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Entrepreneurship and innovation - Feasibility study on sustainable residential food production through Aquaponics

Empreendedorismo e inovação - Estudo de viabilidade na produção residencial sustentável de alimentos através da Aquaponia

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ABSTRACT

The complexity of the current reality drives the insertion of new ideas in the educational context, with empowering projects that impact social, economic, and environmental systems, generating sustainable opportunities. Entrepreneurship in higher education institutions in Brazil requires innovative approaches, in addition to isolated disciplines, to promote a sustainable entrepreneurial culture and contribute to community development. In view of social needs, questions arise about projects that promote individual and collective training, meeting demands for interprofessional training in the social, economic and environmental spheres.

Keywords: Residential Aquaponics, Sustainability, Socio-environmental Responsibility.

INTRODUCTION

The complex reality these days means that new ideas are inserted into the educational context, the introduction of enabling projects permeates actions and impacts on both social, economic and environmental systems, bringing new opportunities and sustainable alternatives for local development and/or or regional.

Entrepreneurship as an educational theme in higher education institutions in Brazil brings a complex approach to be concentrated only on classroom approaches in the form of subjects. New approaches are needed that sustainably expand the culture of entrepreneurship, actions focused on solutions that can create, modify and develop entrepreneurial skills and enable the improvement and development of the academic community and especially the community in general (NEI 2024).

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There are diverse needs of society, raising some questions regarding the possibilities of projects that bring about the improvement of the community. Projects when implemented that can bring individual and collective training and develop activities that meet the needs of interprofessional training in the social, economic and environmental spheres.

Practical projects permeate actions and impacts on both social, economic and environmental systems, bringing new opportunities and sustainable alternatives for local and/or regional development. How to design a project to produce food sustainably for low-income people?

The study of the feasibility and possibilities of sustainable residential food production occurs due to the need to serve a community located in the city of Cachoeira – BA, a city that brings a wide cultural, economic and historical richness to the entire Recôncavo Baiano. But this does not reduce areas of poverty, economic and social inequalities, with a significant portion of the population living in precarious living conditions. The creation of projects in the community aims to alleviate these differences with the purpose of promoting individual and collective development. Inserting itself into the regional reality as a vector of social transformation.

This work becomes an experience report of a test application for food production in a different way, aiming at socio-environmental responsibility, sustainability and application for urban centers.

JUSTIFICATIONS AND IMPORTANCE OF THE PROJECT

Even with the complexity of developing projects that seek to respond to the demands of specific regions, creating and promoting an entrepreneurial and innovative culture brings new opportunities and new positions in the face of the challenges of academic and professional life. (NEI, NERAN, 2024).

ENVIRONMENTAL JUSTIFICATION

Riverine fishing communities in the region of São Francisco do Iguape, São Tiago do Iguape and Engenho da Vitória and the Pedra do Cavalo Dam, their subsistence method is artisanal fishing. In the estuarine region of the Baia do Iguape Resex on the Paraguaçu River, in recent years there has been a considerable decrease in artisanal fishing. This decrease occurs mostly due to the reduction in the supply of this continental water in the estuarine region, increasing the entry of salt water from Baia de Todos os Santos, thus promoting an environmental imbalance in the ecosystem. (MAFEI, 2011).

Artisanal fishing and shellfishing activities in Iguape Bay in recent years are activities that have not brought good financial conditions to workers. The art of fishing and shellfishing is in constant need of continuation. The income of fishermen and shellfish gatherers is very low. (DOS SANTOS, 2008). There are dozens of communities that make their living from fishing in the region, covering three cities, Cachoeira, São Félix and Maragogipe, which fully depend on species of freshwater fish, crustaceans and shellfish. The reduction of these species directly affects social and economic issues, causing difficulties for several families who live from fishing as a form of income and subsistence. (DOS SANTOS, 2008 and MURICY, 2017).

aquaponics project aims to help people, with initiatives focused on agriculture and aquaculture, enhancing some benefits to help meet the needs of these families.

SOCIAL/ACADEMIC JUSTIFICATION

Based on the vision and mission idealized by Faculdade Adventista da Bahia - FADBA, the Administration Course aims to continue regional insertion, highlighting the values of citizenship in the critical understanding of its strategic role in the regional and socioeconomic context, contributing to a collective and individual transformation, being an important vector of transformation through entrepreneurial actions that impact local development in a sustainable and responsible way. (NEI, 2024).

In this sense, the Entrepreneurship and Innovation Center – NEI and the Recôncavo Studies Center in Administration and Business are directly related to a diversity in articulating and developing entrepreneurial ecosystems, not only aiming to train FADBA graduates, but to develop essential skills that contribute directly to regional sustainable economic and social development. Making those involved capable of multiplying knowledge that promotes equality, professional development, and the possibility of sustainability (NEI, 2024).

Many economic and social difficulties are experienced by the local community. Such difficulties would not provide opportunities for development in the region for some families. We saw that we can work with environmental and social/academic justifications, but what motivates us is the justification that we find described in Deuteronomy 6:5 – “You shall therefore love the Lord your God with all your heart and with all your your soul, and with all your might” and “you shall love your neighbor as yourself”. Leviticus 19:18. This must be the biggest justification, as we need to worry about helping people who need it. Many today are hungry, naked and homeless, Parables of Jesus in chapter 21 p. 135 tells us that we should not neglect to share our means with these needy and suffering people. We need to pay attention to the contribution we

can make, using the means and capabilities granted to each one, and in doing so honor our Creator.

OBJECTIVES

Preparing an environment for studies is essential to encourage students to think, research and verify the advantages and disadvantages in theoretical and practical learning.

The learning objectives are characterized by practical intervention and studies in applying and evaluating sustainable tools that assist in the social development of the community.

Focus on projects and studies that encourage the possibility of practical replication with the elimination of errors, as practical presentations and achievements enable learning and improvement in execution with an entrepreneurial vision.

To this end, studies were initiated to analyze possibilities for residential food production in a sustainable way that could bring advantages to low- income families. Tests are then started to verify the feasibility, disadvantages and application possibilities.

The project started in July 2022 and is still in the study phase to be implemented within the community. The project aims to produce vegetables and fish for residential consumption, called: Residential Aquaponics - Integrated Production of Fish and Vegetables.

RESIDENTIAL AQUAPONICS - INTEGRATED FISH AND VEGETABLE PRODUCTION

aquaponics project is based on food production. The word “aquaponics” is derived from the combination of “aquaculture” (production of aquatic organisms) and “hydroponics” (production of plants without soil).

The initial idea of the project is to train families to produce their own food (fish and vegetables), in addition to raising socio-environmental awareness, respecting the environment with up to 90% reduction in water consumption, compared to conventional horticultural systems. (EMBRAPA, 2015).

The tests carried out present some difficulties and challenges, but bring several sustainable advantages and a socio-environmental vision with advantageous points for implementation in a needy community.

The advantages of the Aquaponics project are:

- Total reuse of water, avoiding waste and drastically reducing, or even eliminating, the release of effluent into the environment, reducing the environmental impact with water recirculation (RAS);
- Technique for producing food with low water consumption and which does not generate effluents that contaminate our rivers;
- Food without the need for the use of pesticides, providing a healthy diet for families;
- Possibility of extra income for families, with the sale of vegetables and fish;
- Pedagogical didactic tool for teaching children;
- Taking teenagers or families out of idleness;
- Individual and collective training and learning.

Aquaponics aims to provide food production to support a family with a variety of vegetables and fish. Joint production brings benefits and advantages, as in the end, the result is a diversity of vegetables and fish consumption, which can be expanded to intensive cultivation and sale of the production, bringing extra income to the benefiting family.

Initially, the project is based on serving families, consolidating practice and community involvement. The project aims to reach as many people as possible, subject to the availability of resources.

METHOD *(Planning and Development)*

The project then begins with the idea of testing food production through aquaponics, where possibilities and errors in application can be verified. Preparing an environment for studies is essential to encourage students to think, research and check the advantages and disadvantages.

The project aims to work with 2 groups, initially students from different FADBA undergraduate courses, leading them to learn, study and verify social responsibilities, and apply an innovative project. The second group becomes the main focus and final objective, which is the implementation of aquaponics in society, preparing the community for its own food production in a sustainable way.

The learning objectives are characterized by practical intervention and studies in applying and evaluating aquaponics as a sustainable and supportive tool in the social development of the community. The project encourages the possibility of practical replication with the elimination of

errors, as practical presentations and achievements enable learning and improvement in execution.

The expected results for our students are seen with the possibility of innovative implementation of a practical study in the search for improvements and socio-environmental training. In addition, certification of those involved takes place through courses with partner companies such as Embrapa and Fundação Bradesco. In addition to the involvement of teachers and specialist technicians in the areas of involvement, such as: financial area for studies on ROI – return on investments, guidance on fish farming with fishing engineers, studies of water parameters, population density, chemical parameters and animal health involved with professors of veterinary medicine.

The study schedule began in July 2022, and the tests carried out in the pre-project already demonstrate the feasibility of implementation, as well as positive results for sustainable residential food production.

The period necessary to prepare the environment to receive the fish and plants becomes necessary, which is the period of water cycling and preparation of the cultivation bed and cultivation channels. The testing laboratory then begins with a thousand-liter water tank and 2-hundred-liter drums for the filters and cultivation beds. As shown in figure 1, we can see the first tank for the fish and the cultivation beds.

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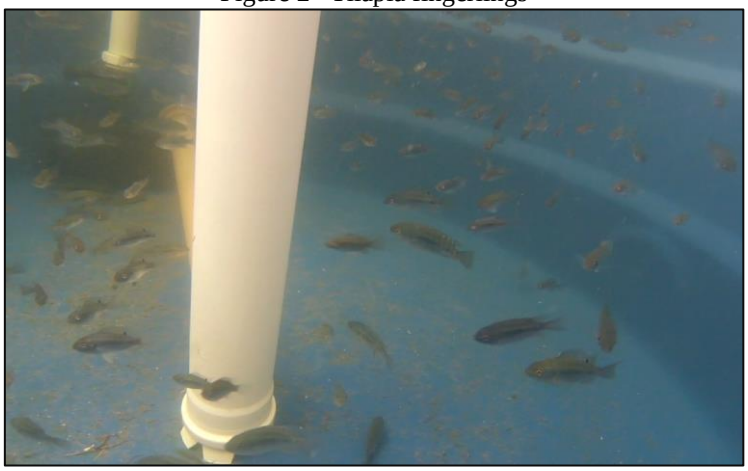
Figure 1Aquaponics pilot project

Source: pre-test carried out by Professor Me Fábio Madureira Garcia

Figure 2– Tilapia fingerlings



Source: pre-test carried out by Professor Me Fábio Madureira Garcia

Cultivation beds, in turn, can be in the form of rigid substrates for root fixation, these substrates can be: expanded clay, crushed stone, pieces of clay bricks and small stones. Figure 3 shows us a cultivation bed using layers of brick blocks, gravel and expanded clay.

Figure 3– Cultivation bed for starting tests

Source: pre-test carried out by Professor Me Fábio Madureira Garcia

After the water cycling period, which takes around 60 days, it was possible to begin testing with vegetables and fish. Implementation and application studies can then begin. As the aim of the project is to provide training for the implementation of residential aquaponics by people from the academic community and the general population, the results could be seen in a short time, and which will benefit those involved, as up until now, they have already been possible have results with the production of various vegetables such as: lettuce, cabbage, pumpkin, ora-pro-nóbis, watercress, mint, mint, chives, taioba and tomatoes (figures 4, 5 and 6).

Figure 4– lettuce, cabbage, chives and cherry tomatoes

Source: pre-test carried out by Professor Me Fábio Madureira Garcia

Figure 5– lettuce chives, mint, pumpkin

Source: pre-test carried out by Professor Me Fábio Madureira Garcia

Figure 6– watercress, mint and cherry tomatoes

Source: pre-test carried out by Professor Me Fábio Madureira Garcia

In the main tank for testing the production of fish, more directly the tilapia, which in three months have already left the fry stage and already with an average of 20 cm (figure 7),

already enabling more in-depth studies on the production of tilapia for consumption, or sale. We can see that in the four-month study period, water consumption is still the same as that started to prepare the tanks for cycling. Which was 2 thousand and four hundred liters of water. No water wastage in the production of vegetables and fish.

When the term waste is discussed in this study, we can also talk about the use of water to maintain vegetables in a conventional way, which generates a cost in production. In aguaponics, this water expenditure is reduced by 85% to 90%. It is only necessary to change the water when chemical parameters are high. Figure 8 shows the water quality in a recirculation model known as RAS, without the need for water exchange and waste.

Figure 7– Fish from the fry stage to the young stage

July 2022

October 2022

Source: pre-test carried out by Professor Me Fábio Madureira Garcia

Figure 8– Tilapia Production

Source: pre-test carried out by Professor Me Fábio Madureira Garcia

As we can see, the studies and pre-test carried out between July/November 2022 already demonstrate the feasibility of implementation, as well as positive results for sustainable residential food production. Upon completion of the pre-tests, the project then became viable for carrying out together with the students and the community, starting the extension project with the various studies and possibilities. In addition to training and training aimed at helping people with this initiative to combine agriculture with aquaculture, enhancing some benefits to help meet the needs of these families. Promoting individual and collective development. Inserting itself into the regional reality as a vector of social transformation.

TEAM INVOLVED IN EXECUTING THE PROJECT

To be able to meet all points, it is necessary to integrate teaching, research and extension. Initially, the presence of the faculty advisors from Faculdade Adventista da Bahia, Ivo Pedro Gonzalez Junior, Fábio Madureira Garcia and Jó Santos and the Entrepreneurship and Innovation Center (Nei) where projects will be developed aiming to fulfill the institutional mission and objectives. Together with Sete Junior (7Jr) to assist with consultancy, research, training and lectures, assisting in academic and social resolutions.

AUDIENCE EXPECTATIONS TO BE REACHED

Initially, the project is based on serving families or projects for training and development in food production, aiming to reach as many people as possible, given the availability of resources.

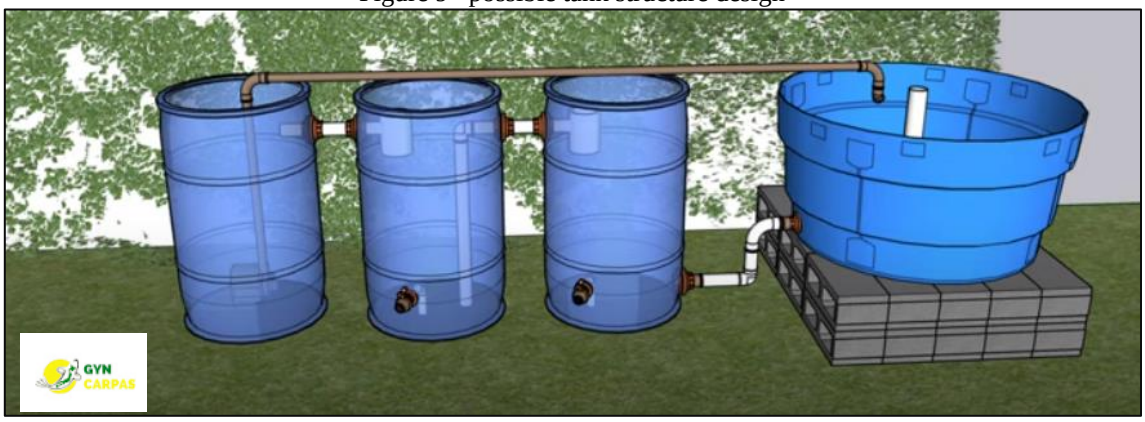
INFRASTRUCTURE REQUIRED TO CARRY OUT THE PROJECT

Materials and infrastructure required for the project must be analyzed during implementation, checking the location, size and quantity desired for initial production.

There is a need to detail costs through a prior study of the desired production quantity of fish and vegetables. The detailed construction of the project design regarding the total value must be carried out with the prior study for implementation.

In figure 9 we can see a small sketch of the layout of the tank and filters, and table 1 describes the estimated values.

Figure 9– possible tank structure design



Source: Gyn Carpas

Table 1 – estimated values to start the project

MATERIALS	LOCAL	AMOUNT	UNIT VALUE	AMOUNT
3000 liter box	main tank	1	R$1,350.00	R$1,350.00
flange 50mm		1	R$55.00	R$55.00
union register 50mm		1	R$70.00	R$70.00
90º curve 50mm		2	R$22.00	R$44.00
knee 90º 50mm		2	R$14.00	R$28.00
glue thread adapter		1	R$3.50	R$3.50
200 liter drum	decanter	1	R$140.00	R$140.00
flange 50mm		2	R$55.00	R$110.00
50mm glue thread adapter		2	R$3.50	R$7.00
union 50mm		2	R$12.00	R$24.00
knee 90º 50mm		1	R$14.00	R$14.00
flange 32mm		1	R$22.00	R$22.00
registration 32mm		1	R$19.00	R$19.00
knee 90º 32mm		1	R$9.00	R$9.00
200 liter drum	mechanical filter	1	R$140.00	R$140.00
flange 50mm		2	R$55.00	R$110.00
glue thread adapter 50mm		2	R$3.50	R$7.00
union 50mm		2	R$12.00	R$24.00
knee 90º 50mm		1	R$14.00	R$14.00
flange 32mm		1	R$22.00	R$22.00
registration 32mm		1	R$19.00	R$19.00
knee 90º 32mm		1	R$9.00	R$9.00
200 liter drum	biological filter	1	R$140.00	R$140.00
flange 50mm		2	R$55.00	R$110.00
glue thread adapter 50mm		2	R$3.50	R$7.00
union 50mm		2	R$12.00	R$24.00
knee 90º 50mm		1	R$14.00	R$14.00
flange 32mm		1	R$22.00	R$22.00
registration 32mm		1	R$19.00	R$19.00
knee 90º 32mm		1	R$9.00	R$9.00
expanded clay		2	R$70.00	R$140.00
200 liter drum	sum	1	R$140.00	R$140.00
flange 50mm		1	R$55.00	R$55.00
water pump 10000 l/h		1	R$1,450.00	R$1,450.00
90º curve 25mm or 32mm		2	R$9.00	R$18.00
PIPES - FORECAST *		1	R$400.00	R$400.00
biological accelerator		1	R$180.00	R$180.00

	TOTAL EXPECTED VALUE **			**R$4,968.50**
* pipe size depends on the location where the system will be installed				
** final values depend on the location where it will be implemented as well as the number of fish Monthly expenses for water quality tests and feed levels used monthly are not included.				

Source: pre-test carried out by Professor Me Fábio Madureira Garcia

RESULTS

With the involvement of teachers, students and the community, the testing phase became the implementation phase in the community. The choice of location, the search for recycling materials, donations and purchase of materials made it possible to anticipate studies to implement aquaponics in the community.

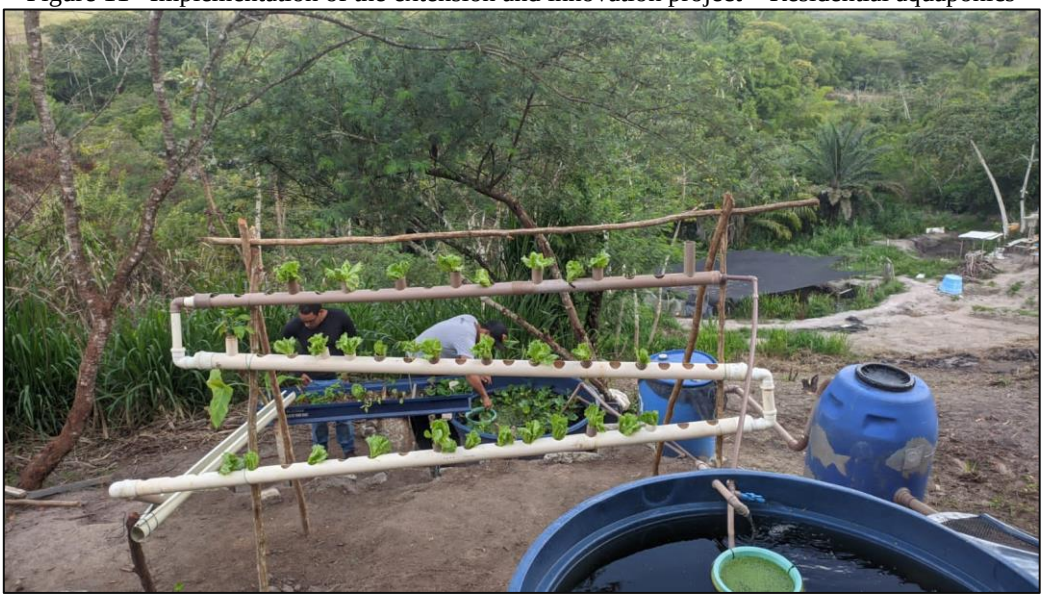
Figure 10– donations and materials for community implementation

Source: community implementation in the city of Cachoeira - BA

The project then began carrying out studies within the community with the participation of students from different FADBA courses. Preparing the land, clicking the water, choosing the vegetables to be produced, as well as fish, were steps that could be advanced due to the period of testing already carried out.

The location for implementation was a fish farm's land, which provided the project with the structure (water and energy) so that studies and training could be carried out. Starting the innovation extension project – sustainable residential food production – Aquaponics.

Figure 11– Implementation of the extension and innovation project – Residential aquaponics



Source: community implementation in the city of Cachoeira - BA

FINAL CONSIDERATIONS

With the implementation of the project within the community, it is necessary to continue studies and its feasibility. As well as the expected results for the community and students involved. Many possibilities arise with innovation and sustainable food production. This can be implemented and carried out in different ways: aquaponics, joint production of fish and vegetables, or just fish farming, or just hydroponics. Leaving several production possibilities, residential or commercial.

With the carrying out of aquaculture tests and studies, new partnerships were formed, with businesspeople, teachers and engineers. What led the project to have support from Bahia Pesca - http://www.bahiapesca.ba.gov.br/ where there is a program to promote aquaculture and fishing, through sustainable projects observing the economic, social and environmental nature and cultural. With the support of Bahia Pesca, several families became aware of the incentive program, which involves registering families, enabling the free removal of 1000 fry to start their own production.

Aquaponics as a project for sustainable residential food production brings fundamental points that could be seen in the initial pre-test. Even in its study phase, it already presents feasibility, with several benefits for those involved. Both students from Faculdade Adventista da Bahia, and from the community where the implementation of residential aquaponics began.

Several other benefits and projects are already emerging with the testing phase and the beginning of implementation in the community, something that will have greater proportions than seen until the present test. The project has already opened up several other areas of studies

and applications, such as: production of vegetables in gutters (figure 12), the use of fertilizer produced by the fish themselves for soil gardens, the creation of compost, the creation of worms to feed the fish and use in plants, assembly of systems integrating with other animal and plant production, and thus providing diversity in food production, aiming for sustainability and practicing socio-environmental responsibility.

Figure 12residential aquaponics project

Source: community implementation in the city of Cachoeira - BA

Innovative projects such as residential aquaponics can alleviate differences and promote individual and collective development as a vector of social transformation. The idealization of the sustainable residential food production project opens up several possibilities for future studies and applications in different realities and specific regions.

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