exploited, accentuating the gap between scientific knowledge and farming practice (Hinojosa et al., 2023).

Resistance to change is an important factor as well since most farmers do not want to adopt any techniques that seem too risky and economically unfavorable for them. Research related to silvopastoral systems in Colombia has revealed that the anticipation of long periods before the results are received and the negative investment character of such initiatives hinder farmers from practicing agroecology (Lee et al., 2020). These findings align with the innovation diffusion theory proposed by Rogers (2019) according to which complexity, incompatibility, and uncertainty prevent innovation.

Likewise, it is the case with social/cultural factors, including the issue of social identity, as both help create resistance. In accordance with Sych et al., people do not accept alien innovations to keep their social identity and avoid becoming stagnant, hence slowing the acceptance of sustainability in the context of traditional societies (2025). It is worth considering that ethnographic research carried out in Brazil shows that agroecological collectivities determine the tempo of changes in agriculture depending on the degree to which alien practices are introduced (Espluga-Trenc, 2021).

Thirdly, there are challenges posed by the dominance of technocratic knowledge systems compared to those of local knowledge systems. Regarding the example of Colombia, Forero et al. (2023) suggest that technical transfer systems in place often underappreciate the knowledge of peasants, thus resulting in either mistrust or lack of understanding of the methods that could work better in the local setting (Bernal et al., 2023). Co-production of knowledge through scientific and community knowledge would help foster this transition process.

Institutional framework, public policies, and incentives for agroecological transition

In the context of Colombia's scenario, it has now been seen that the formulation of public policy pertaining to agroecology has gained much significance in recent times, owing to the formation of the National Policy for Peasant, Family, and Community Agriculture (PNAFCC). According to the statement made by Santos (2020), "the National Policy for Peasant, Family, and Community Agriculture (PNAFCC) seeks to promote sustainable agriculture production, advance food sovereignty, and highlight the importance of rural areas in biodiversity preservation." The National Policy for Peasant, Family, and Community Agriculture (PNAFCC) has a number of proposals, one of which is IPPTA.

Nevertheless, the institutions in rural Colombia have always been weak, particularly in those regions which are vulnerable as well. According to García & Osorio (2023), the implementation of agroecological practices is hindered by a fragmented system of governance, which consists of poor coordination between territorial layers, program discontinuation, and poor extension service delivery in the field. Likewise, according to Leano & Goulao (2024), most rural development projects turn into welfare schemes lacking continuity and local community engagement.

One major impediment to the shift to agroecology is the lack of incentives in terms of economics, finance, and trade to encourage agriculture. In the view of FAO (2021), smallholders encounter numerous challenges in obtaining credit, subsidies, or marketing schemes that would reward sustainable production. Failure to provide these incentives means that innovation and sustainability become impossible, with farmers resorting to other less desirable ways of achieving immediate results.

In spite of this, there are cases that have proved that agroecology can be a powerful tool for transformational change in the case where such initiatives are backed by well-defined public policy initiatives and coordinated community action. In one such case study, García and Moreno (2021) have highlighted the example of "Sembrando Capacidades" (sowing capacities), an initiative that allowed more than 3,500 households to restore their production systems using agroecological principles, thereby increasing income generation as well as building local value chains.

From our theoretical framework, we can conclude that agroecology, which cannot just be considered as another technical activity, is a transformative process based on scientific and historic understanding, and therefore involves a dynamic relationship between the community-ecosystem-production of food systems. The agroecological transition then should not be seen in terms of practice modification based on agricultural production, but in terms of restructuring of the framework of agricultural development itself. Elements of diversity in culture and ecology will become ingredients for this restructuring process.

Conceptual analysis reveals that transitions towards sustainability in agriculture occur through processes that involve social, educational, and institutional factors. Limitations observed are not a product of the will of the producers alone but are a consequence of circumstances that impede innovations and new forms of production. Against this backdrop, there is a need for a comprehensive approach to the problem involving effective public policies, tailored educational measures, and social organizational processes. This way, the conceptual model constructed not only helps achieve the objectives of the research but serves as a basis for understanding the results of the empirical study.

Methodology

In this part, we will discuss materials and methods employed for conducting research that is qualitative in nature. It enables us to study social phenomena of individuals as well as groups (in terms of their reality and practice related to natural resource management). The key point regarding qualitative research, as explained by Haki et al. (2024), is that it studies human activities and the construction of meaning through these activities.

This research is descriptive in nature, fundamentally demonstrating the type of experiences or perceptions of farmers in Aquitania. Keller et al. (2022) point out that a descriptive approach is appropriate for addressing social problems from different perspectives, as it allows for a more complete picture of social dynamics and local contexts to be constructed, with the aim of detailing traditional practices surrounding natural resources in order to establish the factors that limit the use of agroecology in the municipality of Aquitania Boyacá.

The research is carried out using action research design, an approach that encourages the active participation of researchers and participants. Cornish et al. (2023) note that this model not only aims to identify and analyze problems, but also to involve the actors concerned in the development of possible solutions. Through action research, the aim is to establish spaces for dialogue where farmers can share their knowledge and experiences in order to co-create agroecological strategies tailored to their context.

In this research, the use of semi-structured interviews and focus group discussions was carried out to facilitate the process of collecting data in an appropriate manner. This approach helped promote the interaction between the researchers and the farmers, promoting a sense of trust between them and enabling effective teamwork. Data collected was later subjected to narrative analysis, thus helping identify key themes that could contribute towards providing relevant recommendations on agroecology project management in Aquitania Boyacá municipality.

Study unit

The subjects used in this research formed a sample of 120 farmers in the municipality of Aquitania, Boyacá who were actively involved in spring onion cultivation. The chosen subjects were taken from an estimated number of 160 farmers

that ensured that the study provided a representative description of the agricultural scenario revolving around this practice. Selection was done on the basis of inclusion criteria which determined their relevance to the present study. The inclusion criteria were: Being a resident of the municipality of Aquitania, Having prior experience in cultivating spring onions, and Being actively willing to be part of this study.

The choice of working with this community of farmers is inspired by the fact that growing spring onions is a crucial resource in carrying out economic activities in the area, along with issues related to the preservation of natural resources. The opportunity to work with farmers that have adopted agroecological methods enables us to find out to what degree this would contribute towards environmental sustainability in their particular case.

This involvement not only contributes to enriching the research itself, but at the same time it gives insights into the problems and prospects for the farmers as far as carrying out the agroecological projects are concerned. In other words, interviews conducted in this case have helped gather information related to strategies of managing agroecological projects.

The participatory approach not only seeks to reflect the reality of farmers, but also aims to promote dialogue, enable the search for appropriate strategies for the conservation of natural resources, and thus contribute to the sustainability of agriculture in the municipality of Aquitaine.

Stages of the Research Process

The different stages of this study are directly associated with the purposes being sought, considering that the aim is to create a broad definition regarding the elements that affect the integration of agroecology in agriculture in the town of Aquitania Boyacá, which impedes the conservation of the environment. In this respect, the stages in which the research was conducted occurred in two separate steps with distinct objectives that helped address the issue at hand.

- First stage: Characterization of agroecological project management and practices that affect natural resource conservation

The first stage of the study focused on characterizing the management of agroecology projects in the municipality of Aquitania, with the aim of identifying sustainable practices and those that harm the conservation of natural resources. A diagnosis was also carried out, analyzing the predominant methodologies, as well as the people participating in the project and the resources used in each of them. In this way, the diagnostic stage provided a clear view of the factors that enhance or limit agroecological initiatives in terms of environmental sustainability.

- Second stage: Designing an action plan to improve natural resource conservation through agroecological management

The second phase of the study focused on designing an action plan, based on the results of the first stage, aimed at improving natural resource conservation through more effective management of agroecological projects. An action plan was thus designed in cooperation with specialists in the agroecological field and representatives of local communities to ensure that it was feasible and appropriate to the socioeconomic and environmental conditions of the municipality of Aquitaine.

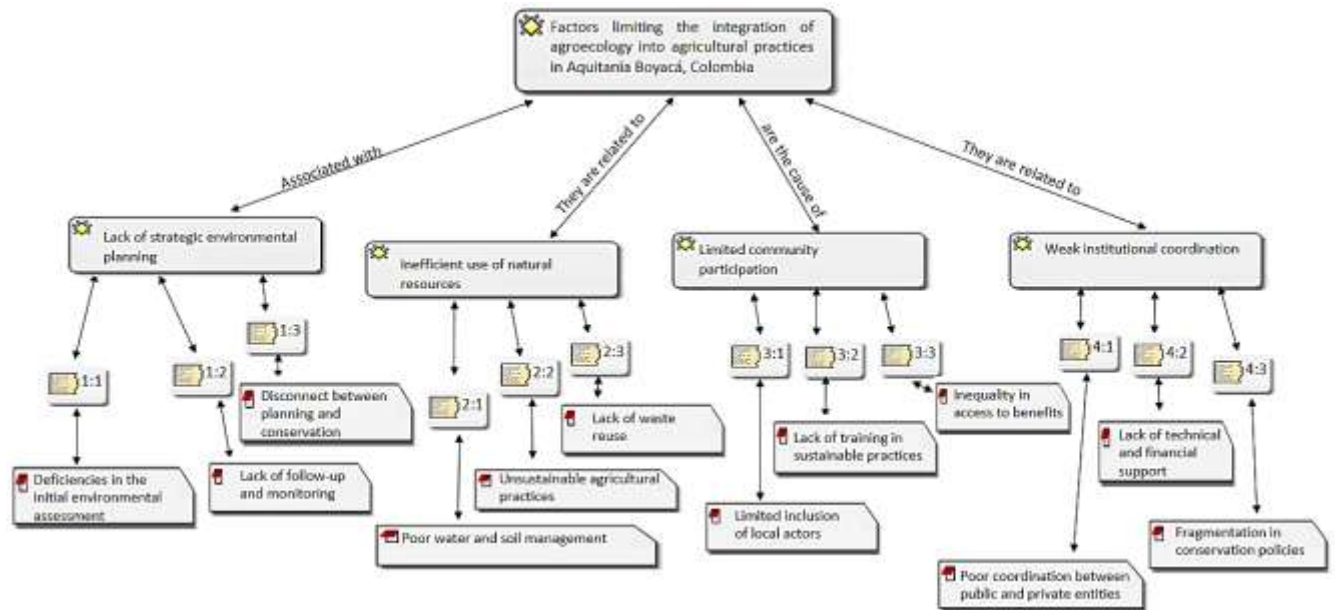
Results And Discussion

The results of the study are geared toward meeting the objectives and are also aligned with the stages referred to in the methodological design.

- Results First stage

The first stage of the research allowed us to characterize the management of agroecological projects in the municipality of Aquitania, in order to describe the guidelines that contribute to the sustainability of natural resources, as well as those that exert negative pressures on them. This diagnostic exercise served as a key starting point because it showed the current state of agroecological initiatives, with their strengths and limitations, as well as the level of coordination between actors, resources, and methodologies implemented in the region.

The methodological process was implemented through semi-structured interviews with 120 key informants related to agricultural, productive, and environmental management practices. The responses obtained were analyzed using Atlas.ti 7.0 software with an open, axial, and selective coding process, which allowed for inductive analysis of the testimonies and the construction of categories that account for the factors that influence the integration of agroecology. Based on the analysis process carried out, a semantic network was configured that summarizes the main findings of the first phase. Figure 1 presents this network, which facilitates the observation of the relationships between the emerging categories and allows for the visualization of the elements that limit or enable the implementation of agroecological practices in the territory.

Figure 1: Semantic network emerging from the analysis of responses provided by key informants

Note: The figure allows us to identify the emerging categories from the analysis of the interview conducted with key informants.

The data obtained in the semantic network forms an important source of information in determining how agroecology evolves and operates within Aquitania. With the aid of this information, the categories representing major constraints will be identified, discussed in this part of the paper. In each case, the newly developed categories refer to certain elements of the reality on-site, in terms of resource allocation, organizational aspects, knowledge and technology, as well as conflicts between production methods and sustainability practices.

- Category analysis results: Lack of strategic environmental planning

The results achieved in this category suggest inadequate strategic environmental planning for agroecological projects in the municipality of Aquitania. Informants agree that, among the large number of projects reviewed, no environmental impact assessment was carried out, which reduces and limits the possibility of anticipating the adverse effects that productive activities may have on the area's natural resources. This is a cause for concern when considering that studies such as those by De Gea et al. (2022) and Shevchenko et al. (2024) show that the absence of environmental impact studies leads to soil degradation, loss of biodiversity, and depletion of water resources. Informants have mentioned that this shortcoming stems from the lack of local regulations that require these studies to be carried out at the start of projects.

Similarly, informants state that one of the most deficient aspects of agroecological project management is the lack of environmental monitoring and control programs. The data obtained in the research reveal that most projects do not have a control plan to monitor medium- and long-term impacts. Informants indicate that, in many cases, local authorities and project promoters do not allocate resources or personnel to carry out systematic monitoring. This view coincides with that of Salcá-Rotaru (2025), who argue that environmental monitoring and control is essential for correcting and adjusting practices that are harmful to the environment. This disconnect between project implementation and their actual environmental impacts compromises resource sustainability.

Another priority issue in this category is the disconnect between project planning and environmental conservation objectives. Informants have mentioned that many of the agroecological projects in Aquitania do not have clear and therefore coherent objectives in the area of natural resource conservation. In some cases, this has resulted in practices that not only do not help conservation, but are even harmful. The statements collected are reflected in studies such as that by Kehinde (2025), which concludes that it is important for productive projects to be aligned with sustainability objectives in order to be successful in the long term. Informants agree that this disconnect is the result of a lack of coordination among the actors involved, who have not adequately integrated the environmental dimension into their action plans.

Finally, informants argue that it is important to urgently implement proposals or action plans to solve the problems arising from the lack of strategic environmental planning. Among the proposals collected are those to establish local regulations that require prior studies of environmental interest to be carried out and the creation of continuous monitoring programs. Similarly, it is recommended that local actors be made aware of the issue so that they can

develop actions aligned with environmental conservation. As stated in Pawar (2023), it is essential to integrate the environmental dimension into project planning in order to guarantee the sustainability of resources in the future.

Results of the analysis of the category: Inefficient use of natural resources

The results gained in relation to the category “Inefficient use of natural resources” point out to serious problems associated with ineffective management of crucial natural resources, namely water and soil. The informants confirm that soil erosion is among the key issues emerging due to the ineffective management of the region of Aquitaine. It was established that soil erosion in the studied region occurs mainly because of excessive cultivation and absence of appropriate practices of crop rotation, as well as absence of any natural obstacles that slow down this process of erosion. Another major issue related to resource management in Aquitaine is the shortage of water sources caused by its intensive consumption.

In relation to the agricultural production techniques used, the informants reveal that there is a considerable number of producers who rely on intensive techniques, which depend on agrochemicals and pesticides that are unsustainable. Although there is an encouragement for farmers to practice agroecology, informants note that a good number of farmers resort to such farming techniques due to ignorance of other ecological options and the fact that agrochemicals are relatively cheaper. Such a situation is supported by Rad et al. (2022), who argue that such practices may lead to increased soil degradation and pollution of water sources.

The first topic discussed by the informants is the limited ability to recycle agricultural waste produced from agricultural activities. It is mentioned that the majority of the waste, which includes crop waste and harvest waste, goes unused and contributes to wastage. There are no specific policies on how to utilize this waste, and there is no proper plan for managing waste. The implementation of practices like composting and recycling waste material to enhance the soil does not take place due to the lack of ability to recycle waste products. This observation correlates with the findings of Koul et al. (2021), who state that waste management is critical to minimize ecological impacts and increase the sustainability of agriculture.

On the other hand, informants agree that there is an urgent need to implement sustainable natural resource management strategies in the municipality of Aquitania, to adopt and implement local policies that promote the adoption of agricultural practices such as water and soil conservation, the promotion of techniques that reduce the use of agrochemicals, suggesting that it is advisable to train farmers in the reuse of waste as a key measure to counteract pollution and improve soil fertility, which is in line with the study by O'Connor et al. (2020). The informants' assessments highlight that these practices are essential for better management of the sustainability of agroecological projects and natural resource conservation in their region.

- Category analysis results: Limited community participation

The results for the category “Limited community participation” indicate that the low level of participation by local actors in the decision-making process is one of the possible explanations for why the development of agroecology projects is considered a challenge in the municipality of Aquitania. Informants have indicated that the participation of local actors in agroecology projects has been low, which has contributed to a weak or almost non-existent level of commitment to project definition and implementation. They also comment that decisions on how to manage resources and on agroecological practices have often been made by people outside the community and by government decision-making institutions without considering the participation of the local community. The limited participation of local actors in the decision-making process reflects a possible disconnect between the needs of the population and the objectives of the agroecology project, as has been pointed out by authors such as Ufitimfura and Amolo (2025).

Where training is concerned, according to the informants, there is a really big challenge in relation to training regarding the use of agroecological practices that would be sustainable. More specifically, according to the informants, while there are certain initiatives that are associated with training that have been established, they have still not been developed enough. This is why there is a tendency among many farmers to apply the techniques that they are familiar with but do not fit into the idea of agroecological sustainability. This is why, as Kansanga et al. mention, this aspect prevents them from practicing agriculture in a sustainable manner.

Another aspect highlighted by the informants is the fact that there is no guarantee that equal access to the benefits derived from agroecological projects will be achieved. From the information provided by the informants, it is clear that resource distribution, hence the benefits that are derived from agroecological projects, has not been equal in all cases, with certain communities receiving more benefits compared to others. Less prioritized communities tend to be de-motivated by this trend. From the information provided by the informants, it can be argued that this aspect of inequality has negative effects on communities both socially and in terms of success of their initiatives.

According to these results, the informants agree on the need to implement more inclusive strategies to generate active participation by social actors through agroecological projects. They state that it is necessary to emphasize comprehensive training for all social actors in sustainable agroecological practices and that mechanisms must be put in place for the equitable redistribution of resources. Similarly, as Nicklay et al. (2020) argue, strengthening community participation is important for agroecology projects to be successful in the long term. In addition, action plans that promote equity and training must be formulated to ensure sustainability and the conservation of natural resources.

Results of the analysis of the category: Weak institutional coordination

The findings generated under the theme “weak institutional coordination” indicate that one of the major challenges facing the implementation of agroecology projects in Aquitania municipality is the weak coordination between the governmental and non-governmental agencies implementing the project. The interviewees indicate that the lack of coordination among the local, regional, and national authorities has negatively impacted the implementation of the project. They argue that in most cases, the decision-making process and the development of conservation measures have been inadequately shared by the relevant institutions, causing a duplication of efforts and development of isolated solutions without considering an integrated approach. According to González et al. (2021), inadequate coordination among different institutions is one of the significant barriers to effective agroecology projects in rural settings.

As far as financial and technical assistance is concerned, there is a general agreement between respondents that agroecological programs in Aquitaine have not received adequate financial assistance that could ensure their sustainability for the long run. According to them, while there are efforts made by various organizations that encourage agroecology in their own way, but these efforts are often halted because of insufficient financial and technical assistance provided by government agencies. Moreover, the absence of financial assistance has led to the failure of many agroecological projects to achieve their ecological goals because of inadequate motivation. As noted by Blanco et al. (2020), insufficient financial and technical assistance are significant hurdles for any agroecological project operating in rural areas.

The informants further reveal that there is fragmentation in the conservation policies that have been adopted at the local and regional levels. According to them, the different projects that are designed do not address the environmental policies that are in place at the national or regional level, and thus it becomes difficult to formulate a comprehensive set of regulations that will guide the implementation of the projects at all stages. The fragmentation in policy formulations between the local and national levels is seen as one of the challenges to conservation coordination. To this effect, Mallawi (2025) cautions that the fragmentation in the formulation of conservation policies leads to project isolation.

On the other hand, respondents clearly agree that institutional coordination and coordination between public and private actors must be improved, and that sustained technical and financial support must be guaranteed. They also express the need for a joint effort to align agroecological projects and conservation policy objectives at the national and regional levels. Alblas and Van (2023) emphasize the importance of establishing clear mechanisms for inter-institutional coordination and, if necessary, implementing action plans to ensure cohesion between environmental policies and agroecological projects. Otherwise, projects and the conservation of natural resources in Aquitaine will be at constant risk.

Second stage results

The diagnosis carried out in the first stage of the research revealed structural limitations in the management of agroecological projects, which made it necessary to formulate an action plan focused on the conservation of natural resources. This plan was developed with the participation of specialists and community actors, ensuring its consistency with local needs and responding to the approach of Utter et al. (2021), who argue that agroecology can only be consolidated through collectively constructed processes adapted to the specific realities of the territories.

Strengthening strategic environmental planning

The lack of strategic environmental planning areas and monitoring systems noted during phase one makes it mandatory to come up with guidelines that will be able to predict, minimize, and rectify any negative effect on the environment from production projects. It is recommended that local environmental impact assessments be carried out, and this relates to the ecological features of Aquitaine. As observed by Adukpo et al. (2025), it is important to incorporate the sustainability system as a cross-cutting concept in production projects. Participatory monitoring programs will also be developed so that the farmers, technicians, and local governments can jointly monitor their project since, according to Sigouin et al. (2025), monitoring equates to natural resources conservation.

Efficient and sustainable use of natural resources

The erosion of the soil, depletion of water sources, and excessive use of agrochemicals show that the resources are not being used efficiently. In this regard, the project will entail promoting regenerative agroecology systems involving the rotation of crops, construction of live fences, and construction of terraces as per the experiences described by Giller et al. (2021). Equally, it is important to promote rainwater harvesting and the development of community micro reservoirs. These strategies have proved effective in relieving the burden placed on underground aquifers (Huang et al., 2021). In addition, the project will seek to manage waste from agriculture through the processes of composting and production of biofertilizers as identified by Al-Suhaibani et al. (2020).

Community participation and social inclusion

Low levels of community participation in the decision-making process limit agroecology adoption. In addressing this limitation, it becomes necessary to establish participatory governance mechanisms whereby farmers, farmer associations, and government officials shall be fully engaged throughout the entire project lifecycle. Social uptake of knowledge becomes essential for achieving sustainability of community processes according to Juusola et al. (2024). Finally, as part of this strategy, it shall be necessary to engage in intensive training of all relevant parties on agroecology, with the adoption of pedagogy that would suit rural settings. Systems for benefit-sharing among beneficiaries are also included within this strategy with the aim of curbing internal conflicts and building social solidarity, as indicated by Norbu et al. (2021).

Institutional coordination and project sustainability

Lack of coordination and fragmented environmental policies necessitate the establishment of a Municipal Council for Agroecological Management, charged with the responsibility of coordinating local activities with regional and national conservation policies, according to De Castro et al. (2020). The council will comprise members drawn from the community, governmental institutions, NGOs, and universities, thereby fostering a holistic perspective. The strategy also involves the establishment of an endowment fund of finance and expertise, derived through partnerships between the public and private sectors, aimed at overcoming the problem of discontinuity, as proposed by Priyanka and Lavleesh (2020).

The description of such actions directly depends on the limitations detected at the previous stage, since the implementation of such actions will help to ensure that the design of agroecology projects in Aquitaine involves not only ecologically sound approaches, but also helps to promote community cohesion. As it is rightly argued by Pretty et al. (2020) and Angeltam et al. (2021), it is equally important to manage the natural resources efficiently as to build up social and institutional capital. Such an action plan, which is created through a participatory process, can become a standard of success when it comes to consolidating agroecology.

Discussion

The conclusions from the above analysis indicate that the obstacles to the adoption of agroecology in Aquitaine are not one-off occurrences; rather, they are symptoms of structural problems inherent in the management of productive and environmental initiatives. Indeed, poor strategic planning, inadequate use of natural resources, inadequate institutional cooperation, and lack of stakeholder involvement not only demonstrate the existence of a discrepancy between the discourse and reality, but also reveal the continuing prevalence of a model of production focused on short-term profits and disregarding socioenvironmental sustainability. From this perspective, the situation in Aquitaine can be seen as an example of what Leakey (2020) referred to as the “crisis of the conventional agricultural model.”

Indeed, research proves that lack of environmental planning and control systems undermines the sustainability of water and soils, thus validating the claims of Nita et al. (2022) that regions failing to assess the impacts of their actions create conditions for over-exploitation. The same can be said about the extensive use of agrochemicals that, while saving money in the short term, create lasting negative consequences for soil and water conditions. This idea resonates with the conclusions made by Khangura et al. (2023), who argue that regenerative agriculture should replace the current system of production. Overall, the results suggest that agroecology in Aquitaine goes beyond the implementation of alternative methods; it represents a paradigm shift in resource management.

One key element identified is limited community participation, which weakens social ownership of agroecology. As Eielenboom and Long (2023) point out, processes that do not integrate the voices of local actors generate mistrust and reduce the effectiveness of initiatives. In Aquitaine, unequal access to the benefits of agroecological projects generates internal social tensions that jeopardize community cohesion. This finding not only implies the need to design equitable redistribution strategies, as proposed in the action plan, but also confirms the findings of Li et al. (2021) that rural sustainability depends as much on ecological management as on the construction of social capital.

Likewise, the weak institutional coordination observed in the municipality is similar to that documented in other rural contexts in Latin America, where policy fragmentation and lack of inter-institutional coordination reduce the effectiveness of environmental programs (De la Mora, 2023). This coincidence shows that Aquitania's problem transcends the local level and is part of a regional pattern of deficient environmental governance. The transfer of these findings allows us to understand that the success of agroecology depends not only on the practices implemented in the field, but also on the capacity of institutions to coordinate, guarantee continuous financing, and provide technical support, as emphasized by Côte et al. (2022).

The action plan designed during the second phase of the work can be considered a solution to the limitations associated with agroecology, as it suggests processes for environmental planning, effective use of resources, increasing participation of the community, and establishing a municipal council on agroecological management within the existing legislation. Beyond Aquitaine, such a framework can be applied by other municipalities in the area facing comparable conflicts between agricultural production and conservation. According to Altieri and Andrieu et al. (2022), agroecology can be realized provided that local action plans are participatory and responsive to socio-ecological features of the area. In this regard, the findings of the research can be used not only as an assessment of the problem but also as a guide for areas experiencing comparable issues.

On the whole, the results point out that there is a need for agroecology in Aquitaine to adopt an approach of sustainable management through environmental, social, and institutional strategies. Otherwise, any weaknesses in these areas will make agroecological initiatives particularly vulnerable to fragmentation and inefficiency. Nonetheless, the action plan proposed represents an opportunity to address these shortcomings, and not only does it apply at the local scale but can be considered as an example for other regions as well.

Conclusions

From the results produced in this study, one can deduce that there are major limitations in the strategic management of agroecological projects in Aquitania, Boyacá. Among many other results obtained, the one that stands out the most is the absence of strategic environmental planning, which in turn results in poor environmental impact assessments and monitoring. The sustainability of natural resources may be jeopardized because of the findings, which coincide with the literature review that has been conducted. In line with previous studies, it is essential to have an effective environmental planning tool to control natural resources from the very beginning of the projects (Wayne et al., 2020). Another significant conclusion concerns the inefficient use of natural resources, particularly water and soil. Current farming practices, although incorporating environmental techniques, are intensive in agrochemicals and generally exclude methods such as crop rotation, which helps prevent soil degradation and water shortages in the area. As other studies suggest, agroecological approaches may be a suitable alternative for ecosystem health and cultivated land production (Kerr et al., 2023).

Likewise, it is concluded that: limited community participation in decision-making, as well as the unequal distribution of benefits, is an obstacle to the success of agroecological projects. The exclusion of stakeholders and limited training in sustainable practices have led to mistrust of conservation initiatives. Recent research indicates that it is essential for local communities to be involved in all phases of projects in order for them to be sustainable (Sattayapanich et al., 2022).

On the other hand, the weak institutional links between private and public actors represent another limiting factor for the effectiveness of agroecological projects in Aquitaine, given that poor coordination and fragmentation of conservation policies impose constraints on environmental management projects. To overcome this challenge, it is necessary to strengthen cooperation between institutions at the local, regional, and national levels, as well as to ensure constant technical and financial support (López et al., 2021).

Lastly, the conclusions bring out the importance of introducing the recommended corrective measures in all the above-mentioned areas so as to prevent any adverse effects that would result from these actions on natural resources. The introduction of an action plan in agroecological ventures implemented in the municipality of Aquitania should incorporate corrective measures and cooperation among the various stakeholders for the development of agroecology.

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