BioResources & Technology

# Report from the visit to farm at Carmel, Bangui, Central African Republic

**AUTHORS: Ing. Jan Staš**

“ Fearless minds, endless potential.”
http://biores.tech/

# 1. Background Information

- Farm Location: Carmel, Bangui, Central African Republic
- Farm Type: Previously an oil palm tree plantation planted around the year 2000, currently transitioning into different agroforestry systems.
- Farm size: 130 ha cca (from which 10 ha are cultivated already)
- Purpose of Visit: To analyse the current state of the farm and propose sustainable solutions for its transformation into a productive and ecologically balanced agroforestry system.
- Animals: 120 cows, 40 goats/sheep, 300 quails, chickens
- Trees: palm oil, teak, mango, guava, cocoa, avocado, citruses, moringa, forest trees,...
- Others: Banana, false banana, papaya, lemongrass, pineapple, herbs, amaranth, salads, several vegetable types

Farm during palm oil tree planting, around the year 2000. Only few houses around the farm.


Farm now from Google maps 2025. Houses all around.

# 2. Current State of the Farm

## 2.1. Land Use: Former oil palm plantation with remnants of monoculture practices.

**Figure 1**. Old palm oil plantation

The land at the Carmel farm, previously used as an oil palm plantation, still shows remnants of monoculture practices that can significantly impact soil health and overall ecosystem balance. Monoculture farming, especially with oil palm, often leads to soil degradation due to the continuous extraction of the same nutrients without replenishment, leaving the soil infertile and less productive over time. Additionally, the lack of crop diversity reduces organic matter input into the soil, increases vulnerability to pests and diseases, and promotes erosion due to minimal ground cover. This approach also limits biodiversity, disrupting natural ecological cycles and making the land less resilient to environmental stresses such as droughts and floods. Addressing these issues requires transitioning to sustainable practices that restore soil fertility and promote a balanced ecosystem. Compounding these challenges, the oil palm trees on the farm are no longer productive, leaving the institution with no financial or practical gains from the current state of the land.

## 2.2. The transition phase to agroforestry was observed, with some integration of crops and trees.

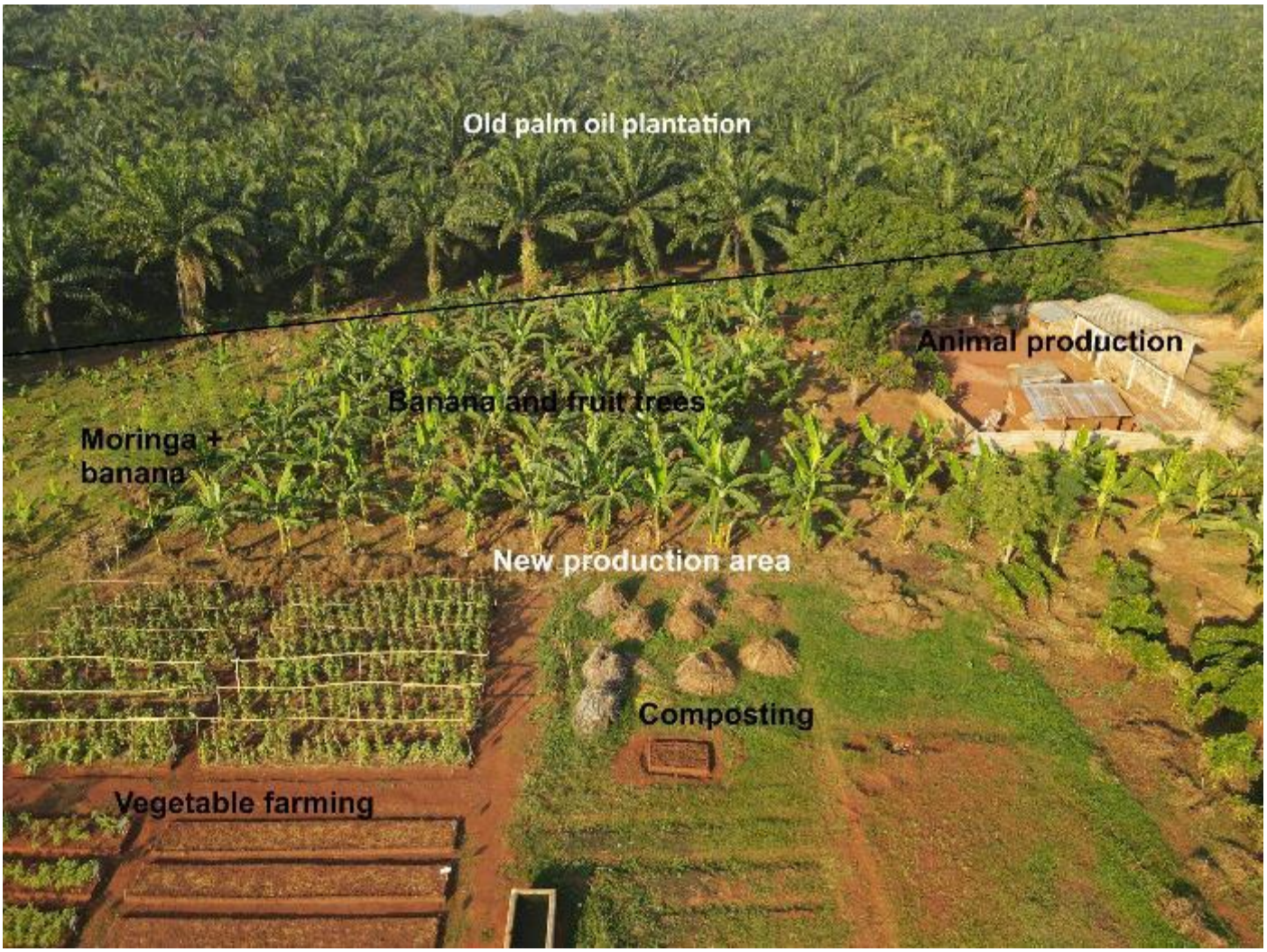


**Figure 2**. Photo of the old plantation and new farm

During the visit, it was observed that the Carmel farm is in a transition phase toward adopting farming practices, including an agroforestry system, with initial efforts to integrate crops, trees and animal production. This approach marks a positive shift from the previous monoculture practices, as combining diverse plant species can enhance biodiversity, improve soil fertility, and create a more resilient farming system. The integration of trees with crops provides multiple benefits, such as shade for certain crops, organic matter from leaf litter, and erosion control through improved root systems. Moreover, the integration of animal production, including livestock such as goats, sheep, chickens, quails, and rabbits, can significantly enhance the agroforestry system by providing valuable manure for fertilising crops, promoting natural pest control, and diversifying farm income while also improving soil health through their grazing and waste recycling activities. The difference between the old, unproductive oil palm plantation and the recently transformed agroforestry areas is striking, as shown in the picture above. The transformed areas are visibly more vibrant and productive, highlighting the potential of agroforestry to rejuvenate the land and ensure sustainable productivity. However, the current efforts still appear to be in their early stages, requiring more systematic planning to fully leverage the potential of this approach.

## 2.3. Existing Resources:

### 2.3.1. Land with potential for crop diversification and animal husbandry

The Carmel farm possesses valuable existing resources, particularly its land, which holds significant potential for both crop diversification and animal husbandry. The farm's soil, although currently impacted by past monoculture practices, still offers opportunities for rejuvenation through the introduction of a variety of crops, such as legumes, fruits, and vegetables. The diverse agroecological conditions of the land could support a range of crops that complement each other, fostering a more resilient farming system. Additionally, the land is well-suited for animal husbandry, with space available for integrating livestock such as goats, sheep, chickens, and rabbits.


**Figure 3**. Area of the farm

This combination of crops and animals can promote a balanced ecosystem, improve soil fertility through organic waste recycling, and provide multiple income streams, enhancing the farm's overall productivity and sustainability.

### 2.3.2. Basic infrastructure is in place but requires upgrades.

The Carmel farm is equipped with several valuable facilities, including a food processing unit for products like cheese, marmalade/jam, juice, dried fruits, etc., chicken and quail houses, fenced areas for livestock, an agriculture school, and other essential infrastructure. These resources provide a strong foundation for enhancing the farm's productivity and operational efficiency. Food processing facilities offer opportunities to add value to raw agricultural products, increasing profitability and market reach while

reducing post-harvest losses. The presence of dedicated housing for poultry and fenced areas for livestock ensures proper animal management, promoting health and productivity while minimising environmental impacts. Additionally, the school and other infrastructure create possibilities for community engagement, training, and knowledge sharing, making the farm a potential hub for education and sustainable development. Leveraging these resources effectively can significantly contribute to the farm's transformation into a model of integrated and sustainable agriculture. Although these facilities are in place and provide a solid foundation for the farm's operations, they would benefit significantly from modernisation and strategic upgrades. Improving the existing food processing units with more varieties of efficient and durable equipment could increase production capacity and ensure compliance with food safety standards, allowing the farm to tap into broader markets. Upgrading animal housing with better ventilation, insulation, and automated feeding systems would enhance the health and productivity of livestock and poultry. Additionally, expanding fenced areas and incorporating innovative systems such as rotational grazing or mobile pens could optimise land use and animal welfare. Investing in renewable energy solutions like biogas plants and solar panels for powering facilities and water pumps would not only reduce operational costs but also align with sustainable practices. These enhancements would transform the current facilities into state-of-the-art resources that maximise productivity, ensure long-term sustainability, and position the farm as a model for modern agroforestry and integrated farming systems.

**Figure 4**. Facilities (cattle/sheep/goat barn - left; Chicken/quails houses and food processing room- right)

### 2.3.3. Labour/Human Capital - Building Capacity for Sustainable Farming Practices

The Carmel farm benefits from having a dedicated team of workers already in place, which is a significant advantage for its ongoing operations and potential expansion. In addition to the workforce, the farm serves as a practical training ground for students, offering them hands-on experience in farming practices and sustainable agriculture, which enriches their education and supports their future careers. However, to fully realise the farm's vision of sustainable and integrated agroforestry, it is essential to invest in the education and training of both workers and students. Providing targeted training

programs on sustainable farming practices, agroforestry principles, and innovative technologies would enhance their understanding of the farm's goals and improve their ability to implement best practices effectively. Educating the staff and students on topics such as soil management, animal husbandry, crop production, food processing, waste recycling, renewable energy systems, and other sustainable agricultural practices would not only increase their productivity but also foster a sense of ownership and alignment with the farm's mission. This investment in human capital would transform the workforce and students into a knowledgeable and skilled team capable of driving the farm's transition to a modern, sustainable, and efficient agricultural system.

**Figure 5**. Workers in the nursery

### 2.3.4. Dedicated leader - the foundation of success

At the heart of the Carmel farm's transformation is its dedicated leader, Father Stefano Molon, whose vision and commitment have been instrumental in driving change. As a priest with a profound sense of responsibility towards his community and the environment, Father Stefano has devoted the past several years to managing the farm and fostering its transition from a traditional oil palm plantation to a sustainable and integrated agroforestry system. His hands-on approach, strategic planning, and passion for sustainability are evident in the farm's growing productivity, biodiversity, and innovative practices. Under his leadership, the farm has become a thriving model of resilience and adaptability, showcasing how dedication and purposeful action can yield impactful results. Father Stefano's unwavering commitment not only ensures the farm's success but also inspires those who work alongside him to embrace the shared vision of a sustainable future.

**Figure 6**. Father Stefano Molon - leader of the farm

### 2.4. Challenges Identified:

#### 2.4.1. Soil fertility declined due to years of monoculture.

One of the significant challenges identified on the Carmel farm is the decline in soil fertility, a direct consequence of years of monoculture practices associated with oil palm cultivation. Monoculture farming, particularly when focused on a single crop like oil palm, depletes essential nutrients from the soil without allowing for natural replenishment. Over time, this has led to reduced soil organic matter, lower nutrient availability, and diminished soil structure, making it harder for crops to thrive. As a result, the soil's ability to support diverse plant growth and sustain high yields has been compromised. To address this challenge, it will be crucial to implement soil restoration strategies, such as crop rotation, the introduction of leguminous plants, the application of organic fertilisers, and the integration of cover crops, which can help rebuild soil health and promote long-term agricultural sustainability.

#### 2.4.2. Limited biodiversity in terms of crops and livestock.

Another challenge faced by the Carmel farm is the limited biodiversity, both in terms of crops and livestock. The previous monoculture oil palm plantation created an environment with minimal plant variety, which not only affected soil health but also restricted the farm's resilience to pests, diseases, and environmental fluctuations. In addition, the lack of diverse livestock breeds and species limited the farm's ability to integrate animal production in a way that would complement crop cultivation. The absence of biodiversity reduces the farm's ecological balance, making it more vulnerable to market fluctuations and environmental changes. To address this, the farm needs to diversify both its crops and livestock, introducing a wider range of plant species,

such as legumes, vegetables, and fruit trees, as well as animals like goats, sheep, and poultry. This is already happening, as mentioned before, but this process should be continuous. This will enhance soil fertility, improve pest control, create more sustainable production systems, and increase the farm's overall resilience and profitability.

### 2.4.3. Lack of innovative technologies for waste management and energy production.

A significant challenge on the Carmel farm is the lack of innovative technologies for waste management and energy production. The farm currently lacks efficient systems to manage the organic waste generated from agricultural activities and animal husbandry. Without proper waste recycling methods, valuable resources like animal manure, plant residues, and food processing by-products are not fully utilised, leading to environmental pollution and lost opportunities for sustainable growth. There is one biogas plant constructed at the farm by FAO, but it is not and was never functioning. Additionally, there is a missed opportunity in renewable energy production, as the farm does not yet have systems like biogas plants or agricultural solar systems that could help reduce dependence on external energy sources. Other potential innovations, such as rainwater harvesting systems, small-scale aquaculture systems and smart irrigation technologies, could further improve water and energy efficiency. Introducing these technologies would not only address waste management issues but also generate renewable energy and organic fertilisers to power the farm's operations, reduce operational costs, and promote long-term sustainability. Implementing such innovations could significantly improve the farm's environmental footprint while enhancing its overall productivity and resilience.

**Figure 7**. Abandoned, never functioning biogas plant constructed by FAO programme

### 2.4.4. Absence of an integrated production system for crops, livestock, and aquaculture.

A challenge facing the Carmel farm is the absence of an integrated production system that combines crops, livestock, and aquaculture. Currently, these components are not sufficiently linked, limiting their potential to support and enhance each other. Integrated farming systems, where crops, livestock, and aquaculture are interconnected, provide a range of benefits, including nutrient cycling, efficient use of resources, and diversified income streams. For instance, livestock can provide manure to fertilise crops, while aquaculture systems can use organic waste from both crops and livestock as feed for fish, creating a closed-loop system. Without this integration, the farm is missing out on opportunities for improved resource management and increased productivity. Developing an integrated system that combines crop cultivation, animal husbandry, and aquaculture will not only enhance soil fertility and reduce waste but also provide a more resilient and diversified approach to farming, ensuring the long-term sustainability and profitability of the farm.

### 2.4.5. On-Farm Feed Production

Another challenge at the Carmel farm is the lack of on-farm feed production for the livestock, poultry, and other animals. Currently, the farm relies on external sources for

animal feed, which can be costly, inconsistent, and unsustainable in the long run. Establishing an on-farm feed production system would provide numerous advantages, including cost savings, improved control over feed quality, and reduced dependency on external suppliers. Growing forage crops such as alfalfa, grasses, or legumes, as well as producing feed from farm by-products like crop residues, can significantly reduce the need for commercial feed. Additionally, incorporating aquaculture waste into the feed system could create a circular process where organic materials are recycled and utilised to support animal nutrition. By adopting sustainable feed production methods, the farm would not only lower operational costs but also enhance its self-sufficiency, making it more resilient to supply chain disruptions and ensuring healthier, more cost-effective livestock.

### 2.4.6. Water Source + No Irrigation System

A major challenge at the Carmel farm is the lack of a comprehensive irrigation system, with only a 60-meter deep well available for garden irrigation. This limited water source restricts the farm's ability to scale up crop production, especially during dry periods when water availability becomes even more crucial. Without access to a reliable, year-round irrigation system, crop yields can be inconsistent, and some crops may not thrive, particularly those requiring regular watering. The reliance on a single deep well for irrigation further heightens the risk of water scarcity, especially as the farm diversifies its production. To address this challenge, the farm could explore water-saving technologies, such as drip irrigation or rainwater harvesting systems, which would improve water use efficiency and provide more consistent irrigation throughout the year. Additionally, integrating water management practices, such as mulching and soil moisture monitoring, could help conserve water and ensure sustainable crop production, enabling the farm to better cope with seasonal water fluctuations.

### 2.4.7. Road for Motorbikes Going Straight Through the Farm

A significant challenge for the Carmel farm is the road that passes directly through its property, used by hundreds of motorbikes daily. This busy thoroughfare leads to several issues, including pollution, waste accumulation, and noise pollution, which can disrupt both the farm's operations and the well-being of workers and livestock. The constant traffic also causes soil compaction, which negatively impacts soil health and reduces its ability to retain moisture and nutrients. Moreover, the presence of motorbikes creates an opportunity for theft, as produce or materials from the farm could be stolen easily during transit. To mitigate these issues, the farm could consider advocating for the construction of an alternative route that bypasses the property or works with local authorities to implement measures that limit the impact of the traffic, such as improved waste management, noise reduction strategies, or barriers to prevent theft. Additionally, the farm could invest in soil rehabilitation techniques to counteract the compaction and restore its productivity.

**Figure 8**. Motorbike road going through the whole farm.

### 2.4.8. Missing Fence Around the Farm

Another pressing challenge at the Carmel farm is the lack of a proper fence, which has become even more critical as the surrounding population grows, with new houses and developments encroaching on the area. The absence of secure boundaries increases the risk of theft, which has already affected the farm significantly. Father Stefano has mentioned that a large portion of the farm's fruit crops has been stolen, impacting both the farm's income and its ability to sustain production. As the population nearby continues to increase, this issue is likely to escalate unless preventative measures are taken. Erecting a solid perimeter fence around the farm would not only help reduce theft but also provide better security for livestock and crops, allowing for more effective management and protection of the farm's resources. In addition to the physical barrier, implementing surveillance systems or engaging the local community in farm protection could further deter theft and ensure the long-term sustainability of the farm's operations.

**Figure 9**. The football field at the farm premises, no fence right next to the fruit orchard

### 2.4.9. Newly Accommodated Neighbors Stealing Trees

A further challenge the Carmel farm faces is the issue of newly accommodated neighbours cutting and stealing trees from the property. As the surrounding area becomes more developed and the population grows, the farm has seen an increase in unauthorised access, with some neighbours taking advantage of the lack of proper fencing to remove valuable trees for their own use. This theft not only diminishes the farm's natural resources but also undermines its efforts to restore the land and transition to a more sustainable agroforestry system. To address this, it is crucial to implement stronger security measures, including the installation of a secure fence and possibly surveillance cameras/guards to monitor the perimeter. Engaging with the local community and educating them on the importance of protecting the farm's resources and the negative impact of such theft could also help reduce incidents. Building positive relationships with neighbours and involving them in the farm's development plans may also foster a sense of ownership and responsibility toward the farm's long-term success.

**Figure 10**. Recently cut and stealth forest tree.

### 2.4.10. Missing Promotion of the Farm and Its Activities

A notable challenge for the Carmel farm is the lack of promotion of its activities, which limits its potential to reach broader markets and attract visitors. With a more robust marketing strategy, the farm could increase sales of its products, such as fruits, vegetables, and processed goods, and reach customers beyond the local community. Additionally, promoting the farm's unique transition to sustainable agroforestry could attract eco-conscious consumers and tourists interested in sustainable farming practices, providing an additional revenue stream. By showcasing its innovative practices, diverse crop production, and educational opportunities, the farm could position itself as a model for sustainable agriculture, attracting visitors, volunteers, or even study groups. Engaging in local and international promotional efforts through social media, partnerships with organisations, and hosting events could significantly enhance the farm's visibility, boost its sales, and create opportunities for community involvement and eco-tourism, benefiting both the farm and the surrounding area.

**Figure 11.** Missing packaging for food products

# 3. Proposed Solutions and Recommendations

## 3.1. Soil Fertility Declined Due to Years of Monoculture

Monoculture depletes essential nutrients and reduces soil organic matter, making soil restoration a priority. To improve fertility, a combination of strategies is recommended: **Crop Rotation**: Under the remaining palm trees, implementing a crop rotation system with shade-tolerant and nutrient-enriching crops can significantly improve soil fertility and diversify production. A good starting point would be to plant nitrogen-fixing legumes such as groundnuts (peanuts), soybeans, cowpeas, and pigeon peas, which replenish soil nutrients and provide an additional source of income. Following legumes, shade-tolerant vegetables like spinach, amaranth, kale, cabbage, mustard greens, taro (Colocasia), and okra can be introduced to diversify the farm's produce and utilise the cooler microclimate provided by the palms. High-value crops such as ginger, turmeric, chilli peppers, and pineapples are excellent for rotation as they thrive in partial shade and generate substantial economic returns. Including soil-enhancing cover crops and green manures like mucuna (velvet bean), sunhemp, sesbania, and clover further aids in soil restoration by adding organic matter and suppressing weeds. Tubers like cassava, sweet potatoes, and yams can also be integrated into the rotation as they grow well in shaded conditions while improving soil structure and aeration. For additional diversity, shade-tolerant cereals such as short-cycle maise varieties and sorghum can be included to provide staple crops for food security. By carefully sequencing these crops—starting with legumes for nitrogen fixation, followed by vegetables and high-value crops, then root crops, and concluding with cover crops for soil recovery—the farm can improve soil health, control pests and diseases, and ensure sustainable, diversified production under the palm canopy.

**Figure 12.** It is visible in some parts of the farm that nature is “taking it back”, which is a great example

**Suggested Rotation Plan (Example):**

1. **Year 1:** Groundnuts or soybeans (Nitrogen fixation).
2. **Year 2:** Leafy greens or vegetables (Nutrient-demanding crops).
3. **Year 3:** Ginger or turmeric (High-value crop).
4. **Year 4:** Cassava or sweet potatoes (Root crops to improve soil aeration).
5. **Year 5:** Velvet bean or sunhemp (Soil recovery).

Organic Fertilisers: Regular application of compost, manure, and biochar can replenish organic matter, improve water retention, and boost microbial activity. Establishing an on-farm composting system using crop residues and animal waste would provide a continuous source of organic fertiliser. Also, the old palm trees can be used.

Cover Crops and Green Manures: Introduce cover crops like clover, alfalfa, or sun hemp to protect soil from erosion, suppress weeds, and contribute to organic matter when ploughed back into the soil.

Agroforestry: Integrating trees and shrubs into the farm can improve soil structure and microclimates. For example, nitrogen-fixing trees like *Gliricidia sepium* can provide shade, prevent erosion, and improve fertility through leaf litter decomposition.

Soil Testing and Monitoring: Conduct regular soil tests to identify nutrient deficiencies and adjust fertilisation practices accordingly. This ensures precise nutrient management and avoids overuse of inputs.

### 3.2. Limited Biodiversity in Terms of Crops and Livestock

A lack of biodiversity increases vulnerability to pests, diseases, and market fluctuations. Diversifying crops and livestock is essential to build resilience:

Crop Diversification: Introduce a variety of crops, including vegetables, fruits, herbs, and spices. High-value crops like ginger, turmeric, and chilli peppers can provide additional income, while staple crops like cassava or maise ensure food security. Intercropping systems, such as growing legumes between rows of oil palms, enhance resource use efficiency. The great thing is that the tree/plant nursery is already established at the farm, and it's working very well.

Livestock Diversification: Keep having small ruminants (goats, sheep) while introducing more poultry (chickens, ducks, guinea fowls, etc.) to complement existing systems. Small livestock provide manure for fertilisation and additional income streams. Indigenous breeds, which are well-adapted to local conditions, are recommended.

Agroforestry Integration: Incorporate more productive trees (mango, avocado, citruses, guavas, anonas, nut trees, etc.) and timber species into the landscape. These enhance biodiversity, provide shade, and contribute to soil restoration while offering marketable products. Plus, integrate some fast-growing plants like bananas, papayas, moringa, etc.

Habitat Creation: Create buffer zones with flowering plants and hedgerows to attract pollinators and natural predators, which help manage pests naturally. Biodiversity

corridors can also connect different farm areas, encouraging ecological balance.

**Figure 13.** A poultry house with chicken, quails and rabbits is a great start to having diversity.

### 3.3. Lack of Innovative Technologies for Waste Management and Energy Production

Efficient waste management and renewable energy systems can significantly improve farm sustainability:

Biogas Plants: Install a small-scale biogas plant to process animal manure and crop residues. The produced biogas can be used for cooking, heating, or powering machinery, while the by-product (digestate) serves as an excellent organic fertiliser.

Solar Power: Invest in more solar panels for electricity generation, prioritising essential operations such as irrigation and lighting. Solar dryers for crops can also reduce post-harvest losses.

Organic Waste Recycling: Establish a centralised composting unit to convert farm waste into high-quality compost. Vermicomposting, involving earthworms, can further enhance the nutrient quality of the compost.

Water Management: Introduce rainwater harvesting systems and efficient irrigation techniques (e.g., drip irrigation) to optimise water use. Recycling water from fishponds or cleaning operations for irrigation purposes can also reduce waste.

**Figure 14.** Wasted energy and nutrients - animal manure from the cattle barn.

### 3.4. Absence of an Integrated Production System

An integrated system allows different farm components to support one another, reducing waste and increasing productivity:

Crop-Livestock Integration: Establish a system where livestock manure is composted and used to fertilise crops. Plant residues can serve as animal feed, creating a closed nutrient loop.

Crop-Aquaculture Integration: Develop integrated aquaculture systems where fish waste enriches water used for crops. Floating gardens or gardens around fishponds can maximise space and resource use.

Multitrophic Farming: Combine fish farming with aquatic plants (e.g., water spinach) and algae production to create synergies and reduce inputs.

Collaboration with Experts: Partner with agricultural extension services or research institutions to design an integration plan that aligns with the farm's specific needs and resources.

### 3.5. On-Farm Feed Production

Producing animal feed on-site ensures quality control and reduces reliance on external suppliers:

Forage Production: Establish dedicated fields for growing nutrient-rich grasses and legumes like alfalfa, Napier grass, and clover. These can be harvested regularly for livestock feed.

Crop Residue Utilisation: Process farm by-products (e.g., maise stalks, oil palm residues, banana stems and leaves, Sweet potato vines and cassava leaves, ) into silage or hay for animal feed. This ensures year-round availability.

Rotational Grazing: Implement rotational grazing practices to improve pasture health and productivity. Animals are moved between paddocks, allowing forage to regenerate.

Aquatic Feed Resources: Use fishponds to produce protein-rich feed components, such as duckweed or azolla, which can supplement animal diets.

### 3.6. **Efficient water management** is vital for consistent crop production:

Drip Irrigation: Install a drip irrigation system to deliver water directly to plant roots, reducing waste and improving water use efficiency.

Rainwater Harvesting: Set up larger catchment systems with tanks or reservoirs to store rainwater for use during dry periods. Ensure runoff channels are designed to minimise water loss.

Soil Moisture Conservation: Employ mulching with organic materials (e.g., straw, grass or palm tree clippings) to retain soil moisture. Planting windbreaks can reduce evapotranspiration rates.

Water Recycling: Reuse greywater from farm operations for irrigation purposes after basic filtration.

### 3.7. Road for Motorbikes Going Straight Through the Farm

Unregulated road traffic poses challenges to farm operations and security:

Barriers and Access Control: Install physical barriers, such as gates or hedgerows, along the road to minimise noise and pollution. Establish controlled entry points to regulate traffic.

Community Collaboration: Engage with local authorities to propose an alternative route that bypasses the farm. Highlight the benefits of rerouting for both the community and the farm.

Soil Rehabilitation: Apply soil restoration techniques in areas affected by compaction, such as adding organic matter or planting deep-rooted cover crops.

### 3.8. Missing Fence Around the Farm

Securing farm boundaries is essential to protect resources and prevent theft:

Perimeter Fencing: Build a sturdy fence using durable materials like wire mesh or wood. For a long-term solution, establish a living fence with thorny plants or fast-growing species like bamboo.

Surveillance Systems: Install cameras or hire security personnel to monitor the farm

perimeter and deter intruders. Motion-sensitive lights can enhance security at night.

Community Involvement: Engage with local residents to foster a sense of shared responsibility. Involving them in farm activities or offering incentives could reduce theft risks.

### 3.9. Newly Accommodated Neighbours Stealing Trees

Unregulated tree cutting undermines agroforestry efforts:

Strengthen Boundaries: Enhance fencing around the farm, especially in areas near neighbours. Living fences of thorny plants or hedgerows provide a natural deterrent.

Reforestation and Awareness Campaigns: Organise community workshops to educate neighbours on the environmental benefits of tree conservation. Offer saplings or alternative wood sources to reduce pressure on farm trees.

Local Collaboration: Collaborate with community leaders to mediate disputes and establish agreements that protect the farm's resources while addressing neighbour needs.

### 3.10. Missing Promotion of the Farm and Its Activities

Effective promotion can increase sales, attract visitors, and strengthen community ties:

Brand Development: Create a strong farm identity with a logo, slogan, and marketing materials. Develop a narrative that highlights the farm's transition to sustainable practices.

Online Presence: Launch a website and maintain active social media accounts to showcase products, farming practices, and success stories. Share educational content to engage followers.

On-Site Events: Organise farm tours, workshops, or open days to attract local visitors and tourists. Events could include hands-on experiences in agroforestry, livestock management, or organic farming.

Partnerships: Collaborate with local businesses, schools, and organisations to promote the farm as a model for sustainability and innovation.

These solutions focus on long-term sustainability and resilience, aligning with the farm's goals for productivity and ecological health.

## 4. Other recommendations and tips

### 4.1. Example of implementation Plan

- Short-Term (0–6 months):
    1. Conduct soil testing to determine fertility restoration needs.
    2. Begin pilot programs for poultry and small-scale aquaculture.
    3. Establish composting and vermiculture systems.

- Mid-Term (6–18 months):
    1. Expand integrated farming practices across the farm.
    2. Install a biogas plant and initiate renewable energy usage.
    3. Train farm workers on sustainable agroforestry and animal husbandry.
- Long-Term (18–36 months):
    1. Develop a market strategy for diversified products (fruits, eggs, fish, organic fertiliser).
    2. Expand tree planting for carbon sequestration and long-term sustainability.

## 5. Expected Outcomes

Implementing the proposed solutions is expected to result in significant improvements across multiple dimensions of the Carmel farm's operations and its contribution to the surrounding community:

**Increased Productivity and Profitability**

By adopting integrated farming systems, diversifying crops and livestock, and utilising innovative technologies for waste management and renewable energy production, the farm will achieve higher yields and more efficient use of resources. The introduction of value-added processing and on-farm feed production will further lower costs and create new revenue streams, enhancing the overall profitability of the farm. The ability to produce a wider variety of high-quality products will also open new markets, strengthening the farm's economic stability.

**Figure 15.** Cocoa seedlings - a great source of income and tree source.

## Enhanced Soil Fertility and Biodiversity

The transition from monoculture to a diverse agroforestry system will restore soil health through practices like crop rotation, cover cropping, and organic fertilisation. Increased biodiversity in crops, fruit trees, and livestock will improve the ecological balance of the farm, making it more resilient to pests, diseases, and climatic changes. The cultivation of a variety of crops and the introduction of fruit trees will not only enrich the soil but also provide a more stable and sustainable production system.

**Figure 16.** A great example of multi-cropping - papaya together with moringa - fast-growing plants which can fastly cover the soil and produce not only food but also shade.

## Reduced Environmental Impact

The implementation of renewable energy systems, such as biogas and solar energy, coupled with efficient waste recycling methods, will significantly reduce the environmental footprint of the farm. Organic waste will be transformed into valuable resources like compost, fertilisers, and animal feed, reducing reliance on external inputs and minimising waste disposal challenges. These measures will also decrease greenhouse gas emissions, contributing to the farm's environmental sustainability.

**Figure 17.** Improper storage of manure.

## Improved Livelihoods for Farmworkers and Community Members

Enhanced productivity and profitability will create more employment opportunities and ensure fair wages for farmworkers, improving their livelihoods and quality of life. Training programs and community engagement initiatives will empower workers with new skills and knowledge, fostering a sense of ownership and pride in the farm's success. Additionally, the increased availability of nutritious food and the farm's role as a model for sustainable agriculture will benefit the local community, promoting food security and economic development.

**Figure 18.** Basic fruit processing - papaya/mango jam.

**Strengthened Farm Reputation and Community Relationships**

With effective promotion and marketing of the farm's activities, products, and sustainability achievements, Carmel Farm will gain recognition as a leader in sustainable agriculture. This will attract more customers, eco-tourists, and potential collaborators, creating new opportunities for growth. Positive engagement with local communities and education on the importance of sustainable farming will build stronger relationships, ensuring long-term support and mutual benefit for both the farm and its neighbours.

**Figure 19.** Visitors and buyers come to the farm to buy cheese, jam, etc., but only in small quantities.

By addressing these interconnected outcomes, the Carmel farm will establish itself as a thriving and sustainable enterprise, capable of serving as a model for similar initiatives in the region.

## 6. Conclusion

The Carmel farm possesses immense potential to transform into a model of sustainable agroforestry in the Central African Republic. By implementing the proposed solutions, the farm can achieve remarkable economic, ecological, and social benefits while setting an example for sustainable agricultural practices in the region. Diversifying crops, enhancing biodiversity, integrating production systems, and adopting innovative waste management and renewable energy technologies will not only improve the farm's productivity and profitability but also restore soil fertility, conserve natural resources, and reduce environmental impact. Furthermore, these measures will foster community engagement, improve livelihoods for workers and local residents, and strengthen food

security in the region.

The incredible work that has already been accomplished by Father Stefano cannot be overlooked. His dedication and leadership in transitioning the farm from a monoculture plantation to a sustainable agroforestry system have been exceptional. His commitment to improving the farm, coupled with his understanding of sustainable farming practices, has set the foundation for this transformation. Father Stefano's efforts have been instrumental in initiating the changes that will propel the farm toward greater productivity, environmental stewardship, and community impact.

However, achieving this ambitious vision will require financial resources and external support. To implement all of the proposed solutions effectively, it will be necessary to secure funding from donors or development agencies. Raising these funds is a critical step toward realising the farm's full potential. Collaboration with the Czech University of Life Sciences (CZU), Faculty of Tropical AgriSciences, offers an excellent opportunity to facilitate this process. CZU can not only assist in fundraising efforts but also provide access to a network of experts who can address specific challenges faced by the farm. These experts can deliver targeted training, offer technical guidance, and conduct workshops or lectures to empower the farm's team and surrounding communities with the knowledge and skills needed for long-term success.

By building strong partnerships and securing the necessary resources, the Carmel farm can become a beacon of sustainable agriculture in the region. This transformation will not only benefit the farm and its stakeholders but also inspire similar initiatives, contributing to broader environmental sustainability, regional development, and food system resilience in Central Africa.

With regards,

Jan Staš

stas@ftz.czu.cz

https://biogas.czu.cz/en

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