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# Technical visit as a tool to stimulate critical thinking in sustainability: experience report

Visita técnica como instrumento para estimular o pensamento crítico em sustentabilidade: relato de experiência

Visita técnica como instrumento para estimular el pensamiento crítico en sostenibilidad: relato de experiencia

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## Abstract

Despite the recognition of the benefits of sustainable agricultural practices, they are still rarely addressed in academic training. This study aims to discuss, through an experience report, how technical visits to agroecological systems can serve as an active and integrative methodology that fosters critical thinking on socio-environmental sustainability in academic education. The methodology used is an experience report based on direct observations and informal dialogues with farmers during technical visits to an agroforestry system and a macroalgae production site. The results indicate that the activity provided an interdisciplinary practical experience, integrating theory and practice, and highlighting the contribution of these practices to agricultural sustainability and environmental conservation. It is concluded that technical visits, as an active methodology, promote critical thinking and interdisciplinarity in higher education, reinforcing the importance of public policies that support rural extension and technical assistance to producers who adopt sustainable practices.
**Keywords:** Agroecosystems, Biodiversity, Active methodology, Agroecological transition.

## Resumo

Apesar do reconhecimento dos benefícios das práticas agrícolas sustentáveis, elas ainda são pouco abordadas na formação acadêmica. Este trabalho tem como objetivo discutir, por meio de um relato de experiência, como a visita técnica a sistemas agroecológicos pode funcionar como metodologia ativa integradora, estimulando o pensamento crítico em sustentabilidade socioambiental na formação acadêmica. A metodologia utilizada é um relato de experiência baseado em observações diretas e diálogos informais com agricultores durante a visita técnica a um sistema agroflorestal e a uma produção de macroalgas. Os resultados indicam que a atividade proporcionou uma experiência prática interdisciplinar, integrando teoria e prática, evidenciando a contribuição dessas práticas para a sustentabilidade agrícola e conservação ambiental. Conclui-se que visitas técnicas, como metodologia ativa, favorecem o pensamento crítico e a interdisciplinaridade no ensino superior, reforçando a importância de políticas públicas que promovam a extensão rural e o apoio técnico a produtores que adotam práticas sustentáveis.
**Palavras-chave:** Agroecossistemas, Biodiversidade, Metodologia ativa, Transição agroecológica.

**Resumen**
A pesar del reconocimiento de los beneficios de las prácticas agrícolas sostenibles, estas aún se abordan poco en la formación académica. Este trabajo tiene como objetivo discutir, a través de un relato de experiencia, cómo las visitas técnicas a sistemas agroecológicos pueden funcionar como una metodología activa e integradora que estimula el pensamiento crítico en torno a la sostenibilidad socioambiental en la educación académica. La metodología utilizada es un relato de experiencia basado en observaciones directas y diálogos informales con agricultores durante visitas técnicas a un sistema agroforestal y a una producción de macroalgas. Los resultados indican que la actividad proporcionó una experiencia práctica interdisciplinaria, integrando teoría y práctica, y evidenciando la contribución de estas prácticas a la sostenibilidad agrícola y la conservación ambiental. Se concluye que las visitas técnicas, como metodología activa, fomentan el pensamiento crítico y la interdisciplinariedad en la educación superior, reforzando la importancia de políticas públicas que promuevan la extensión rural y el apoyo técnico a los productores que adoptan prácticas sostenibles.
**Palabras-clave:** Agroecosistemas, Biodiversidad, Metodología activa, Transición agroecológica.

## INTRODUCTION

Many sustainable agricultural practices based on agroecology have begun to be studied in recent decades in various parts of the world, consequently leading to an increase in research on the benefits and challenges of implementing this form of agriculture (Farias; Soares; Alves, 2021). Therefore, Agroforestry Systems (AFS) began to be disseminated in the 1980s in Brazil, with the arrival of the Swiss Ernst Götsch, who is considered a reference in the development and implementation of this type of system (Canuto, 2017).

AFS consist of different integrated forms of land use and management. In them, trees or shrubs are intentionally and strategically combined with agricultural crops and/or livestock production, organized within the same area. This system allows for production diversification, allocation of labor, income generation, soil and water protection, as well as fostering the involvement of the local population and biodiversity (Senar, 2017). Sustainable management practices are used in this system, such as green manure, mulching, composting, and intercropping of different species (Altieri; Silva; Nicholls, 2003), in addition to biological pest control.

Sustainable production alternatives can also be carried out in aquatic environments, such as macroalgae production systems in coastal regions, which can be integrated into agriculture and aquaculture (Kimpara; Garcia; Vetorelli, 2024). Macroalgae, such as *Kappaphycus alvarezii* (Doty) Doty ex P.C.Silva (Rhodophyta, Florideophyceae), are rich in nutrients and represent a vast source of raw material, with potential use as biofertilizers, improving soil quality and increasing crop productivity. They can also be

applied in gastronomy, textile industries, cosmetics production and the pharmaceutical field (Costa, 2024).

The *Kappaphycus alvarezii* was experimentally introduced on the northern coast of the state of São Paulo in 1995 and in 1998, marking the beginning of seaweed aquaculture, still in an incipient form, in Ilha Grande Bay in the state of Rio de Janeiro (Hayashi; Reis, 2012). In 2008, Normative Instruction No. 185/2008 of the Brazilian Institute of the Environment and Renewable Natural Resources (IBAMA) (*Instrução Normativa nº 185/2008 do IBAMA*) definitively regulated the species in Brazil, allowing its cultivation in the region spanning from Ilhabela (SP) to the district of Itacuruçá and the municipality of Mangaratiba, located in Sepetiba Bay (RJ) (Ibama, 2008).

These different sustainable production systems promote nutrient cycling, reducing the need for synthetic fertilizers that may cause various environmental damages. The natural decomposition process contributes to incorporating nutrients into the soil, from sustainable sources, in a slow and gradual manner for crops. Another important aspect is climate resilience. By diversifying production, AFS become more resistant to extreme events, such as droughts and floods, which are becoming more frequent due to climate change (Brasil, 2021; Embrapa, 2024). In addition, trees and algae play a significant role in capturing atmospheric carbon, contributing to the mitigation of climate change effects. AFS, for example, stand out among their numerous advantages due to their carbon sequestration potential, both through their plant biomass and soil accumulation (Crespo; Souza; Silva, 2023). Marine macroalgae are also an important source of ecosystem services, encompassing social, environmental, and economic dimensions (Ferreira, 2020).

Despite the understanding of the benefits associated with these sustainable agricultural practices, there are still few approaches within academic training. Therefore, institutional technical visits aimed at learning about these types of systems, involving students from different educational levels, are important to stimulate the development of critical thinking in the context of sustainable agricultural production. In addition, it can be included as a practice within active teaching-learning methodologies.

The technical visit has demonstrated significant value regarding the study and systematization of pedagogical practices, especially in highlighting the role of farmers' reality in the implementation of AFS. According to Mangas and Freitas (2020), the technical visit has great potential for use, as it has the advantage of bringing students closer to the labor market, allowing them to visualize the processes discussed in theory in everyday practice. Gonçalves and Almeida (2020) also emphasize that the technical visit is a didactic-pedagogical resource that contributes to excellent educational outcomes, as it brings motivation and meaning to learning, in addition to stimulating observation skills and critical thinking.

In the context of active methodologies, the technical visit enriches learning by connecting theory with professional practice. This strategy allows students to observe real work situations, reinforcing classroom learning and providing new analyses and assessments. Therefore, in a time of profound social transformations, it is important to emphasize that in active methodologies, learners take an active role in their learning process. According to Lovato *et al*. (2018), for example, in the problematization methodology, students identify problems through the observation of the reality in which the study issues are occurring. Reality is problematized by the students, and there are no restrictions regarding the aspects included in problem formulation, since these are drawn from social reality, which is dynamic and complex.

The technical visit involves students in all stages, from operational procedures to report writing, requiring ethical commitment and responsibility in data collection and analysis (Senac, 2018). For Andrade (2018), it is a valuable opportunity to construct, demonstrate, and apply various concepts, promoting articulation between theory and practice, which strengthens meaningful learning. When properly planned, technical visits become methodological resources that enable the transformation of alternative conceptions into technical and scientific knowledge (Andrade, 2018). Thus, they constitute an essential tool in student training, preparing them to face adverse situations with critical thinking and autonomy. Conducting technical visits in non-formal learning spaces can awaken interest in learning, motivating students to build meaningful learning. This occurs due to the contextualization between their previous experiences and the knowledge shared by

collaborators in the visited spaces, mobilizing specific and relevant knowledge already present in the individual's cognitive structure (Moreira, 1999; Senac, 2018).

Considering the current context of socio-environmental problems, incorporating the perception of sustainability into educational practices, whether in formal or non-formal spaces, is of critical importance. According to Frederico, Neiman, and Pereira (2018), technical visits in higher education can serve as alternative strategies to immerse university students in socio-environmental contexts, allowing them to understand the existing challenges and to reflect on potential mitigation strategies. In the field of Agroecology, the technical visit proves to be a pedagogical tool of great importance, as it enables the concrete experience of sustainable practices and promotes the integration between scientific and popular knowledge, increasingly improving the human–nature relationship (Sousa, 2022).

Given the urgency of promoting educational practices that integrate sustainability into higher education, this work aimed to discuss, based on an experience report of a technical visit to agroecological systems, how active methodologies, especially technical visits, can stimulate critical thinking in socio-environmental sustainability, contributing to the interdisciplinary training of Agronomy students. It is assumed that direct exposure to sustainable practices enhances the integration of theory and practice, in addition to fostering critical reflection on conventional agricultural production models.

Thus, the technical visit reported in this work sought to provide students with an interdisciplinary practical experience, integrating content covered in the courses of Extension Practices, Environmental Management, Plant Physiology, General Ecology, and Soil Biology and Organic Matter. It also aimed to stimulate synergy between land-based knowledge and scientific knowledge through the experience of students from the Federal Institute of Education, Science and Technology of Rio de Janeiro (*Instituto Federal de Educação, Ciência e Tecnologia do Rio de Janeiro*) – Pinheiral *Campus,* (IFRJ-CPIN), Brazil, with local farmers at the destination of the visit. In this context, the objective was to promote the recognition of agricultural production models that operate in greater harmony with the dynamics of local ecosystems and to incorporate worldviews transmitted through the oral traditions of farmers. Such an initiative reaffirms a vanguard

movement of resistance to technicist agriculture standards, valuing practices aligned with the principles of Agroecology and socio-environmental sustainability, in addition to serving as a means of disseminating agroecological activities developed in the region.

## METHODOLOGY

The present research is characterized as an experience report based on observations carried out during a technical visit. The information described was obtained in a non-invasive manner, through direct observation and informal dialogues with farmers, without the application of structured questionnaires or the collection of personal data. According to CNS Resolution No. 510/2016, which regulates research in Human and Social Sciences in Brazil, studies that do not involve participant identification or the analysis of individual data do not require approval by a Research Ethics Committee (*Comitê de Ética em Pesquisa – CEP*). Thus, this report is exempt from submission to the CEP, as it is based exclusively on the researchers' perceptions of the experienced activity, without records that could expose or identify those involved (Brasil, 2016a), except for public and freely disseminated materials.

Therefore, the experience report of this work was developed based on students' feedback after a technical visit to an AFS managed by a local farmer and to a macroalgae production site of the species *K. alvarezii*, belonging to the Caiçara community of São Gonçalo, managed by a local resident. Both sites are located near Estrada de São Gonçalo, district of Tarituba, Paraty (RJ).

Located within the area of activity of the Bocaina Observatory of Sustainable and Healthy Territories (*Observatório de Territórios Sustentáveis e Saudáveis da Bocaina* – OTSS), these traditional territories, occupied and claimed by the Caiçara, Indigenous, and Quilombola people of Angra dos Reis (RJ), Paraty (RJ), and Ubatuba (SP), highlight the importance of knowledge, learning, and scientific dissemination about the initiatives developed in these locations.

The technical visit was carried out on September 19, 2024, with the participation of students from the Bachelor's Program in Agronomy at IFRJ-CPIN, accompanied by four professors. The program has an agroecological focus. Thus, developing methodological proposals that allow students to experience content and practical activities provides a better understanding of the program and of the agronomist's role as more sustainable. Several authors corroborate the view that active methodologies in the Agronomic Engineering program promote students' engagement in knowledge construction through integrative activities, resulting in a critical and reflective profile on sustainability within the academic field (Carvalho; Simonetti, 2023).

For the visit, the students received a guide with instructions for data collection, information, and photographic records, aiming to integrate the related subjects. The guide required students to include the following information in the report, based on the observations made during the visit:

More detailed description of the site, including general characteristics of climate, soil type, cultivated plant species, and management practices used. In addition, the history of implementation and evolution over time.

Interaction with the community, including the involvement of the local community in each of the systems. The aim was to describe how local producers collaborate and benefit from the practices and how they can improve their agricultural practices and income.

Presentation of aspects addressed during the technical visit that relate to the subjects studied, such as the structure and composition of the AFS; arrangement of organisms in the system; interactions among species and other organisms and their importance in physiological processes, productivity, and system resilience; effects of agroforestry management on plant nutrition; plant residues in the soil and their role in the formation and maintenance of organic matter and soil quality; experience of the teams with extension programs, sharing with the local community, and farmer training initiatives.

Critical evaluation identifying the main challenges encountered in the systems and in the implementation of extension practices. This included a discussion of the

opportunities and relevance that the visited sites offer for promoting sustainable agriculture and environmental conservation, as well as a reflection on how different disciplines integrate into these systems and how this integration can be applied in future projects.

After the visit, the students prepared reports based on the guide provided. Based on the selection and excerpting of one of these reports, the present experience report was developed, directed toward analyzing the formative potential of the technical visit as an active pedagogical strategy in the context of higher education. An experience report in the academic context goes beyond simply describing what was experienced, as it also provides a critical and reflective analysis, aiming to highlight the value of the reported experience (Mussi; Flores; Almeida, 2021).

## RESULTS AND DISCUSSION

The technical visit provided students with an interdisciplinary practical experience that integrated the theory and practice of the subjects involved. During the visit, students were able to closely observe an AFS and a macroalgae production site, correlating the experience with topics learned in theoretical classes, as well as how these practices contribute to agricultural sustainability and the conservation of regional ecosystems. Below are the detailed information and descriptions of each evaluated aspect.

### Detailed description of the sites visited

The region of Paraty is characterized by a mountainous and rugged terrain covered by Atlantic Forest that descends toward the coastline, forming an indented coast with some beaches and the Rio-Santos highway (BR-101) crossing the landscape. The area is dominated by a tropical climate with high rainfall well distributed throughout the year (Guerra *et al*., 2013). The relief of the region is marked by the Serra do Mar, which presents two distinct morphological units: the Atlantic Crystalline Plateau and the Paraíba do Sul Valley, both related to tectonic processes. The Serra do Mar acts as a natural barrier, influencing the local climate and causing intense orographic rainfall, especially in summer, with annual precipitation averages ranging from 1,400 mm to 2,300 mm,

depending on proximity to the ocean (Guerra *et al*., 2013). The Atlantic Forest vegetation, which covers the steep slopes, is one of the most important ecosystems in the region, although it has undergone significant degradation due to human occupation and unplanned urban expansion.

## The Agroforestry System

The AFS visited covers about 19 hectares, with approximately 42 different plant species. Several intercropping arrangements can be observed in it, such as banana (*Musa* spp. – Musaceae) with cupuaçu (*Theobroma grandiflorum* (Willd. ex Spreng.) K. Schum – Malvaceae) and cocoa (*Theobrom cacao* L. – Malvaceae), in addition to the presence of Non-Conventional Food Plants (*Plantas Alimentícias Não Convencionais* – PANC) and species such as ingá (*Inga* spp.– Fabaceae). The beginning of the intercropping of peach palm (*Bactris gasipaes* Kunth – Arecaceae) with pineapple (*Ananas comosus* (L.) Merriland – Bromeliaceae) and potato (*Solanum tuberosum* L. – Solanaceae) was also observed. The peach palm was planted along contour lines, with crop residues maintained on the soil, ensuring coverage and the supply of nutrients through decomposition and nutrient cycling. In addition to the intercropping arrangements observed, leguminous species such as crotalarias (*Crotalaria* spp. – Fabaceae) and white mucuna (*Mucuna* spp. – Fabaceae) were also present, serving as green manure on the property.

Other species, both plant and animal, play an important ecological role in the AFS area. Thus, an important example mentioned is the increase in bird sightings. This fact is extremely important, since it consequently leads to an increase in seed dispersal. According to Bento (2024), agroforestry is an efficient strategy to combat global biodiversity loss, as it promotes the coexistence of native species with cultivated plants. By creating more diverse environments, it favors the reestablishment of local fauna and flora, providing habitats that would otherwise be destroyed. In addition, agroforestry functions as an ecological corridor, connecting forest fragments and contributing to biodiversity conservation. With this focus, the AFS becomes a key element in conserving biodiversity while maintaining agricultural productivity sustainably. Vasconcelos *et al*. (2020) reinforced the importance of AFS in biodiversity conservation and other

ecosystem services, such as soil quality control and carbon sequestration, compared to monoculture, in the municipality of Santa Bárbara (PA).

Regarding soil characterization, in the more coastal regions, soils with sandier characteristics were observed, whereas in the hillside and mountainous areas, a greater presence of clay was noted alongside sandy features. The soils of the region are known for their high acidity, resulting from the region's high rainfall index, and are susceptible to erosion when not properly managed (Santos; Guerra, 2021). However, due to the lack of trained professionals, the farmer does not have a clear definition of the soil type present in the AFS. The lack of technical assistance was, in fact, one of the complaints observed during the visit. The presence of a qualified extensionist to implement sustainable practices is essential. In agroecological transition processes and in maintaining production with this purpose, support from Agroecological Rural Extension is necessary. This must go beyond the classic diffusionist model of rural extension, in which the extensionist, in addition to their technical role, must act as a facilitator (Caporal, 2020). According to the same author:

> The socio-environmental imperative, as a response to the civilizational crisis in which we find ourselves, demands new public policies for rural development. Therefore, given the challenge of supporting strategies guided by socio-environmental sustainability, it becomes essential that the State provide Technical Assistance and Rural Extension (ATER) services imbued with the purpose of contributing to a broad agroecological transition, aiming at the construction of agricultural and agri-food systems that are ecologically more sustainable, resilient, and socially more inclusive (Caporal, 2020, p. 8).

The history of the AFS area is one of family inheritance, passed from father to son. PR1 inherited it from his father and currently manages it with the participation of his son. The area underwent a transition from a banana monoculture system, where slash-and-burn was a common practice, to a later attempt at pasture. However, before the full implementation of the system, he realized and reflected that he could develop something more profitable and sustainable on his property. Thus, the AFS was established, and it has been in operation for about 25 years, with the objective of producing food while also caring for and conserving the local fauna and flora.

Regarding the species cultivated in the AFS, the main ones listed were: peach palm, cupuaçu, banana, cocoa, pineapple, cassava (*Manihot esculenta* Crantz – Euphorbiaceae), yam/taro (*Colocasia esculenta* (L.) Schott – Araceae), turmeric (*Curcuma* sp. Zingiberaceae), as well as several species of non-conventional food plants (PANC) and other native species of the Atlantic Forest. According to PR1, all species show good yield and quality (**Figure 1**). In cultivating these species, the management practices described by the farmer were as follows: liming, to control soil pH, within what is permitted for agroforestry systems; manual control of spontaneous vegetation and thinning, without the use of fire; pest and disease control using biological solutions, such as the one derived from cassava, known as *manipueira*. In this way, the importance of balanced management was emphasized. *Manipueira* is a milky, light-yellow liquid derived from cassava that has been cut into small pieces, grated, and pressed. The resulting liquid, when diluted in water, can serve various functions depending on the dilution, and thus be used as: fertilizer, insect repellent in crops, control of external parasites in animals, and a source of nutrients for animals (Brasil, 2016b). In the AFS visited, the acquisition of *manipueira* is carried out in partnership with other local farmers who produce cassava flour in the region.

It was also mentioned that PR1 provides assistance to his neighbor by donating seedlings and seeds, which enabled the establishment of another AFS, preventing the neighboring land from being sold. However, regarding external support, the farmer mentioned the difficulty of not receiving assistance from certain institutions and the challenges of acceptance as an organic farmer in some local cooperatives, maintaining interactions mainly with the population of Ubatuba. Due to the difficult car access to the property, which is located near the Serra da Bocaina National Park (*Parque Nacional da Serra da Bocaina*), his products are transported using wheelbarrows or animal traction.


**Figure 1.** Examples of plants cultivated in the visited AFS, showing intercropping arrangements and well-developed, good-quality products **A.** Yam/taro. **B**. Pineapple. **C.** Banana. **D**. Peach palm.
**Source:** Authors, 2024.

## The Macroalgae Production System

Regarding the macroalgae production site, in the Caiçara community of São Gonçalo, Rancho Ayres and Rancho Tânia have ancestral roots of more than 150 years in the region, emerging through much struggle and resistance. During the visit, PR2 and her mother felt comfortable sharing a bit of their story. When PR2 was still young, both already lived in a house in the region, but they received an eviction order from "large companies" that sought to exploit the area. However, they reported that they did not give up, even in the face of great difficulties. The first occupations of the area were through fishing, subsistence farming, extractivism, and the production and trade of bananas, flour, and fish. Many years later, the opportunity arose to participate in an extension course on Seaweed Farming and Sustainable Territorial Development, held from 2021 to 2022, offered by the municipality of Paraty in partnership with the Federal Rural University of

Rio de Janeiro (UFRRJ), in which PR2 participated and has since been applying the knowledge on São Gonçalo beach. Initiatives such as this reinforce the importance of practical and extension activities involving both the academic community and the local community. As observed in other contexts, it is noteworthy that partnerships between universities and communities can generate significant impacts (Gallo; Nascimento, 2019; Vaniel *et al*., 2022).

From the production of *K. alvarezii* algae (**Figure 2**), they are enriching the region's cuisine with the preparation of various recipes, such as coconut candy and jelly, which were offered for tasting during the visit. They highlighted that the algae are used for several other purposes, including agriculture, as biofertilizers.


**Figure 2.** Algae *Kappaphycus alvarezii*. **A.** Fresh samples, with pigment differentiation according to the location and depth of collection. **B**. Dried samples intended for culinary use.
**Source:** Authors, 2025.

Based on the survey by Suzart and Vendramini (2021), *K. alvarezii* stands out for its richness in several aspects. In terms of chemical composition, the presence of sulfated polysaccharides, antioxidant compounds, and mineral salts promotes skin hydration, nutrition, health, and recovery. From a nutritional perspective, this alga has high levels of soluble and insoluble fibers, benefiting the intestinal microbiota and serving as raw material for probiotic food products for both humans and animal feed. In medical applications, new drugs, antimicrobial agents, hypoglycemic agents, and neurotrophic agents are being studied. Furthermore, in the agricultural sector, the alga's richness in potassium and phytohormones may contribute to the National Bioinputs Program under Brazil's Ministry of Agriculture, Livestock and Supply (MAPA), aimed at promoting

healthy, natural, and pesticide-free agribusiness growth (Suzart; Vendramini, 2021). This reinforces the importance of Agronomy students becoming familiar, through technical visits, with different sources and applications of raw materials as a way to promote more sustainable production. In addition, such experiences contribute to encouraging production and regional development, as also advocated and promoted by OTSS, according to Gallo and Nascimento (2019).

PR2 has also organized a buffet in the region for certain events and contributed to the publication of a book about productive activities in the territory, its history, and the products offered by the community. In addition to their activities, the book also describes the other communities in the region. Rancho Ayres also hosts visits for educational tourism, during which PR2 guides participants to explore and understand the importance of algae, while also reinforcing sustainable development and the need for support. Currently, UFRRJ has been an important partner. PR2 expressed pride in mentioning that her daughter is enrolled at this university as an undergraduate student, which will significantly contribute to improving the knowledge needed to continue production and foster local development.

Recently, PR2's daughter, a member of the Youth Nucleus of the Forum of Traditional Communities of Angra, Paraty, and Ubatuba, represented the community by giving a talk at the event promoted by the Brazilian Supreme Court (STF), *"Inspira"*, with the theme *"Memories and Histories of a Territory"*, sharing part of the history and the importance of living in this space (Inspira, 2024)[1]. In this way, this work also contributes to the dissemination of these activities, expanding the visibility of local history and practices, which play a fundamental role in promoting knowledge, production, and environmental conservation.

Tourism is another potential source of income through the provision of lunch to visiting groups, prepared by PR2 and her mother. For the IFRJ-CPIN class, they also prepared lunch (**Figure 3**) at a more affordable cost for students and staff. They are hopeful about

[1] INSPIRA. **Memórias e Histórias de um Território**. Participação da filha da PR2 no evento promovido pelo STF. Brasília, 2024. 1 video. Available on:<https://www.youtube.com/watch?v=ksHrRrNVdnQem> Accessed in: 26 set. 2025.

the dissemination of their work, as well as the expansion of the partnership with IFRJ-CPIN. Initiatives like this break prejudices and some negative paradigms regarding the opportunities and returns that the education system can offer, while also demonstrating the importance of support projects that bring greater assistance for participation, enrichment, and benefits to the visited sites.

During her talk, PR2 mentioned that she used to have prejudice against universities and educational and research institutions in general, since the return of knowledge did not always reach them. However, now, with increased contact through the courses she has taken, institutional visits, and the presence of her daughter at the university, she sees this initiative differently, also developing an important critical sense.


**Figure 3.** Lunch offered to visitors, students, and professors of IFRJ-CPIN at Rancho Ayres.
**Source:** Authors, 2024.

## Interaction with the community

The AFS strengthens the community by providing safe food to the population and by fostering collaboration with other similar producers. Fourteen years ago, the Agroecological Association of Rural Producers (*Associação de Agroecologia de Produtores Rurais* – APOV) was founded in the region, consisting of 14 farmers. Thus, these farms implement sustainable practices in the region and fight for public policies to promote and provide technical assistance for these production systems. However, in addition to the lack of a Rural Extensionist, the community also faces a shortage of scientific and technical guidance from Agronomists and Forest Engineers, which hinders the improvement of agricultural practices and income for these people.

Most of these farmers' production is destined for schools in Paraty, while a smaller portion is sold individually. In addition, there is strong and important integration among the farms through collective work efforts, in which farmers help each other. The activities carried out vary according to each producer's expertise, fostering the sharing of knowledge and even products.

Therefore, since this production is free from pesticides harmful to the environment and does not rely on heavy agricultural machinery, the products of this system are marketed through the National School Feeding Program (PNAE). As they fit into the category of organic products, they receive an additional 30% over the value, which significantly contributes to improving household income. In this way, PNAE contributes to health promotion and is considered a Healthy Public Policy (Kroth; Geremia; Mussio, 2020). PR1's surplus products are delivered to regional farms and local consumers.

According to the Institute for Applied Economic Research (IPEA), there is a positive association between the PNAE program and student performance, especially among those in the municipal public school system. This occurs because investment in healthy school meals, provided by family farming, is associated with the quality of learning among Brazilian children in these educational institutions (Silva; Ciríaco; Zen, 2024). These data were obtained from a study involving student results in the Basic Education Assessment System (SAEB) and the public purchases made from family farming through PNAE in the periods of 2013 — the beginning of implementation and recent rules of PNAE — and 2019 — a longer period of program implementation and improved application of the rules (Silva; Ciríaco; Zen, 2024).

Extension initiatives in the Caiçara community have focused on training local fishers and farmers in sustainable algae farming techniques, covering everything from management practices to product commercialization, thereby enhancing the value of local culture and encouraging the preservation of the marine environment. In addition, PR2 participates in workshops, festivals, agronomy fairs, and has also appeared on the television program *"Expedição Rio"* (Expedição Rio, 2024)[2].

[2] EXPEDIÇÃO RIO. **Participação da PR2/UFRJ no programa Expedição Rio**. São Gonçalo, 2024. 1 vídeo. Available on: <https://www.instagram.com/p/C7hWg1UJzWd>. Acesso em: 25 jul. 2025.

These actions strengthen the local economy and promote more conscious use of marine resources. The production systems in the Caiçara community of São Gonçalo represent a synergy between traditional practices and innovation, contributing to the sustainability and resilience of the local economy and marine ecosystems. The systems visited demonstrate practices aimed at reducing dependence on harmful synthetic chemicals, promoting water conservation, and improving soil health, based on the principles of sustainable agriculture and seaweed farming. The integration of different crops and the conscious use of natural resources not only benefit producers but also play an important role in environmental conservation and a sustainable economy (Gallo; Nascimento, 2019).

The success of the productive systems in both visited locations results from exclusively family-based work, since, up to now, there has been no effective and continuous external support in the region. In the Caiçara community, innovation occurred with the introduction of algae into various food recipes, whereas in the AFS, agroecological production stands out for the quality of its products. Furthermore, these farms, like others in the region, hosted in 2024 the 1st International Meeting of Territories and Knowledge (EITS), organized by OTSS and its partners. The event, held shortly before the technical visit by IFRJ-CPIN students, marked a historic moment in the articulation between scientific and traditional knowledge, promoting a territorialized approach to health and sustainable development. With the goal of establishing a political-strategic proposal for international advocacy, the meeting sought to strengthen the participation of communities and traditional peoples in global climate discussions, with special focus on COP 30, which will be held in Brazil in 2025. According to OTSS (2024), the Final Charter reinforces the importance of dialogue between traditional and scientific knowledge, highlighting community practices as solutions to the global climate emergency.

In this way, the technical visit provided students with an experience that highlights the importance of recognizing the territory in the process of sustainable production, considering the conservation of regional ecosystems and the appreciation of traditional peoples' knowledge in the process of reconnecting agriculture and nature. Maldi (1998) explains that territory is a collective representation, a primary ordering of space. The

transformation of space into territory is, basically, a representational phenomenon through which human groups construct their relationship with materiality. Thus, the territory not only defines the physical space but also carries meanings, values, and stories that are important in building community identity and belonging.

The extension activities addressed during the visit also play a crucial role in disseminating sustainable practices and fostering rural development. Through training and exchanges of experiences, local farmers and fishers are trained to adopt methods that respect the environment and promote ecosystem health. These initiatives not only improve productivity and the quality of life in communities but also strengthen ecosystem resilience. Thus, extension becomes a vital tool for promoting a more sustainable and just future in rural areas (Milagres *et al*., 2023).

## Relevant aspects of the technical visit and its relation to the subjects

During the technical visit, it was possible to integrate various contents related to the subjects involved, as well as to observe a broader expansion and connection with other topics due to the contextualization carried out. In the Plant Physiology course, students observed the physiological interactions among different plant species and the acclimation capacity of algae in the aquatic environment, understanding how plants use available resources and how these interactions affect crop growth and development as well as ecosystem health. Trees, in addition to providing shade and shelter, benefit small-scale crops. Thus, the importance of many physiological processes involved in plant functioning is highlighted, such as photosynthesis, which is fundamental for healthy plant growth. Water regulation, due to the control of gas exchange through transpiration, also plays a crucial role, helping plants adjust to different environmental conditions. In addition, plant physiology influences their ability to respond to stresses such as drought and pests through responses that include protective physical mechanisms and the activation of defense phytohormones (Taiz *et al.*, 2017). These adjustments are essential to maintaining ecosystem health and ensuring crop productivity.

In algae production, sustainable farming practices demonstrated the relevance of water quality and proper management. Algae are cultivated in suspension systems, with nets used as support in the water column. This arrangement allows algae to receive adequate

sunlight and nutrients from the water column. According to Viana *et al.* (2021), the main environmental factors responsible for the distribution of macroalgae are light, temperature, and nutrient availability. Furthermore, proper management includes monitoring water quality and applying sustainable cultivation techniques. It is worth noting that the cultivated species is exotic, so great care must be taken to avoid uncontrolled dissemination.

In the General Ecology and Soil Biology and Organic Matter courses, it was possible to understand the importance of organic matter in water retention, soil structure, and nutrient availability, aspects fundamental to sustainable agricultural practices. Nutrient cycling and the role of forests in protecting water resources were discussed as essential factors for the maintenance of the AFS. Therefore, the adoption of sustainable production systems, combined with the promotion of good agricultural practices, not only contributes to reducing greenhouse gas emissions but also promotes the conservation of natural resources such as soil, water, biodiversity, and forests, ensuring long-term production sustainability (Embrapa, 2024). AFS contribute to improving soil quality through the addition of organic matter resulting from litterfall (Crespo; Souza; Silva, 2023). Moreover, the ecological interaction between different plant species and soil microorganisms in the AFS plays a fundamental role in maintaining the balance and fertility of the system through mutualistic associations that enhance nutrient absorption and confer resilience to environmental variations. In this context, some studies have highlighted the potential of macroalgae as effective natural biofertilizers, helping to improve soil structure, increase moisture and nutrient retention, and stimulate microbial activity, thereby favoring nutrient mineralization and mobilization in the soil (Raghunandan *et al*., 2019).

During the visit to the property, it was possible to observe a large amount of decomposing plant residues on the soil, forming litterfall (**Figure 4**). This is the main pathway for the return of nutrients to the soil and is responsible for physical, chemical, and biological restoration, thereby increasing the soil's cation exchange capacity (CEC) (Rebêlo *et al*., 2022). Litterfall is extremely important, as it helps reduce erosive processes, provides substances that aggregate soil particles, making it more stable, and acts as a barrier that

prevents leaching caused by rainfall. In this way, it allows the development of a large group of niches for mesofauna and contributes to plant growth and development (Lal; Follett, 2015).

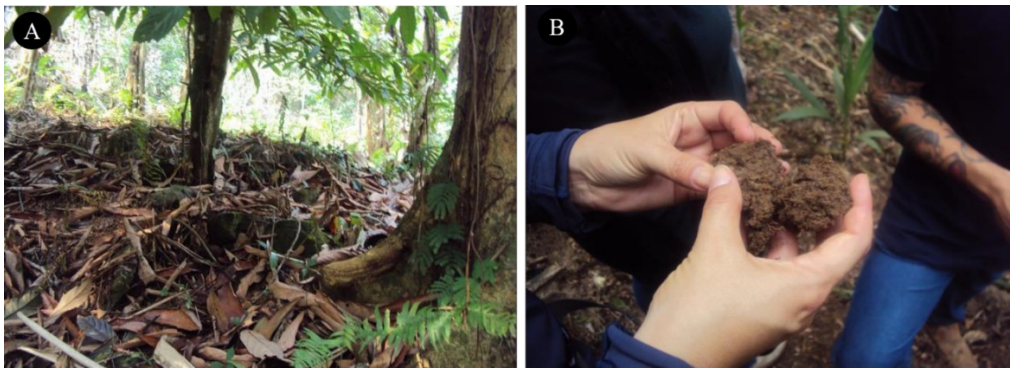


**Figure 4. A.** Litterfall in the AFS, protecting and maintaining nutrient cycling in the soil. B. Observation of a soil sample, with cohesive and structured characteristics, with the presence of roots and probable occurrence of glomalin.
**Source:** Authors, 2024.

Finally, the visit established a significant connection with the subjects of Rural Extension Practices and Environmental Management by demonstrating how farmers implement these sustainable systems on their properties. The experience highlighted the essential role of rural extension in encouraging the adoption of good practices and training farmers to diversify their sources of income. Furthermore, the visit reinforced the importance of the relationship with natural cycles and the appreciation of the worldview (*cosmovisão*) of ancestral territories, which encompasses different ways of understanding and relating to the environment, guided by traditional and cultural knowledge. This perspective fostered broad awareness about environmental management and preservation in maintaining the ecological balance of ecosystems in Paraty. Above all, it highlighted the need to recognize the negative impacts of the inappropriate use of natural resources and the environmental costs associated with these practices. According to Nickel Junior and Dück (2020), the concept of worldview emerged in anthropological studies on culture, revealing how different societies interpret the world based on their own logics. Much of this knowledge, however, has historically been devalued and subjected to prejudice.

The integration of the content studied in the classroom with the observation and reflection obtained in practice reinforces the importance of interdisciplinarity in higher education and of technical visits as a means to build more reflective, critical, and active knowledge.

In this sense, the dialogue between subjects, from an educational perspective, promotes the pursuit of innovation and analytical skills among students. According to Cunha (2007), it is through interdisciplinarity that one acquires a more critical stance and a better understanding of the reality in which human beings are embedded. Interdisciplinary scientific productions and research play a very important role in students' learning and in their personal and professional development. These contributions benefit undergraduates, who bring critical thinking and the ability to disseminate science to other people into their daily lives (Almeida; Oliveira, 2021). In this way, technical visits are consolidated as an essential tool to stimulate reflection and critical thinking through direct experience of reality. By experiencing, learning, and feeling, students are encouraged to reflect and adopt more responsible attitudes. This practical experience promotes an interdisciplinary approach capable of generating a broader and more complex understanding of the environment in which they are embedded (Frederico; Neiman; Pereira, 2018).

The knowledge acquired during the visit can be applied in various fields of Agronomy. The practices observed in agroforestry management can be adapted to other regions, promoting agroecological practices and the conservation of natural resources. In algae production, sustainable cultivation techniques can be implemented in other coastal communities, aiming at food security and the local economy. In this context, the visit reinforced the importance of integrating the knowledge acquired in the subjects with practice and community knowledge, contributing to the construction of more sustainable, resilient, and profitable agricultural systems and algae cultivation for farmers. Moreover, it provided students with a practical experience and the opportunity to interact directly with the producers.

## Critical analysis

The critical analysis aims to highlight the possible obstacles encountered in the management of the two systems visited, as well as the potential challenges to enabling extension practices. Regarding the problems found in the management of the AFS, the following stand out: difficulty in finding specific biological inputs, the occurrence of fungal and bacterial diseases, the need for proper planning to avoid competition among

species, climate change, and labor shortages. In macroalgae management, issues with water quality due to pollution and eutrophication, climate change, and improper constructions are among the anthropogenic influences that may compromise the habitat of these species and hinder the production of sea farms in the future.

However, part of these problems can be solved through extension practices, which are currently hindered by the lack of public policies and funding allocated to sufficient technical support for the community. The importance of both sites in offering opportunities for sustainable agriculture is evident, even with all the aforementioned problems. In addition to providing safe food for the population, they offer an environment for the development of studies and research, spaces of resistance and struggle for more rights, as well as enabling better working and subsistence conditions.

It is important to highlight the way in which the integration of the disciplines involved provided a holistic view of the systems visited, allowing an integration between technical-scientific knowledge and the empirical and ancestral knowledge shared by community members. The knowledge acquired during the visit can be applied in various fields of Agronomy. Furthermore, the understanding of physiological processes and their ecological interactions can be integrated into teaching, research, and extension programs, raising awareness among future professionals about the importance of biodiversity and the mechanisms involved in plant development.

## CONCLUSIONS

The technical visit fostered the experience of participatory dialogical methodologies, and one of the main pedagogical aspects demonstrated by the activity was the dialogue between theory and practice. The thematic subjects discussed in the classroom during the activities represented new academic perspectives for the students, especially in learning about the historical role of belonging to the territoriality of agroecological production and the Caiçara producers. As a result, the activity provided students with an interdisciplinary practical experience. Students were able to observe how these practices contribute to agricultural sustainability and environmental conservation. Furthermore, it also enabled

them to integrate and contextualize knowledge, being able to closely observe and identify both the benefits and challenges of these productive systems. In this way, it reinforced the importance of integrating prior knowledge with community knowledge, contributing to the construction of more sustainable, resilient, and profitable systems for farmers.

The study demonstrated how Agroecology and sustainable seaweed farming contribute to environmental conservation, food security, and the strengthening of local communities. The reported experience highlights the need for public policies that encourage rural extension and technical support for producers who adopt sustainable practices. Therefore, this study emphasizes the relevance of technical visits as an active methodology to foster critical thinking and interdisciplinarity in higher education, as it brought a new perspective to participating students. Finally, this work seeks to disseminate these initiatives so that they may serve as inspiration and a foundation for other regions and courses.

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