NICARAGUA

REGENERATIVE AND HIGH QUALITY COFFEE AGRONOMIC GUIDE

VERSION 3

MARCH 2025

Preamble

At *Nespresso*, we believe that Nature is our greatest ally in securing the future of coffee in general and especially the high-quality coffees we source for our business.

For 20 years, our sourcing program, the *Nespresso* AAA Sustainable Quality™ Program, has been the vehicle for the adoption of innovative agricultural practices. In this new chapter, the AAA Program will further promote the investment into Natural Capital. The transformative power of Nature can deliver the services that famers and society critically need: resilience, yield, quality consistency, new sources of income, carbon sequestration and biodiversity conservation.

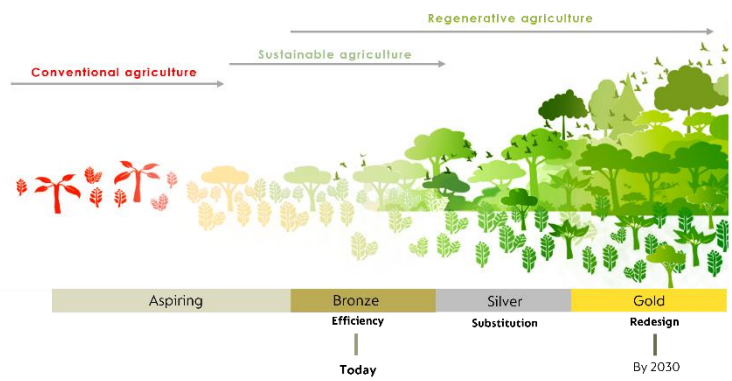
In this new chapter, Sustainable Quality will further integrate high quality coffees with healthy ecosystems, quality of life and thriving communities.

Nespresso and Rainforest Alliance share a common vision of regenerative agriculture building on 3 foundational principles:

I. Produce in ways that actively restore and protect biodiversity in-and-around production areas.
II. Reduce greenhouse gas emissions, adapt to climate change and build resilience in the farm.
III. Preserve the livelihoods of the farmers now and in the long-term.

It is our conviction that these three foundational principles are the only way to guarantee a long-term sustainable supply of high-quality coffee.

The co-created Rainforest Alliance's Regenerative Coffee Scorecard helps understand where one stands in the transition: **FROM BRONZE TODAY TO GOLD BY 2030.**



Once Gold, the farms will in turn offer many benefits to society: offering habitats or corridors for species, sequestrating carbon and replenishing watersheds. Thanks to the availability of organic matter, the soil of the farms will maintain living organisms needed for nutrients cycling.
Equally Nespresso and its partners will continue to enrich this document with new scientific insights towards an integrated quality concept ie cup profiles, healthy soil, healthy ecosystems and thriving communities.

We invite you to read this agronomic guide which will lays the pathway towards Gold.

NICARAGUA

This document aims to guide the implementation of regenerative coffee growing in the field, training, support work for coffee growers, and cluster planning actions. The Agronomic Guide connects the vision of the Rainforest Alliance Regenerative Coffee Scorecard with the technical and environmental research and recommendations available in Nicaragua.

Regenerative agriculture is about change management, therefore relies on motivation, knowledge, and resources to ensure the transition of the practices. *Nespresso* provides to the AAA farmers, the enabling conditions for a smooth change management, price premiums paid by AAA coffee, investment, infrastructure and alternative solutions, and technical assistance.

To motivate behavioural change among producers and their families, field teams implement an adoption strategy through local producer networks, supported by influential local producers – opinion leaders – and encourage the exchange of experiences in their local contact networks. The innovation and creativity in the work of AAA producers, AAA agronomists, *Nespresso* and their partners guarantee optimism for transforming coffee production with a positive impact.

Nespresso acknowledges the contributions of ECOM and NicaFrance in Nicaragua. Their experience in the field has been a fundamental input to building this agronomic guide and consolidating the work of the AAA Program.

RAINFOREST ALLIANCE ENDORSES THIS GUIDE as a set of recommendations for the journey toward Gold Standard regenerative coffee production in AAA coffee farms in Nicaragua; this guide is in alignment with the Rainforest Alliance Regenerative Coffee Scorecard.

AT *NESPRESSO*, WE BELIEVE THAT NATURE IS OUR GREATEST ALLY IN SECURING THE FUTURE OF COFFEE

"Regenerative Agriculture …a farming approach that emphasises protecting and restoring natural resources (primarily soil, but also water and biodiversity) to deliver multiple benefits to farmers, environment and society. By strengthening soil health and ecosystem services, regenerative agriculture helps make agroecosystems more productive and resilient, while also improving farmers' livelihoods. A focus on regenerative agriculture further creates important opportunities to mitigate greenhouse gas (GHG) emissions ".[1]

THE GUIDANCE DEFINED BELOW IS BUILT FOR AAA AGRONOMISTS AND TEAMS IN THE CLUSTER TO GUIDE FARMERS IN THE TRANSITION.

THE AGRONOMIC GUIDE BUILDS ON THREE PRINCIPLES that will be conveyed to the farmers as the Cluster Operational Plan is deployed. These three principles require a mindset change of the producers and the coffee partners *Nespresso* works with.

I. By Design, the farm generates organic materials and biocontrol.
II. Soil Health first before plant nutrition
III. Resilience and profitability vs. productivity

IT REFLECTS THE NESPRESSO JOURNEY TOWARD REGENERATIVE WITH ONE CHAPTER BY KEY PRACTICES' AREAS:

1. **FARM DESIGN**
2. **SOIL HEALTH**
3. **PLANT NUTRITION**
4. **PLANT HEALTH**
5. **WATER MANAGEMENT**
6. **FARM FINANCIALS**

THROUGHOUT THE DOCUMENT, WE WILL PROVIDE DIFFERENT SECTIONS FOR EACH CHAPTER. **WE IDENTIFY THREE LEVELS AS FOLLOWS**:

01 → **PERFORMANCE EXPECTATION** is primarily based on the criteria of the Rainforest Alliance Regenerative Coffee Scorecard.

02 → **IMPLEMENTATION RECOMMENDATIONS** that AAA Agronomists present to AAA Farmers.

03 → **ACTIONS** that are planned at the cluster level to facilitate the adoption and change towards regenerative practices.

[1] Pulleman et al., 2023, p. 16.

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1. FARM DESIGN

1.1 REHABILITATION & RENOVATION

"Planning for renovation, and to some extent rehabilitation, provides a perfect opportunity to implement other regenerative practices that require restructuring of the production system. These practices include system diversification using well-suited intercropping and agroforestry designs as well as soil conservation practices and other measures to improve soil health." [2]

"Healthy and productive trees, well adapted to the local agroecological conditions and farming systems, are a basic prerequisite for obtaining a good response to the adoption of any (regenerative) practice." [3]

Figure 1 illustrates some terms that can be confusing in translation and technical description.

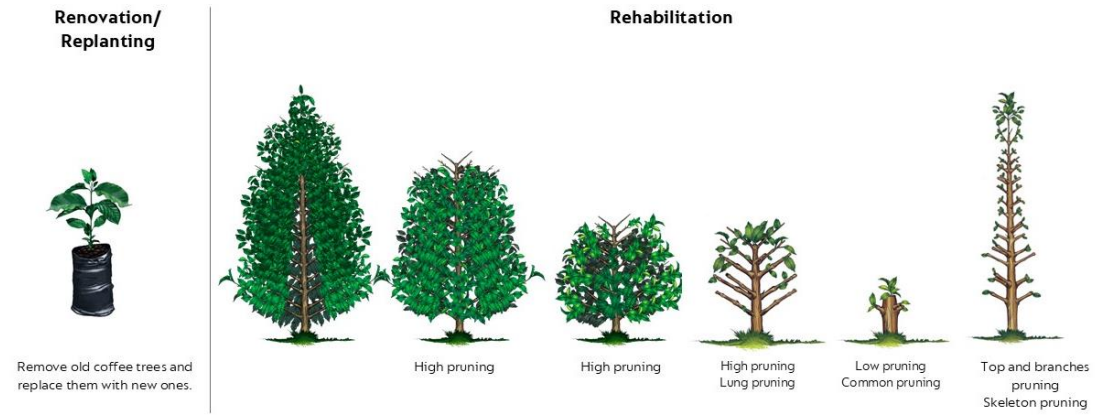


Figure 1. *Conditions of renovation and rehabilitation.*

Note: Please review Annex 2 for further details on these terms in the context of the Rainforest Alliance Regenerative Coffee Scorecard.

[2] Pulleman et al., 2023, p 50.
[3] Pulleman et al., 2023, p. 48.

Promote the rehabilitation or renovation of coffee plantations as a key strategy to improve medium- and long-term productivity. Although this practice has low adoption rates among coffee growers, its positive impact on productivity is significant. It is essential to consider that this intervention requires substantial investment and may cause a temporary decrease in productivity. Therefore, financial and technical support mechanisms should be designed to facilitate its implementation. Rehabilitation or renewal cycles should be a management measure to prevent production decline.

RECOMMENDATIONS

a. Conduct a comprehensive assessment of the state of coffee crops, evaluating key aspects such as plant quality, planting density, the net number of coffee trees per plot, current production potential, and plot areas. This information will serve as the foundation for planning and decision-making.

b. Develop a comprehensive farm plan that includes specific actions for rehabilitation and renovation. This plan should incorporate adjustments to varieties and planting densities and the integration of agroforestry designs. All these actions must align with the coffee growers' objectives, available resources, and the environmental characteristics of each farm.

REHABILITATION:

"Rehabilitation involves pruning and stumping the coffee trees, while maintaining the current root stock." [4]

"Frequent pruning to maintain coffee tree health and productivity."[5]

[4] Pulleman et al., 2023, p. 48.
[5] Rainforest Alliance, 2022 a.

RECOMMENDATIONS

a. Rehabilitation (or pruning as a specific practice) aims to intervene in the coffee plant's tissues to promote the formation of young tissue that restores production. When the coffee plants have few productive branches, rehabilitation can restore coffee productivity (Figure 1).[6]

b. Rehabilitation increases plant productivity through tissue management via pruning. As an initial measure, it is applied to plantations with low productivity due to age, pests, diseases, or poor agricultural practices. Production management aims to establish a rehabilitation program for coffee plantations as a regular practice in different farm plots each year to maintain stable production. .

c. Coffee plant tissue rehabilitation frequency is determined based on the annual productivity trend. The rehabilitation cycle is the years between two successive prunings of a part (stem or branch) of a plant or all the plants in a row or plantation blocks[7].

d. Rehabilitation can combine types of pruning (low, high and top pruning). It can be applied selectively in rows, a complete plot, or a combination.[8]

e. The definition of rehabilitation types depends on several factors, such as variety, biophysical context (altitude, rainfall and soil), plant age, vigour, agronomic management, pest incidence and diseases[9].

[6] Pulleman et al., 2023, p, article 51.
[7] Somarriba and Quesada, 2023 b.
[8] Rojas & Ramírez, 2016.
[9] Somarriba et al, 2021

RENOVATION:

"Renovation involves uprooting old trees and filling gaps with new plantings to replace the current coffee variety as well as the rootstock. This practice also makes it possible to increase planting densities or change to a different system design." [10]

"Replanting or renovation, implemented to ensure at least 50% of the plot is in young or middle age (≤ 8 years) trees. RA Scorecard – Gold Level. [11]

"Coffee variety is selected based on quality, productivity, and rust resistance. Use of rust-resistant varieties on >50% of the plot. RA Scorecard – Gold Leve.[12]

The main limitations to the implementation of renovation and rehabilitation are the high upfront investments in planting materials and labour, especially in the case of renovation. A further disadvantage is that the practice leads to an initial, short-term loss of yield and income. [13]

RECOMMENDATIONS

a. The installation of the germinator and nursery must be planned, considering the age of transplantation of the plants to the field. Planting is recommended in May when the rains begin.[14]

b. Before the renovation, a soil analysis is performed to determine the correction needs for pH and aluminium. One month before planting, the necessary corrections are

[10] Pulleman et al., 2023, p. 48.
[11] Rainforest Alliance, 2022 a.
[12] Rainforest Alliance, 2022 a.
[13] Pulleman et al., 2023, p. 54.
[14] Instituto del Café de Costa Rica, 2020.

applied using options such as calcium carbonate, magnesium carbonate, calcium hydroxide, calcium sulphate, and agricultural gypsum.[15]

c. As a preventive practice, it is recommended to disinfect the substrate in coffee nurseries using the steam method, heating it between 60°C and 70°C for 30 minutes to eliminate pathogens and weed seeds without harming beneficial microorganisms. Another option is solarisation, spreading the substrate in a thin layer and covering it with transparent plastic for 4-6 weeks, which is ideal for warm climates. Afterwards, it is essential to incorporate beneficial microorganisms, such as Trichoderma or mycorrhizae, to restore the substrate's microbiology and prevent diseases. Two products are available on the market for application as a soil drench. The first is Nemaxxion, composed of *Bacillus spp*., *Trichoderma spp., Paecilomyces spp*., *Tagetes erecta* extract, and organic conditioners. The recommended dosage is 3 to 4 litres per hectare, with three applications per year. The second product is Best Ultra, which contains *Bacillus spp., Trichoderma spp., Paecilomyces spp., Beauveria spp*., stabilisers, and plant extracts. The recommended dosage for this product is 2 to 3 litres per hectare, also with three annual applications.

d. The renovation allows the incorporation of coffee cultivars that are resistant to pests and diseases and adaptable to climate changes. In turn, it allows for the establishment of new roots, the development of vigorous stems, and increased productivity during the plant's growth cycle.

e. The main varieties of Arabica coffee grown in Nicaragua are Costa Rica 95, Caturra, Parainema, Marsellesa, Catuaí Rojo, among others. The varieties are of good productivity and quality but some of them susceptible to coffee rust. ECOM and other companies have developed new varieties and hybrids (cultivars) available for plantation renewal (Table 1). The varieties listed in the table meet the quality profile required by Nespresso. According to the renovation programs, the goal is to have at least 50% of the planted area with varieties tolerant to coffee leaf rust.

CULTIVAR	BEHAVIOUR AGAINST COFFEE RUST	NEMATODE BEHAVIOUR
Marsellesa	Tolerant	Susceptible
Starmaya	Tolerant	Tolerant
Centroamericano (H1)	Tolerant	Grafted onto *C. canephora*, it is resistant to some species of nematodes from the genus *Meloidogyne*.
Mundo Maya (EC16)	Tolerant	Resistant to some species of nematodes of the genus *Meloidogyne*
Parainema	Tolerant	Resistant to some species of nematodes of the genus *Meloidogyne*
Obatá Rojo	Tolerant	
Costa Rica 95	Tolerant	
Lempira	Tolerant	

Table 1. *Coffee cultivars available in Nicaragua* [16] [17]

[15] Instituto del Café de Costa Rica, 2020, p. 84
[16] World Coffee Research, 2023.
[17] Starbucks, 2023.

f. AAA Agronomists will advise and encourage farmers to choose a suitable variety or cultivar (hybrid) based on their analysis of local variables. All varieties and cultivars listed in Table 1 fit the *Nespresso* quality profiles associated with each group. Given the investment required for a change in varieties, the renewal process should be done gradually, at a rate of 10-15% per year on the total coffee area.

g. Nurseries can be built on the ground in planting beds (1.5 m width, 10-15 cm high, maximum 40 m longIn Nicaragua, biodegradable bags and technologies like Jiffy pellets and Ellepot biodegradable plugs are available. The pellets contain compressed biodegradable peat and support the plant for 12–16 weeks. At ECOM Nicaragua, the plugs are reused with polypropylene tubes, lasting up to 10 years. The substrates are composed of 65–70% inert material, 30% coconut fibre, and 5% compost made from coffee pulp. *Nespresso* and the clusters may consider encouraging renewal through centralised nursery programmes that provide planting materials to producers. These nurseries should follow agronomic management recommendations regarding overall plant health and management. Nurseries must have certification from the competent national authority in Nicaragua, corresponding to the Institute of Agricultural Protection and Health (IPSA) certification programme.

h. Hybrid cultivars, such as H1 and EC16, should not be reproduced from seed due to variation or segregation towards the characteristics of their progenitors.

i. The recommended density/spacing depends on technical criteria, such as variety, climatic conditions, length of the rejuvenation cycle, and agronomic practices. Different planting distances between trees and lines can be applied, with some models based on the prevalence of the dry season throughout the year (Table 2).[18]

j. A temporary shade level can be promoted during the establishment stage using fast-growing species. This shade level helps improve the coffee's growing environment while the permanent shade trees are being established. In Nicaragua, species like pigeon pea, castor bean, or banana are used.

VARIETY	DISTANCE BETWEEN ROWS (M)	DISTANCE BETWEEN PLANTS (M)	TREES PER HECTAREA
Marsellesa	2	1,25	4000
Parainema	1,90	1,10	4784
Catimor	1,75	1,25	4571
Obatá Rojo	2	1	5000
Starmaya	3	1	3333
Centroamericano (H1)	2,5	1,25	3333
Mundo Maya (EC16)	3	1	3333

Table 2. *Some Planting Distance Alternatives for Coffee Renovations in Nicaragua. Source: Sustainable Management Services (SMS), Nicaragua, 2024*

[18] Instituto del Café de Costa Rica, 2020.

STEPS IN THE CLUSTER ACTION PLAN

STEPS	CLUSTER MANAGER	AAA AGRONOMIST
Promote the adoption strategy for the defined acceleration group of AAA Farmers.	☑	☑
Define and implement the renovation/rehabilitation plan by considering variety, density, arrangements, cycles, and productivity performance. Each farm defines the renovation plan with the help of the AAA Agronomist. The clusters monitor annual progress regarding the area and the number of trees renovated or rehabilitated	☑	☑
Identify alliances and coordinate with the renovation and rehabilitation programmes of the Government, coffee institutes or private companies.	☑	

1.2 AGROFORESTRY

"Maintaining agroforestry cover, including a diversity of trees on the overall farm (coffee plots and/or surroundings), with at least eight species (ideally native), manages species diversity, as described in the Silver level, and provides two strata of tree levels. If agroforestry cover is not suitable for the local environmental conditions, trees may also be planted around the infrastructure, borders, etc. RA Scorecard – Gold Level." (Rainforest Alliance, 2022a). [19]

RECOMMENDATIONS

a. The agroforestry projects implemented by *Nespresso* and PUR promote three plantings: Hedgerows planted around coffee plots, intercropping with coffee shade, and plantations around coffee plots or degraded or eroded land. Trees planted in agroforestry projects are tracked using geolocation.[20]

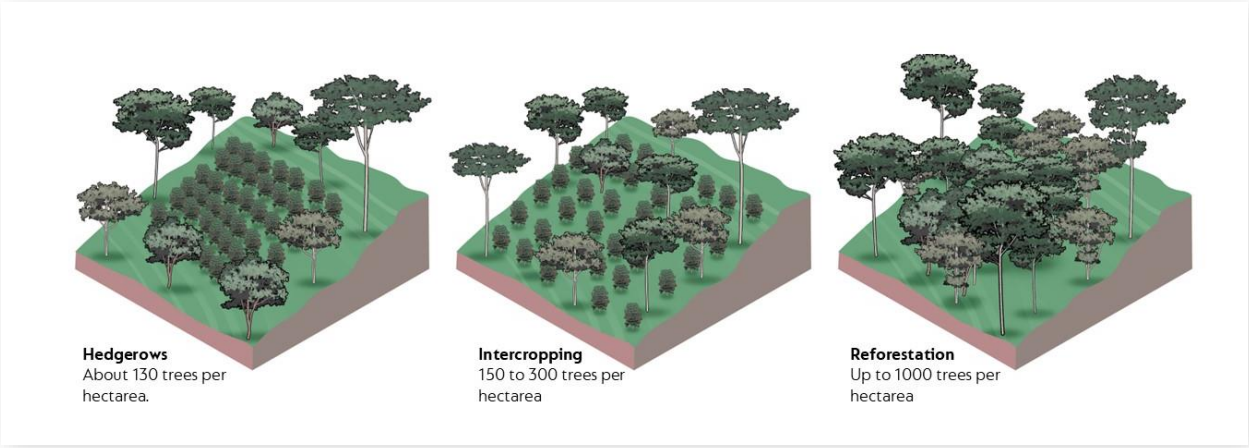


Figure 2. *Different agroforestry models implemented in AAA farms. Source: Nespresso, Adapted from PUR Projet, 2021.*

[19] Rainforest Alliance, 2022
[20] *Nespresso*, Proyecto PUR, 2021, p. 159.

b. The choice of species is based on on-site assessments and farmers' needs. Trees are selected based on their proven suitability for site conditions and the purposes of the trees in agroforestry or forestry systems (wood production, shade, nitrogen-fixing species, soil improvement, etc.). Most of the species planted will be native (Table 3). Based on the experience of implementing agroforestry projects (PUR), recommendations for settlement are proposed for each farm and agreed upon with coffee growers, considering their needs and expectations. Models may vary depending on the stage of coffee production.

c. The spatial arrangement of trees (density and canopy level) will be considered as species are selected.

d. Planting waves occur during the rainy season, the same months indicated for coffee renovation.

e. Table 3 shows the tree species most commonly used in the PUR agroforestry models in clusters of Nicaragua.

COMMON NAME	SCIENTIFIC NAME	TYPE (NATIVE/NON-NATIVE)
Búcaro	*Erythrina fusca*	Native
Caoba	*Swietenia macrophylla*	Native
Cedro	*Carapa guianensis*	Native
Cedro real	*Cedrela odorata*	Native
Chaperno	*Lonchocarpus minimiflorus*	Native
Coyote	*Platymiscium dimorphandrum*	Native
Granadillo de montaña	*Dalbergia cf. cubilquitzensis*	Native
Guaba	*Inga spp.*	Native/Naturalised
Helequeme	*Erythrina poeppigiana*	Naturalised
Laurel	*Cordia alliodora*	Native
Nogal	*Juglans olanchana*	Native
Roble macuelizo	*Tabebuia rosea*	Native
Chilamate	*Ficus obtusifolia*	Native
Aguacate	*Persea americana*	Non-native
Limón	*Citrus limon*	Non-native
Naranja	*Citrus x sinensis*	Non-native

Table 3. *Tree species for the agroforestry projects in Nicaragua.*

f. During the renovation, implement the multi-layer agroforestry models based on diverse native trees (at least 8 tree species, if local conditions allow). The selection of tree species shall be based on the following critical criteria: tree morphology and physiology, pruning requirements, complementarity and compatibility of species, ability to fix nitrogen and other beneficial functional traits, multifunctionality and economic value.[21]

g. The CATIE Research Centre is an invaluable source of knowledge on the benefits of tree technical management, the responses of shade-grown coffee crops and the

[21] Pulleman et al., 2023.

economic analysis of agroforestry systems. It has detailed information on experiments with more than twenty years of evaluation. CATIE research indicates that the optimal shade levels for *Erythrina poeppigiana* are around 40% for the best levels of coffee productivity.[22] [23]

h. According to a recent meta-analysis, maintaining a shade level between 10% and 40% is recommended to optimise the yield of *Coffea arabica*. This study shows that this shade range can have neutral or positive effects on the productivity of various cultivars, providing additional benefits against adverse climatic conditions and improving soil health.[24]

i. Shade systems with *Erythrina poeppigiana* and the combination with *Chloroleucon eurycyclum* (cashá) have shown the highest coffee productivity. Implementing agroforestry systems has proven effective in preventing soil acidification and improving physical and chemical properties.[25]

j. The planting density of service shade trees, with a pruning model like *Erythrina poeppigiana*, varies between 100 and 160 shade trees per hectare. The amount depends on the site's luminosity and the coffee crop's planting density.

k. In intercropping, tree planting arrangements range from a minimum of 6 m × 6 m to 15 m × 15 m. In the case of edge arrangements, between 6 and 8 m is recommended for 100 to 125 trees per linear kilometre.[26] (Tabla 4)

IN SOWING (DISTANCE IN METERS)	NUMBER OF TREES/HECTARE	AFTER THINNING 50% (7 TO 8 YEARS)	NUMBER OF TREES/HECTARE
TIMBER			
5 × 5	400	10 × 10	100
10 × 10	100	20 × 20	25
15 × 15	44	30 × 30	11
FRUIT			
15 × 15	44	Not applied when permanent	44
20 × 20	25		25
SHRUBS (< TO 3 M HIGH)			
6 × 6	277	If it is a temporary crop, it is eliminated when it has already fulfilled its functions. Continuous management is given if permanent, and the need for thinning is defined.	
7 × 8	178		
10 × 10	100		

Table 4. *Definition of the appropriate planting distances (timber, fruit trees, shrubs) in coffee plantations.*[27]

[22] Muschler, 1999 , p. article 39.
[23] Virginio, et al., 2015.
[24] Koutouleas et al.2022.
[25] Virginio, et al., 2015.
[26] Gómez, 2022.
[27] Virginio, 2024.

I. The Cornell Lab has identified trees in Nicaragua with high value for wildlife and ecosystem services. It is recommended to promote key species in coffee plantations, which are detailed in Table 5. These species support biodiversity and benefit specific bird species, even though some have low commercial value. Selection should prioritise species resistant to climate change, with a focus on families such as Lauraceae, Fabaceae, and Anacardiaceae. In live fences and forests, natural regeneration is encouraged alongside species like Cedars and Ceibas. Forest conservation aims to maintain biodiversity in coffee landscapes by connecting patches through reforestation and live fences. Existing forests provide shelter and food for various species, also contributing to pest control, such as coffee borer beetles. Furthermore, the restoration of water source edges and improved farm practices are promoted to strengthen ecological connectivity.[28]

COMMON NAME	SCIENTIFIC NAME	TYPE (NATIVE/NON- NATIVE)
Búcaro	*Erythrina fusca*	Native
Caoba	*Swietenia macrophylla*	Native
Cedro	*Carapa guianensis*	Native
Cedro real	*Cedrela odorata*	Native
Ceiba	*Ceiba petandra*	Native
Chaperno	*Lonchocarpus minimiflorus*	Native
Coyote	*Platymiscium dimorphandrum*	Native
Copalchi	*Croton niveus*	Native
Granadillo de montaña	*Dalbergia cf. cubilquitzensis*	Native
Guaba	*Ingas*	Native
Guanacaste	*Enterolobium cyclocarpum*	Native
Guarumo	*Cecropia peltata*	Native
Helequeme	*Erythrina poeppigiana*	Naturalised
Laurel	*Cordia alliodora*	Native
Nogal	*Juglans olanchana*	Native
Roble macuelizo	*Tabebuia rosea*	Native
Chilamate	*Ficus obtusifolia*	Native
Aguacate	*Persea americana*	Non-native
Limón	*Citrus limon*	Non-native
Naranja	*Citrus x sinensis*	Non-native

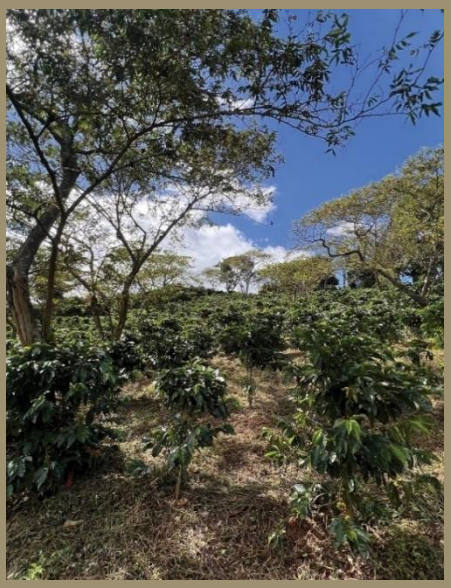
Table 5. *Tree Species in Nicaragua Providing High Wildlife Value and Ecosystem Services.*

[28] Tórrez, M., Molina, I., et al. 2023

"Pruning of companion trees ensures optimal light and microclimatic conditions for coffee growth, flowering, and fruit development. Regulating temperature and humidity in the lower levels is also important to control pests and diseases. Ideally, pruning should be planned according to climatic conditions and pruning calendars." [29]

"Ensuring that aquatic ecosystems are surrounded by riparian buffers of natural vegetation following thestandard width parameters. RA Scorecard – Gold Level."[30]

"Establishing agroforestry systems requires investment and labour, including specific skills and tools (e.g., to prune tall canopy trees), and it can take a long time (typically 5–20 years for fruit and timber trees) before farmers reap the economic benefits."[31]



[29] Pulleman et al., 2023, p. 64.
[30] Rainforest Alliance, 2022 a.
[31] Pulleman et al., 2023, p. 67.

STEPS	CLUSTER MANAGER	AAA AGRONOMIST
Implement the agroforestry programme.	☑	
Integrate agroforestry into the coffee production system.	☑	☑
Define with the producers the plots for planting the trees according to the local climate, soils, and associated crops.		☑
Select the agroforestry model to be implemented with the producers and define the management that will be done for the trees and the crop (technical knowledge, inputs and labour) with them.		☑
Select the best tree species according to the expected benefit, local adaptation, availability, and possibility of local propagation.	☑	☑

1.3 CONSERVATION AREAS

"If agroforestry cover is not suitable for the local environmental conditions, trees may also be planted around the infrastructure, borders, etc., maintaining an area equivalent to 15% of the farm area with natural vegetation. RA Scorecard – Gold Level." [32]

"Natural vegetation: Vegetation made up predominantly of native or locally adapted species, where the species' composition and structure resemble the vegetation that occurs or would occur in the absence of human interference. Natural vegetation may be managed (or, in the case of restoration, established) to incorporate a minority component of exotic species if these are beneficial for regenerating the land, adapting the ecosystem to current or future climates, and/or enhancing biodiversity. If invasive species are present, natural vegetation is managed to reduce their presence." (RA Scorecard, definition)[33]

RECOMMENDATIONS

a. Areas of natural vegetation on AAA farms are (i) tree plantations in agroforestry systems, (ii) buffer zones as described in the area and location of Section 5.1 Water Use and Conservation, (iii) Conservation areas within the farm, (iv) Border plantings, live fences and barriers around housing and infrastructure, or in other ways [34].

b. AAA Producers can define conservation and restoration areas representing at least 15% of the total farm area. This option applies when making agroforestry arrangements in the coffee crops is impossible.

[32] Rainforest Alliance, 2022 a.
[33] Rainforest Alliance, 2022a.
[34] Rainforest Alliance, 2022 a.

c. Conservation areas can further contribute to biodiversity conservation if they are established as corridors or areas of connection with other vegetation areas. This initiative is coordinated with other farmers at the landscape level.

STEPS IN THE CLUSTER ACTION PLAN

STEPS	CLUSTER MANAGER	AAA AGRONOMIST
Identify the geographical location of farms concerning areas of conservation interest, buffer zones, and biological corridors.	☑	☑
Plan conservation areas on each farm, especially when implementing agroforestry models is not feasible.		
Select the most suitable species for biological corridors in collaboration with farmers, promoting native species that align with conservation objectives.		☑
Maintain an up-to-date inventory of conservation areas on AAA farms.		☑

2. SOIL HEALTH

2.1 SOIL HEALTH ANALYSIS

Soil health is a fundamental principle of regenerative agriculture. It is defined as the continuous ability of the soil to function as a vital living ecosystem that supports plants, animals, and humans. Its essential functions include retaining and cycling nutrients, sequestering carbon, enabling infiltration, facilitating water storage and filtration, suppressing pests and diseases, and detoxifying harmful chemicals. Soil health is linked to plant health and vice versa.

Each soil has a functioning capacity. The more this capacity is understood, the less external inputs are needed. It's a virtuous cycle!

Soil health involves integrating biological, physical, and chemical conditions. Although labs are still in the early stages of providing integrated analytics to measure soil health, it is the only way to inform regarding adopting regenerative practices to improve soil quality and stability beyond optimising fertilisation.

A soil health analysis can indicate if the soil is at full functioning capacity, if it is degrading, or is regenerating.

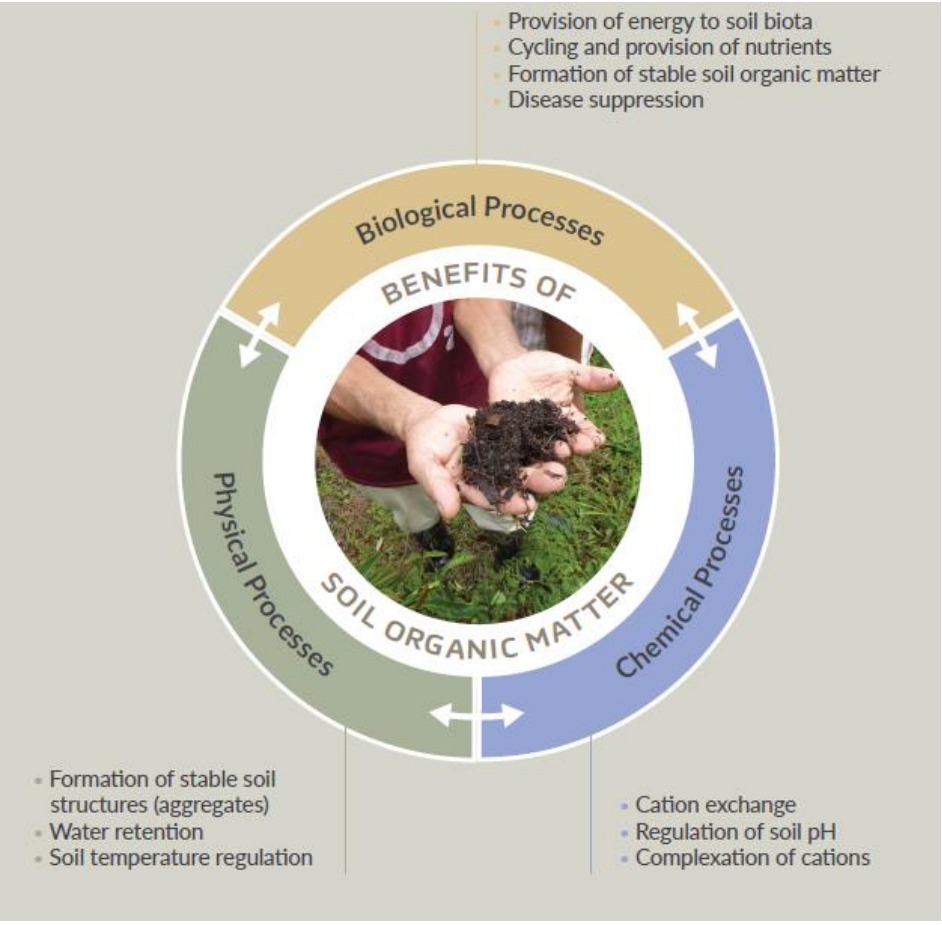


Figure 3. *The benefits of soil organic matter through its effect on biological, chemical and physical processes.*
Source: Pulleman et al., 2023, p. 23.

RECOMMENDATIONS

a. Healthy soils are essential for high-quality and resilient agricultural production on a large scale.

   Agricultural practices, such as using pesticides and applying synthetic fertilisers, unbalance the biological conditions of the soil, and mechanised activities compact the physical conditions of the soil. On the other hand, practices such as tree planting, organic matter application, cover crops, and biochar application positively impact soil conditions, leading to better water retention, erosion reduction, and nutrient retention.

   Maintaining healthy soils is an investment in the natural capital and assets of the farm. They present a challenge to change our temporal perspective in management decisions. We are used to planning activities based on the cycle of coffee cultivation, and even fertilisation is often limited to the expected results of a single year or harvest. However, this short-term horizon is insufficient to observe improvements that require more time and persistence. Soil improvement and health should be considered long-term, as many changes cannot be evaluated with immediate results.

   Regenerating degraded soil takes time, and optimal regenerative practices will (unfortunately) not yield productive results immediately. A new approach to fertilisation should focus on improving the functional capacity of the soil. Guidance on soil health analysis and practice recommendations will continue to evolve and be available for informed decision-making.

   In Nicaragua, coffee farmers usually process the beans on their farms, generating significant by-products, primarily coffee pulp, which accounts for a considerable volume. While many farmers already use this pulp as fertiliser, compost production provides a more stable and higher-quality process.[35]

b. Measuring soil health is a broad topic, and tools are currently being developed to define indicators that enable effective management at the local level. Conducting soil analyses to determine carbon and organic matter levels is a fundamental starting point, as these are key elements closely linked to the concept of soil health.

[35] López, 2020.

2.2 SOIL CONSERVATION

"In addition to soil cover (...), physical structures, such as terraces, trenches, vegetative erosion barriers, or stone barriers, can help control erosion and runoff. Drainage canals and planting in furrows can allow water to infiltrate the soil during high-rainfall events. Terracing has the additional advantage of facilitating farm operations on steep hills, but it requires considerable labour and initial investment. Vegetative solutions should be prioritised over the construction of physical structures whenever possible, as the latter generally involve considerable investment in labour and/or machinery." [36]

"Monitoring soil cover and loss, implementing basic soil conservation practices according to the slope of the farm, and adjusting conservation practices as needed. RA Scorecard – Gold Level." [37]

RECOMMENDATIONS

a. Identify areas of the farm susceptible to or affected by erosion.

b. Follow a soil conservation and erosion prevention programme. Implement soil conservation practices based on the identification made and according to the slope of the farm.

c. The pruned branches and leaves of the coffee tree can serve as mulch to cover the soil surface.

d. Agroforestry systems are an effective strategy for soil conservation, providing a constant supply of leaf litter and a protective canopy that reduces the decomposition rate of organic matter. This makes them more efficient in minimising soil erosion and moisture loss.[38]

[36] Pulleman et al., 2023. p. 82
[37] Rainforest Alliance, 2022 a.
[38] Pulleman et al., 2023, p. 85.

e. Establish the coffee trees by planting them on contour lines transversely to the slope.[39]

f. Implement plant barriers to reduce the velocity of runoff water. Other conservation practices include terraces for planting coffee trees, hillside ditches, and runoff water diversion channels.[40]

g. Whenever possible, prioritise the plant solution over the construction of physical structures, such as vetiver barriers, as the latter usually involves a considerable investment of labour or machinery.

h. Identify if adjustments must be made to the conservation practices implemented and adapt them accordingly. Continue to monitor soil cover and loss.

2.3 SOIL COVER

Although cover crops can be established in existing plantations, this may prove challenging in plantations with high planting densities and shade levels (e.g., agroforestry systems). This practice is most suitable in the first years after crop establishment or on farms with larger inter-row distances and/or no shade (as on mechanised farms and in coffee monocultures). During the first years after coffee establishment, smallholders may prefer to use intercropping (e.g., with banana, which also provides sufficient biomass residues), and thus strengthen household food and income security. [41]

Maintaining at least 80% of bare ground covered with mulch or cover crops (preferably flowering)."

RA Scorecard – Gold Level. [42]

[39] Instituto del Café de Costa Rica, 2021.
[40] Instituto del Café de Costa Rica, 2021.
[41] Pulleman et al., 2023, p. 85.
[42] Rainforest Alliance, 2022a.

RECOMMENDATIONS

a. Evaluating the existing coverage, including low interference weed cover, is essential as a first step to establishing a soil cover. This will help identify areas where additional cover crops are necessary and feasible to enhance soil protection.

b. Identify the most feasible areas/plots to introduce cover crops and select the species.

c. The following species are suggested as live cover: *Canavalia ensiformis*, *Vigna radiata*, *Crotalaria caunse and Cajanus cajan*, with management information (Table 6). Also, *Brachiaria ruziziensis*, *Brachiaria brizantha*, Rye Grass/Mega, *Panicum maximum/mombaza* and *Panicum maximum/massai*.

SPECIES	CHARACTERISTICS	MANAGEMENT RECOMMENDATIONS
Canavalia ensiformis	*Fixation of 50 kg atmospheric N/year*	***Planting in lines*** *It is sown at a depth of 3 cm.* *It should be covered with soil.* ***Propagation*** *Maximum 6 kg of seeds/ha.* *Risk of loss of plantation density due to ant and bird attacks.*
Crotalaria sp.	*Annual coverage.* *Slow growth rate.* *Fixation of 33-55 kg atmospheric N/ha.* *It is recommended to prune before flowering to extend life cover.* *Pollinating attractant.* *Nematicidal effect.* *Incorporates organic matter.* *Improves soil structure.*	***Planting in lines*** *It is sown at a depth of 3 cm.* *It should be covered with soil.* ***Propagation*** *Maximum 6 kg of seeds/ha.* *Risk of loss of planting density due to ant and bird attacks.*
Vigna radiata	*Annual coverage.* *Nitrogen fixation 40-55 kg atmospheric N/ha.* *Pollinating attractant.* *Excellent establishment.* *It does not compete with the crop.* *It allows you to get closer to the coffee trees without affecting them.*	***Planting*** *Two seeds/site.* *It is sown at a depth of 3 cm.* *Distance between plants of 15-20 cm.* *It should be covered with soil.* ***Propagation*** *Maximum 6 kg of seeds/ha.* *Risk of loss of planting density due to ant and bird attacks.*
Cajanus cajan	*Fixation of 33-45 kg atmospheric N/ha*	***Planting in lines*** *It is sown at a depth of 3 cm.* *It should be covered with soil.* ***Propagation*** *Maximum 6 kg of seeds/ha.* *Risk of loss of plantation density due to ant and bird attacks.*

Table 6. Living cover species.[43]

[43] Corado, 2024

d. The introduction of cover crops during renovation helps preserve soil health and reduces the use of herbicides in renovation areas, especially if an agroforestry system is not in place. Cover crops generally benefit coffee production by improving the availability of water and nutrients. However, they also can compete with the coffee plants for light, water and nutrients, causing yield losses. Therefore, it is recommended to limit them to spaces between rows. The area around the canopy of the coffee plant can be covered with clippings from these crops.[44]

e. Keep the leaves of shade trees that remain on the ground (*mulching*).[45]

2.4 INTEGRATED WEED MANAGEMENT

Use of at most one herbicide active ingredient from the list of risk mitigation pesticides in Annex Chapter 4 of the Rainforest Alliance Standard.

RA Scorecard – Gold Level. [46]

RECOMMENDATIONS

a. Integrated Weed Management (IWM) is an approach designed to modify the composition of weed populations in the production system, promoting beneficial weeds while limiting the growth of aggressive ones. This approach seeks to classify and manage weeds based on their level of interference with crops, as shown in Table 7, which categorises the main weeds affecting coffee crops. [47][48].

[44] Pulleman et al., 2023, p. 81.
[45] Farfán, 2014, pp. 146, 159.
[46] Rainforest Alliance, 2022a.

[48] Virginio et al., 2021 b.

INTERFERENCE LEVEL	WEED SPECIES		
Noble weeds: **GOOD COVER**	*Arachis pintoi* *Borreria laevis* *Borreria sp.* *Commelina difusa* *Commelina elegans* *Commelina erecta* *Commelina virginica* *Desmodium canum* *Desmodium sp.* *Dichondra repens*	*Drymaria cordata* *Drymaria villosa* *Euphorbia hirta* *Euphorbia prostrata* *Hydrocotyle bowlesioides* *Hydrocotyle mexicana* *Hydrocotyle umbellata* *Hyptis atrorubens* *Indigofera spicata* *Jaegeria hirta*	*Mucuna urens* *Oplismenus burmannii* *Oxalis acetosella* *Oxalis corniculata* *Oxalis latifolia* *Oxalis sp.* *Phyllanthus niruri* *Phyllanthus sp.* *Richardia scabra*
Medium: **REGULAR COVER**	*Ageratum conyzoides* *Amaranthus hybridus* *Amaranthus viridis* *Arachis hypogaea* *Argemone mexicana* *Asclepias sp.*	*Bidens pilosa* *Cajanus cajan* *Canavalia ensiformis* *Centrosema pubescens* *Chamaesyce hirta* *Chenopodium album*	*Conyza apurensis* *Conyza bonariensis* *Impatiens walleriana* *Indigofera suffruticosa* *Llum pinnatum*
COMPETING SPECIES	*Amaranthus spinosus* *Blechum pyramidatum* *Borreria alata* *Eichornia crassipes* *Emilia fosbergii* *Equisetum arvense* *Euphorbia heterophylla* *Galinsoga ciliata*	*Galinsoga parviflora* *Glicina max* *Hyptis capitata* *Impatiens balsamina* *Ipomea batatas* *Ipomea nil* *Ipomea quamoclit* *Lantana camara*	*Ludwigia sp.* *Mikania micrantha* *Mimosa púdica* *Momordica charantia* *Plantago major* *Pseudelephantopus spicatus* *Rumex crispus*
VERY COMPETING SPECIES	*Andropogon bicornis* *Cynodon dactylon* *Cyperus rotundus* *Digitaria sanguinalis*	*Eleusine indica* *Phytolacca icosandra* *Polygonum nepalense* *Portulaca oleracea*	*Pteridium aquilinum* *Ricinus communis* *Rottboellia cochinchinensis* *Rumex obtusifolius*

Table 7. *Common weed species in coffee crops and their level of interference. Source: Adapted from Virginio et al., 2021 a.*[49]

b. In newly planted coffee plantations, the first 12 to 18 months after planting are critical for controlling weeds that compete with the crop. Weed control should aim to keep the fertilisation strip clean and promote adequate coverage at the intersection to prevent soil erosion.[50]

c. Identify the most competitive weeds within the coffee plots.

d. Follow an Integrated Weed Management (IWM) plan that prioritises mechanical control and localised herbicide applications to manage competing weed populations effectively. By employing multiple strategies, IWM offers an economically and environmentally sustainable approach, reducing reliance on herbicides while enhancing productivity and fostering a balanced ecosystem within the coffee production system.
e. Define and follow a herbicide application reduction plan with specific objectives over time. It is recommended that the Eco-Weeder (weed selector) be promoted for focused control and reduction of herbicide doses.

[49] Virginio et al., 2021 a
[50] Instituto del Café de Costa Rica, 2020.

f. Use no more than one active ingredient from the list of risk mitigation pesticides and eliminate herbicides banned under the Rainforest Alliance Standard (Annex Chapter 4: Agriculture Document SA-S-SD-22). Table 8 shows the category of herbicides used in Nicaragua. According to the Gold Level of the Rainforest Alliance Regenerative Coffee Scorecard, only products marked under the risk mitigation category should be used, and only one of them .

g. Eliminate the use of herbicides included in the Exceptional Use Policy from Rainforest Alliance Standard Annex Chapter 4.

ACTIVE INGREDIENT	CAS Number	CATEGORY: RAINFOREST ALLIANCE
2,4-D	53404-37-8	Risk mitigation
Diuron	330-54-1	Risk mitigation
Diquat	2764-72-9	Risk mitigation
Flumioxazine	103361-09-7	Risk mitigation
Glyphosate	38641-94-0	Risk mitigation
Metribuzin	21087-64-9	Risk mitigation
Oxadiazon	19666-30-9	Risk mitigation
Oxyfluorphene	42874-03-3	Risk mitigation
Paraquat dichloride	1910-42-5	Prohibited
Paraquat	4685-14-7	Prohibited
Glufosinate ammonium	77182-82-2	Prohibited

Table 8. *Herbicides used in coffee in Nicaragua. (Updated: July 30, 2024)*

STEPS IN THE CLUSTER ACTION PLAN

STEPS	CLUSTER MANAGER	AAA AGRONOMIST
Analyse soil health and define practices for soil conservation and improvement soil conservation and improvement practices before focusing on crop nutrition.		☑
Promote soil protection and conservation actions with producers, such as slope and runoff management, terraces, drainage, and living barriers.		☑
Implement soil conservation actions, such as integrated weed management, cover planting, and cover crops.		☑
Eliminate the use of banned *herbicides*		☑

3. PLANT NUTRITION

3.1 SOIL ANALYSIS

"Key components of Integrated Nutrient Management (INM) include: (i) addressing constraints that limit crop response to fertilisation, such as soil acidity, ageing of coffee plants, and shade density; (ii) balanced and efficient fertiliser use based on the 4R concept (right source, right rate, right time, and right place); and (iii) management of organic resources to improve soil health and stimulate biological nutrient cycling. In line with the principles of circular agriculture, INM seeks to recycle nutrients from residue and waste streams generated on and around the farm. Agroecological conditions (such as soil type, topography, and climate), production practices, and the age and phenological stage of the coffee plants all have a strong effect on nutrient requirements, which should be taken into account when making fertilisation plans.[51]

"Conducting a soil assessment and analysis including, if relevant: Erosion-prone areas and slope; Soil structure; Soil depth and soil horizons; Densification of compaction areas; Soil moisture and water level in the soil; Drainage conditions; Identification of areas with visual symptoms of nutrient deficiencies; Soil organic matter ". RA Scorecard – Gold Level.[52]

"Soil testing must be done at the right time (at least three to four months after the last fertilisation) and repeated regularly (every two to three years). The use of proper sampling protocols is also critical for ensuring that results are representative of the specific plot or farm; large, heterogeneous farms require multiple tests." [53]

[51] Pulleman et al., 2023. pp. 107-108
[52] Rainforest Alliance, 2022 a.
[53] Pulleman et al., 2023. p.113

RECOMMENDATIONS

a. Soil analysis should be understood as the analysis of its health. It provides information about it's physical, chemical and biological conditions. Assessing soil fertility requires chemical, physical, and biological studies.

b. It is recommended that soil evaluation be conducted at least every two years, using a representative sample of the coffee growing area.

c. Based on the soil assessment, relevant management measures and actions can be identified to maintain the best-growing conditions and improve productivity.

d. Observe the symptoms of nutritional deficiencies and foliar analysis[54]. Thechemical analysis of the soi is the primary diagnostic tool to evaluate the nutritional status of crops and make management decisions.[55]

e. Design and follow a fertilisation plan based on the results of the soil assessment, identified soil management measures, and additional recommendations from the AAA Agronomists.

[54] Sadeghian & Gonzáles-Osorio, 2022, p. 135-136.
[55] Pulleman et al., 2023, pp. 110.

STEPS IN THE CLUSTER ACTION PLAN

STEPS	CLUSTER MANAGER	AAA AGRONOMIST
Identify the soil's chemical, physical, and biological composition with soil analysis.		☑
Identify constraints to the fertilisation response and consider soil acidity correction, crop age, shade level, compaction, and degradation.		☑
Consider solutions based on improving soil organic matter levels and microorganism diversity among the alternatives to mitigate soil acidity.		☑
Propose fertilisation plans that consider the agroecological conditions of the crop, crop management practices, and soil analysis results.		☑

3.2 LOW CARBON & FERTILISATION

The analysis of CO_2 equivalent emissions in AAA farms in Nicaragua, carried out with the Cool Farm Tool methodology, reveals that 51% of the GHG footprint at the farm level is related to using fertilisers. The efforts will focus on three principles to reduce this footprint:

(I) A healthy soil is a fertile soil. Working on improving soil first will improve the entire ecosystem, which ultimately benefits coffee production.
(II) Nitrogen source is key (Nitrate, ammonium and/or urea) as each one has a different reaction and GHG emission factor. [56]
(III) Nitrogen is the primary source of GHG emission, but nitrogen must be analysed in relation to production.

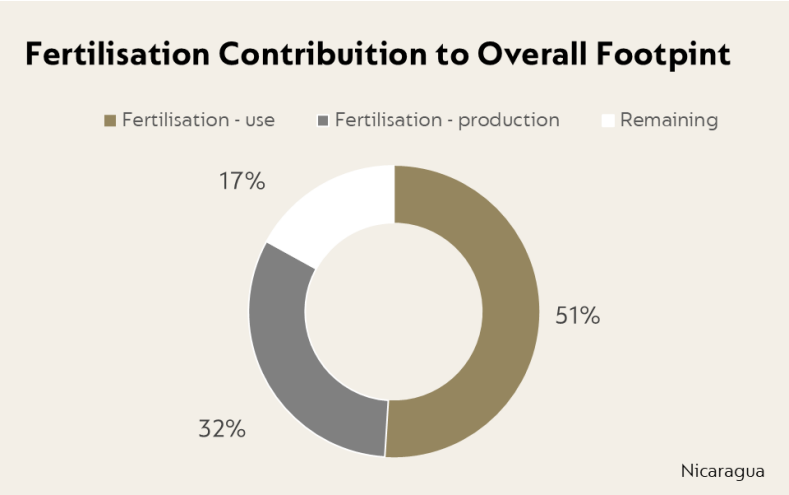


Figure 4. *Contribution of fertilisation to the GHG footprint – Nicaragua. Fountain: Nespresso, 2023/2024 cycle.*

There are several sources of nitrogen fertilisers with different percentages of nitrogen contribution. Table 9 details some fertilisers that provide nitrogen in various chemical forms.[57] With respect to nitrogen losses related to fertiliser sources mainly relate to volatilisation and leaching processes. Nitrogen losses by volatilisation volatilisation are more substantial in urea than in ammonium nitrate; the opposite is true for leaching. [58] Understanding potential nitrogen dioxide (NO_2) emissions is critical, considering their impact in terms of CO_2 equivalent. N-Ureic-based fertilisers should be avoided.

[56] YARA International, 2011.
[57] YARA, 2023, p. 4.
[58] Sadeghian & Gonzáles-Osorio, 2022.

NITROGEN SOURCE	N-Total	$CO(NH2)_2$ N-Ureic	N-ammonium NH_4	N-Nitrate NO_3
YaraMila Hydran	19		10	9
YaraLiva Nitrabor	15,5		1.1	14,45
YaraMila Complex	12		7	5
Purple Multifer	17		8,5	8,5
YaraBela NITROMAG	27		13,3	13,7
YaraMila Nitrocomplex	21		13,5	7,5
Urea	46	46		
Ammonium sulphate	21		21	
Ammonium nitrate	33,5		16,9	16,9
MAP (Monoammonium phosphate)	10-11		10-11	
DAP (Diammonium phosphate)	16-21		16-21	
Calcium nitrate	15,5		1,1	14,4

Table 9. *Nutrient content of commonly used fertilisers and the produced by YARA.*

RECOMMENDATIONS

a. Following the concept of the 4Rs, efficient levels of synthetic fertiliser are applied to enhance productivity. The 4R concept focuses on optimising the efficiency and effectiveness of fertiliser use by applying the right source of nutrients in the right dose, at the right time, and in the right place.[59] The nutrient source will be supplemented by organic fertilisation (see section 3.3).

b. When applying nitrogen fertilisers to crops, it is essential to consider where the nitrogen used will end up. The quantities to be applied must also consider the immediate fixation in the soil's organic matter, the soil cation exchange complex, and the losses due to denitrification, volatilisation, or leaching.

c. Use efficient nitrogen sources that are readily available to the plant. The application of nitrates (= nitrogenous fertilisers with more than 50% NO_3) is efficient due to low losses of ammonia volatilisation and faster assimilation by the plant.

[59] Pulleman et al., 2023, p. 114.

d. During the growing season, the nitrogen dose must be adjusted to the actual demand of the coffee crop. This calibration is guided by the nitrogen requirements at different growth stages of the coffee tree, soil analysis results, and field diagnostics.

e. Split the nitrogen dose to optimise its efficiency in crop uptake, considering factors such as soil texture, the type of nitrogen source, and precipitation conditions.

f. Choose a good time to lime and fertilise, usually during the first rains; add organic matter throughout the year so that the soil can retain more moisture; and make a foliar application in the summer to supplement some nutrients.[60]

g. In rainy seasons, if the soil is very acidic, whitewash before applying fertiliser. Fractionate fertiliser applications. Some growers mix fertiliser with compost before applying it to retain more in the soil. It is important to evaluate whether this practice is more functional or to apply fertiliser and compost on top and separate the application[61].

h. To correct soil acidity (pH) and neutralise aluminium, it is recommended to apply any of the following sources based on the interpretation of the soil analysis: calcium carbonate, magnesium carbonate, calcium hydroxide, calcium sulfate, and agricultural gypsum. These amendments must be of adequate purity and granulometry. A separation of at least 30 days between applying the amendment and applying the fertiliser is recommended. Use 500 to 2000 kg per hectare, depending on the soil analysis result and the lime quality.[62]

[60] López, 2020
[61] López, 2020.
[62] Instituto del Café de Costa Rica, 2020.

STEPS IN THE CLUSTER ACTION PLAN

STEPS	CLUSTER MANAGER	AAA AGRONOMIST
Recommend fertilisation sources with the best nitrogen use efficiency (NUE) and proper planning of dosage, timing, and place of application.		☑
Define interventions to promote and incentivise adopting efficient nitrogen fertiliser use based on the previous recommendations.	☑	☑
Collaborate with producers to implement organic-mineral fertilisation practices, validating their effectiveness through demonstration plots on farms.		☑

3.3 ORGANIC FERTILISATION

"The availability of organic residues determines to what extent organic inputs can substitute for or complement mineral fertilisers. Coffee farms generally do not generate sufficient organic residues to fully satisfy plant nutrient demand. Synchronising nutrient availability with crop demand can also pose challenges when using organic inputs. Therefore, combining mineral and organic fertiliser is the recommended option. The establishment of local capacity to produce quality organic inputs from local waste streams on larger coffee farms or in smallholder coffee communities should also be encouraged."[63]

"Apply organic fertiliser, or composted organic matter, on at least 75% of the farm, when possible, using organic material coming from the same farm." RA Scorecard – Gold Level [64]

RECOMMENDATIONS

a. Increasing organic matter is crucial to maintaining soil health. Soil organic matter positively impacts chemical, physical, and biological properties and processes. It influences nutrient retention and cycling, cation exchange capacity, and soil acidity buffering in chemical processes. In physical processes, organic matter improves soil structure, regulates soil temperature, and improves water retention and purification. It is also the primary energy source for soil biota, affecting nutrient cycling, fertiliser efficiency, and disease regulation in plants. [65]

b. Cover crop management, *mulching*, and leaf litter produced by shade species are important sources of biomass and soil organic matter.

[63] Pulleman et al., 2023, p. 121.
[64] Rainforest Alliance, 2022a.
[65] Pulleman et al., 2023, p. 23

c. Chemical fertilisation can be partially or wholly replaced by organic fertilisation without affecting production, provided the appropriate sources and required quantities are supplied. In addition, organic fertilisers can support the soil's physical, chemical, and biological properties.

d. In Nicaragua, coffee is mainly processed at on-farm mills, followed by centralised wet mills. The coffee pulp generated can be composted under aerobic conditions. In centralised processes, the quality of the composting process (aeration, humidity and temperature) is controlled. Transferring this knowledge to producers is important to obtain a stable, high-quality product. When obtaining the compost, doses from 0.5 kg per plant to 2 kg have been handled, so it is essential to evaluate the optimal dose to generate better results in the coffee plantation.[66]

e. Add elements that improve the soil's structure with products such as compost, bokashi, and vermicompost[67].

f. Some field experiences in Nicaragua have shown that if the organic matter level in the soil is below 2%, crop responses can be observed by adding 0.5 to 1 kilogram of compost, vermicompost, or composted manure per plant. Incorporating it 2-5 cm into the soil.

g. ECOM transforms honey water into Biol, coffee pulp into compost, and pruning residues into biochar through controlled pyrolysis. Compost combines 70% coffee pulp, 25% *Crotalaria juncea*, and 5% biochar, resulting in a low-cost, high-quality product. Biochar enhances nutrient and water retention and stabilises soil carbon. Applying 1 kg of compost per year during planting or fertilisation is recommended. Biol is applied at 2-3 L/ha, 2 to 3 times a year via drench.

[66] López, 2020.
[67] López, 2020.

STEPS IN THE CLUSTER ACTION PLAN

STEPS	CLUSTER MANAGER	AAA AGRONOMIST
Promote the application of composting according to the availability of organic matter on the farm; prioritise their use and that of other sources of organic matter available on the farm. Integrate organic sources into the coffee fertilisation plan.		☑
Identify the availability of other sources of organic matter in commercial products within the local context.		☑
Support farmers in the gradual adoption of organic fertilisation practices, ensuring sustained productivity during the transition process.	☑	☑

4. PLANT HEALTH

4.1 INTEGRATED PEST MANAGEMENT (IPM)

"Reducing the use of pesticides (two or fewer ingredients from the risk mitigation list) and eliminating the use of synthetic chemical nematicides on the farm."
RA Scorecard – Gold Level (Mandatory criteria)[68]

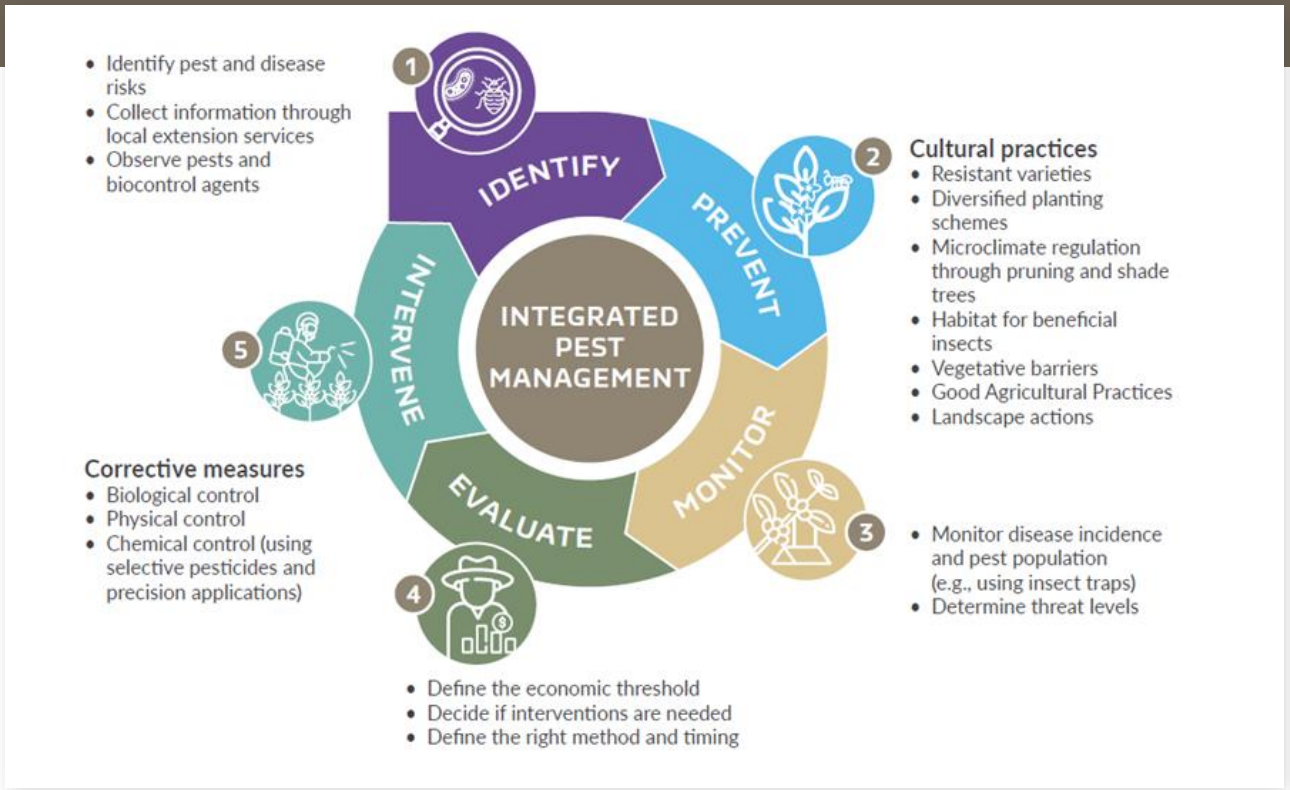


Figure 5. *Key components of an integrated pest management approach.*
Source: Pulleman et al., 2023, p. 97.

RECOMMENDATIONS

For all phytosanitary problems:

a. Follow IPM principles and create IPM plans at cluster and farm level.

b. Use agrochemical application only when cultural and physical methods have been exhausted, and threshold levels of pests and diseases have been reached.

[68] Rainforest Alliance, 2022a.

c. Carry out monthly monitoring of pest incidence to detect, assess, and manage pest populations in crops in a timely manner, and make decisions to prevent yield losses.

d. Use agrochemicals with the lowest possible toxicity and highest selectiveness.

e. Apply agrochemicals only to affected coffee areas/plants.

f. Apply chemical control only as a last resort and keep usage to a minimum. Use only the correct dosage and precision applications of selective pesticides (two or fewer ingredients from the RA risk mitigation list) following directions for usage, as described on the label, in line with Chapter 4 of the Rainforest Alliance Standard Annex.[69]

COFFEE BERRY BORER

g. Cultural control is the crucial component of integrated coffee berry borer management. It is based on manipulating the environment to make it less favourable to pest-insect populations. Some cultural control:
   (i) The crop age (Young coffee plantations, with low height and high production, will allow for better cultural management and good quality control of coffee harvesting) and sowing distance are needed to allow a good harvest.
   (ii) Renovate and rehabilitate coffee plantations on time and thus prevent the spread of the borer.[70]
   (iii) Integrated weed management to promote the presence of beneficial fauna and natural control.
   (iv) Good control of the coffee picking during harvest and at the end of the season to reduce the borer population in the coffee plantation.[71] [72]

h. Traps are used to monitor coffee borer populations and detect when adults emerge from coffee beans, while also contributing to control by capturing insects. They can be made from recycled plastic bottles, using a mixture of ethanol and methanol in equal parts as an attractant. They should be installed after the harvest, at a height of 1.20 meters, with a density of 17 to 22 traps per hectare, and checked every two weeks.[73]

i. Insecticides are only applied when the infestation in the field exceeds 5%. No control measures below this level are needed.[74], The affected areas must be identified considering the dispersion of the coffee berry borer in the field, and a localised control must be carried out.

j. The symbiotic relationship between birds and bees is crucial for coffee pollination, and its impact is significant on its yield. Research results suggest that the combined contribution of birds and bees to pollination accounts for 24.7% of total coffee yield. In addition, birds and bees act as natural enemies of the coffee borer in the field.[75]

[69] Rainforest Alliance, 2022 b.
[70] Somarriba et al 2021.
[71] Benavides et al., 2013.
[72] Constantino, 2023.
[73] ANACAFE,2017.
[74] Instituto del Café de Costa Rica, 2021.
[75] Martínez-Salinas, et al., 2022.

COFFEE RUST

k. The main recommendation is to renew the plantations with tolerant varieties or hybrids.

l. It is recommended to implement the following measures for adequate control of the disease:
   (i) Establish appropriate planting distances for the coffee variety and region.
   (ii) Prune-depleted or diseased plants stimulate productive plant tissue growth and remove some inoculum and tissue damaged by rust.
   (iii) Integral management of weeds to avoid excessive humidity.
   (iv) Regulate shade trees, maintaining between 30 and 40% shade, depending on the type of agro-ecological conditions that prevail in the area. [76]
   (v) Carry out good fertilisation at the appropriate times and following the soil analysis results.
   (vi) Chemical control of coffee rust should be based on constant monitoring of the disease in the coffee plantation. If the incidence of rust in the coffee plantation is less than 10%, protective fungicides (cupric) should be used. If the level of infection is higher than 10%, systemic (curative) fungicides should be used. It is crucial to carry out rust sampling at appropriate times of the year to define strategies for action. Biological fungicides could be considered within the IPM (e.g., Best Ultra/Roya Out, *Bacillus subtillis, Trichoderma hazianum, etc*).
   (vii) Promote the use of windbreaks to prevent the spread of fungi.

AMERICAN LEAF SPOT (OJO DE GALLO).

m. Management recommendations for COFFEE LEAF RUST IPM also effectively control Leaf Spot. These include pruning, shade management, host weed management, proper nutrition, plant spacing, and soil moisture management. In the case of chemical control, contact fungicide applications such as Bordeaux mixture or copper oxychloride can be considered due to their excellent results in controlling the pathogen.

ANTHRACNOSE

n. Control with copper-based fungicides and biological control from *Bacillus subtilis*.

NEMATODES

o. Carry out control treatments on the substrates of the seedbeds with biological products, especially with decomposed organic matter. It is essential to eliminate the use of synthetic chemical nematicides on farms.

p. The active ingredients of phytosanitary products are registered in Nicaragua and benchmarked with the Rainforest Alliance 2020 Standard and its requirements (Table 10). The safety conditions in the application, the times of re-entry to the field, and the safety periods before harvest must be respected.

[76] De Melo and Astorga, 2015.

GROUP	ACTIVE INGREDIENT	CAS NUMBER	RAINFOREST ALLIANCE CATEGORY
Fungicide	Flutriafol	76674-21-0	Without restrictions
Fungicide	Hexaconazole	119446-68-3	Without restrictions
Fungicide	Copper hydroxide	20427-59-2	Without restrictions
Fungicide	Tebuconazole	107534-96-3	Without restrictions
Fungicide	Azoxystrobin	131860-33-8	Risk mitigation
Fungicide	Copper oxychloride	1332-40-7	Risk mitigation
Fungicide	Copper oxide	1317-39-1	Risk mitigation
Fungicide	Copper sulphate (pentahydrate)	7758-99-8	Risk mitigation
Fungicide	Epoxiconazole	133855-98-8	Prohibited
Fungicide	Chlorothalonil	1897-45-6	Prohibited
Insecticide	Diazinon	333-41-5	Risk mitigation
Insecticide	Cypermethrin	52315-07-8	Risk mitigation
Insecticide	Cyhalothrin, lambda	91465-08-6	Risk mitigation
Insecticide	Hexachloro-endomethylene	115-29-7	Prohibited
Insecticide	Thiamethoxam	153719-23-4	Prohibited
Insecticide	Imidacloprid	105827-78-9	Prohibited
Insecticide	Chlorpyrifos	2921-88-2	Prohibited

Table 10. *Active ingredients registered in Nicaragua. Rainforest Alliance Use Status. (Updated, July 30, 2024)*

q. Table 11 shows some available biocontrol products with registrations for use in coffee in Nicaragua. The Instituto de Protección y Sanidad Agropecuaria of Nicaragua, has a registry of products that can be consulted as alternatives for control using biological inputs.[77]

[77] Instituto de Protección y Sanidad Agropecuaria, 2022. https://chatgpt.com/c/67033a47-5cb8-8004-a1f5-b1aed93beae6#:~:text=Agropecuaria%20(IPSA).-,https%3A//www.ipsa.gob.ni/Portals/0/4%2520Sanidad%2520Vegetal%2520y%2520Semillas/Insumos/vigente_enero_2022.pdf,-Recuerda%20que%20debes

BIOLOGICAL CONTROL PRODUCT	ACTIVE INGREDIENT	PEST TARGET
Roya Out	Clove oil, *Bacillus subtilis*	Coffee rust
Best Ultra F	*Bacillus spp.*, *Azotobacter spp.*, *Pseudomonas spp.*, plant extracts	Coffee rust
Bralic	Garlic extract	Coffee Berry Borer
Bio-Bass	*Beauveria bassiana*, *Metarhizium anisopliae*	Coffee Berry Borer

Table 11. *Biocontrol products available with registrations for use in coffee in Nicaragua.*

STEPS IN THE CLUSTER ACTION PLAN

STEPS	CLUSTER MANAGER	AAA AGRONOMIST
Promote the implementation of Integrated Pest and Disease Management.	☑	☑
Use pesticides considering the lists of prohibited and restricted use products. Chemical pesticides should only be applied as a last resort and in specific applications. Favour the application of biological or low-toxicity products.		☑
Eliminate the use of banned pesticides.		☑

5. WATER

5.1 WATER USE & CONSERVATION

"Reducing total water usage during processing (per unit of product) and significantly reducing irrigation from off-farm water sources RA Scorecard – Gold Level." [78]

"Ensuring that aquatic ecosystems are surrounded by riparian buffers of natural vegetation following the RA standard width parameters. RA Scorecard – Gold Level."[79]

RECOMMENDATIONS

a. It is recommended that farmers conserve riparian buffer zones of natural vegetation adjacent to aquatic ecosystems. These zones have the following width parameters:
   (i) 5 meters horizontal width along both sides of watercourses between 1 and 5 meters wide. In the case of farms of less than 2 ha, the width of the buffer zone may be reduced to 2 metres on both sides.
   (ii) 8 meters wide horizontally on both sides of waterways between 5 and 10 meters wide and around springs, wetlands, and other bodies of water.
   (iii) 15 meters wide horizontally on both sides of rivers over 10 meters wide.[80]

b. Ensure proper management of coffee by-products to avoid contamination of water sources. Promote reforestation near water sources.

c. Promote reforestation near water sources.

d. All wet mills must implement practices to optimise water consumption. Those with piping or hose systems for water transport must keep them in good condition, avoiding leaks. During the daily cleaning of the facilities, the least amount of water possible should be used.[81]

[78] Rainforest Alliance, 2022.
[79] Rainforest Alliance, 2022.
[80] Rainforest Alliance, 2022.
[81] Ministerio de Fomento, Industria y Comercio, 2007.

e. During the pulping process, coffee cherries should be transported using mechanical means or recirculated water. The pulping should be dry or use as little water as possible. It is recommended to use fermentation tanks with rounded corners and bottom walls, with gratings in the center and a slope of 4 to 6% directed towards the gratings and the channel. The run-off or classification channels should be appropriate for the production volume, and the water used in the final coffee wash should be reused[82].

5.2 WATER TREATMENT

Coffee farming is associated with significant water consumption for domestic use and wet coffee processing. If wastewater is not managed correctly, these activities can contaminate water. Therefore, treating the water before it is discharged into aquatic ecosystems is essential to mitigate environmental impacts and ensure sustainable practices.

RECOMMENDATIONS

a. Domestic wastewater should be treated in septic tank systems.

b. In Nicaragua, legislation 620 (Decree No. 21-2017), the General Law of National Waters, and its regulations on environmental management instruments indicate among its restrictions that domestic, industrial, agro-industrial, commercial, and service discharges may not introduce effluents into the receiving body that modify and alter the characteristics of water quality for the different uses to which it is intended. It prohibits the direct or indirect discharge of treated or untreated wastewater into the ecosystems of volcanic lakes or lagoons. [83]

c. Build pulp pits to store the pulp from the pulping process, ensuring they are protected from the weather. These pulp pits should be built considering the daily volume of processed coffee and facilitate the pulp's decomposition for later use.[84]

d. Wastewater treatment systems must comply with established regulations, controlling the discharge of domestic, industrial, and agricultural wastewater.[85]

[82] Ministerio de Fomento, Industria y Comercio, 2007.
[83] National Assembly of Nicaragua, 2017.
[84] Ministerio de Fomento, Industria y Comercio, 2007.
[85] Wastewater treatment systems (STAR) must comply with established regulations, controlling the discharge of domestic, industrial, and agricultural wastewate

STEPS IN THE CLUSTER ACTION PLAN

STEPS	CLUSTER MANAGER	AAA AGRONOMIST
Define with producers' actions for the rational use of water, considering the maintenance of water distribution networks and reducing household consumption.		☑
Keep water consumption for coffee processing below 10 L/kg of dry parchment coffee, which is Nespresso's maximum threshold, and if the current usage is lower, maintain it while continuing to seek further efficiencies.	☑	☑
Promote and encourage the processing of coffee pulp as an organic fertiliser.	☑	☑
Identify and conserve riparian buffer zones on each farm following the Rainforest Alliance Regenerative Coffee Scorecard (Gold Level) criteria.		☑

6. FARM FINANCIALS

6.1 FARM FINANCIALS

"Regenerative agriculture seeks to improve coffee farmers' livelihoods by achieving these objectives:

- ***Improving productivity and income.***
- ***Strengthening food security.***
- ***Ensuring good labour conditions, health, and safety.***
- ***Diversifying production and sources of income."*** [86]

"Monitoring costs of production and calculating revenue from the sale of coffee", "Creating farm management or business plans", "When appropriate, diversifying income streams, and adjusting business practices as necessary. RA Scorecard – Bronze, Silver & Gold. [87]

The main drivers of household income are annual coffee production, selling price, and other household income. All of these variables contribute to family income. However, when considering the limited size of smallholder land, changes in productivity increase the risk of a low household income (net income) (Figure 6).

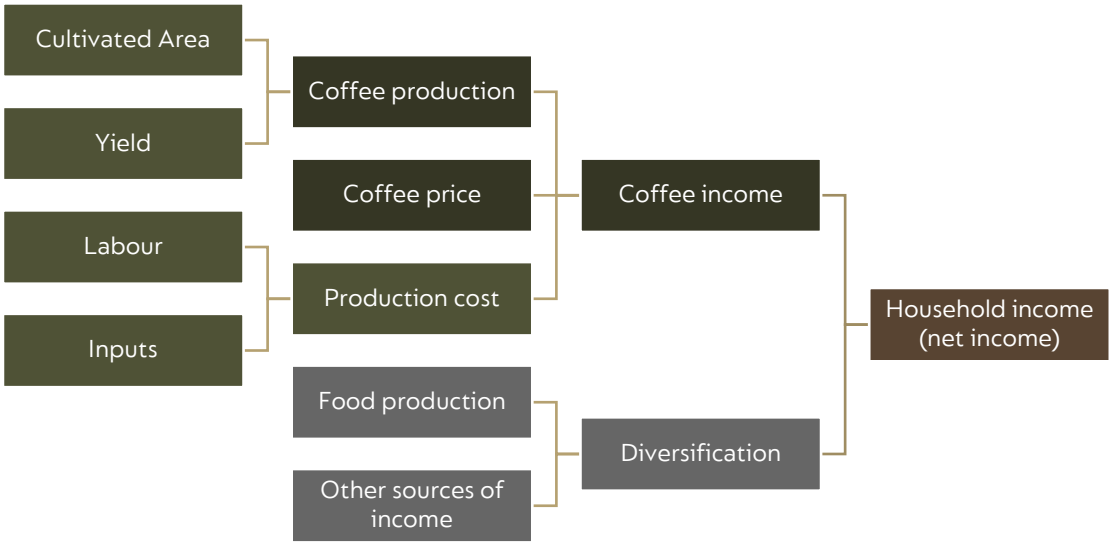


Figure 6. *Household income drivers.*

[86] Pulleman et al., 2023, pp. 34-35
[87] Rainforest Alliance, 2022.

From the perspective of producers, the adoption of regenerative coffee farming requires a series of decisions that consider the following:

- Current income risks
- Risks to your future income
- Availability of resources for investment.
- Uncertainty about expected outcomes.
- Market access.
- Time for change
- Incentives
- Benefits and cost savings
- Effect on the adaptation and resilience of farms.

Actions to implement regenerative coffee farming can contribute to improving the family income. Adopting regenerative agriculture is a transition process that depends on the availability of labour, inputs, and capital and the capacity of farmers to face the risks.

Each producer and their farm begin the journey at a different time. On the one hand, it depends on the condition of input use, the resilience of the farm, and the ecosystem services. On the other hand, it depends on the level of productivity and income. Figure 7 shows the possible trajectories for coffee farms. The blue dotted curve shows the so-called "productivity-sustainability frontier". The red dot represents a situation that growers cannot attain because maximising coffee yields or profit (shown on the horizontal axis) is inconsistent with maximising ecosystem services and resilience (shown on the vertical axis). However, depending on the starting point, farms might still have room for improvement for either one or both objectives without necessarily incurring a trade-off until they reach the frontier. Conditions for Farms 1 and 2 will be changed to improve their income, based on better use of resources and, in some cases, improving the ecosystem services they receive. In the case of Farm 3, it could gain resilience and ecosystem services, but ultimately, with decreased profitability. [88]

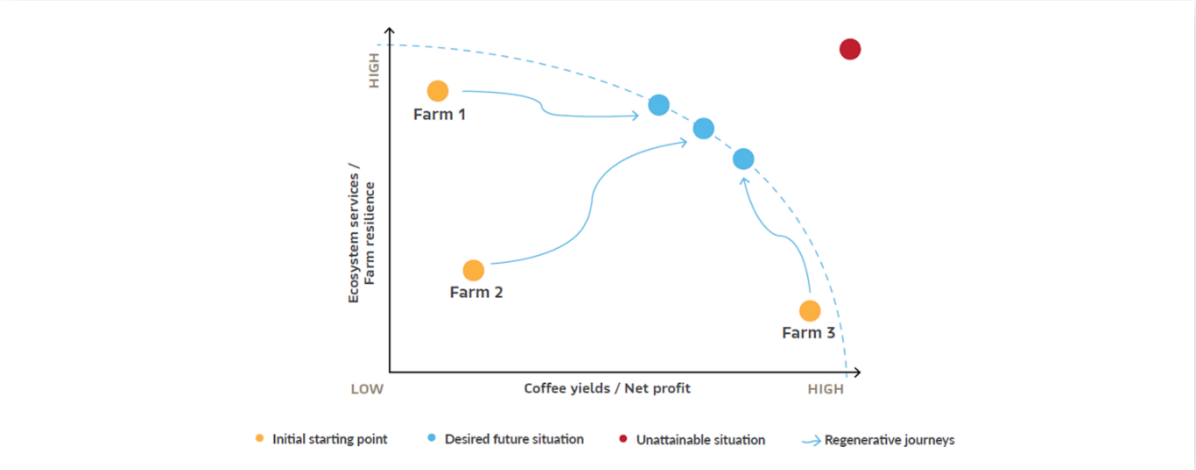


Figure 7. *Possible trajectories for coffee farms seeking to improve the balance between two objectives: productivity and sustainability*
Source. Pulleman et al., 2023, p. 46.

[88] Pulleman et al., 2023.

Table 12 shows some impacts of adopting the agronomic guidance on income, resilience, and potential risks. As described in Figure 7, the same technology can produce different results depending on the initial conditions of the production model.

	BETTER INCOME	RESILIENCE EFFECT	RISKS AND UNCERTAINTIES FOR FARMERS
FARM DESIGN Renovation and rehabilitation	+++	+++	Lower productivity in the short-term, improvement stage of the renovation
FARM DESIGN Agroforestry	++	+++	The level of shade on some farms can reduce productivity. The design of the agroforestry arrangement and the level of shade are determining factors in this effect.
MANAGEMENT OF SOIL HEALTH AND ORGANIC MATTER	++ | - -	+++	Implementation costs can be considerable in the short term, especially if organic inputs are substituted and labour demand is more significant.
NUTRITION PLAN	+++	+	Capital demand in the short term mainly in inputs for soil acidity correction and better fertilisation sources and doses.
HEALTH PLAN	+++	++	Integrated Pest Management may demand higher costs when compared to conventional pest control using chemical pesticides. Adopting an IPM requires a transition plan that protects current production and income levels. In the medium term, the results in quality and income can be positive if viable and efficient natural control alternatives are available.
WATER MANAGEMENT	+	+++	Investment in the wastewater treatment system for domestic wastewater.

Table 12. *Expected impacts of the adoption of the agronomic guide on the economy of AAA families.*

RECOMMENDATIONS

a. From 2024, *Nespresso* will initiate a monitoring plan for technical-economic performance indicators of coffee production in different archetypes of farms. This information will be a reference to monitor the economic efficiency of changes in adopting the agronomic plan and the basis for projections in farm management plans.

b. Use benchmarking information on production economics to guide coffee producers in making strategic and operational decisions to manage their businesses efficiently through the farm management plan.

c. Plan renovations and rehabilitation to stabilise production and mitigate the risk of decreased yield.

d. Reduce production costs by adopting regenerative practices such as soil conservation, integrated nutrient management, and natural weed, and pest control.

e. Producers can begin information management by recording their production and income from coffee sales.

f. Diversify income sources through agroforestry and intercropping.

g. Promote income saving by promoting food production for family consumption.

STEPS IN THE CLUSTER ACTION PLAN

STEPS	CLUSTER MANAGER	AAA AGRONOMIST
Define expected sustainable productivity levels and propose farm management plans.	☑	☑
Promote record-keeping of coffee production, costs, sales, and other revenues.	☑	☑
Promote and encourage income diversification projects.	☑	☑

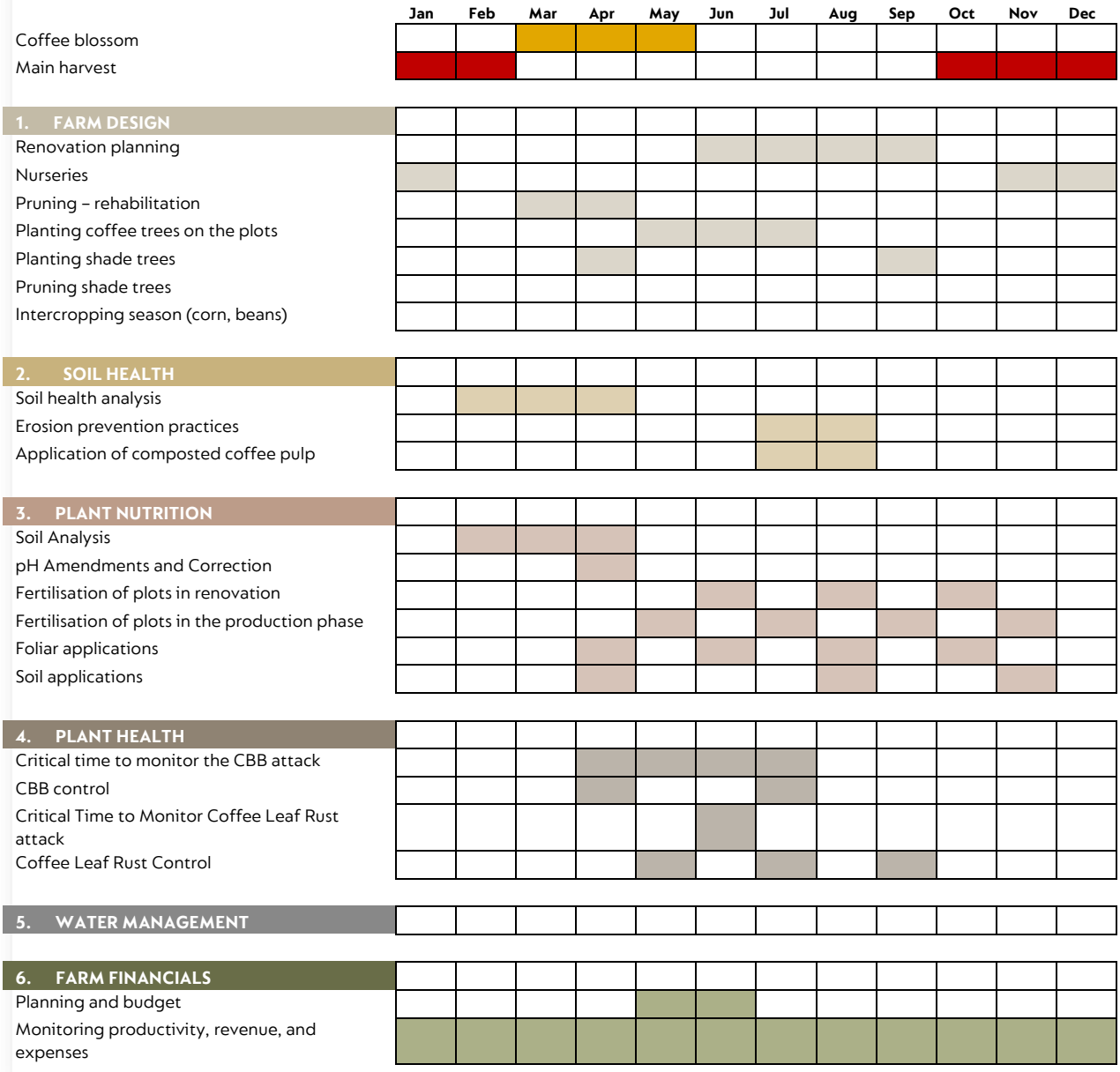
ANNEXES

ANNEX 1

REGENERATIVE COFFEE: AGRONOMIC GUIDE

Calendar of activities in coffee cultivation in Nicaragua

NICARAGUA



ANNEX 2

LOCATION OF THE IMPLEMENTATION CRITERIA FOR THE REGENERATIVE COFFEE SCORECARD-RAINFOREST ALLIANCE

Thes Rainforest Alliance has reviewed these criteria based on the recommendations and arguments of this agronomic guide.

	LEVEL	SCORECARD CRITERION
SOIL **FARMS PROMOTE SOIL HEALTH BY:**	Gold	Apply, organic fertiliser or composted organic matter on at least 75% of the farm, using organic material from the same farm when possible.
LOCALISATION FOR NICARAGUA	*Nespresso* recommends utilising the total available coffee pulp and, to the extent that availability and productivity allow, replacing it with organic matter based on soil analysis recommendations. However, there is no defined minimum application for a percentage of organic matter or farm area. This condition would evolve by first improving productivity levels. AAA Producers utilise all available organic matter on the farm through composting coffee pulp. They prioritise its use and combine it as part of the fertilisation recommendation. The primary source of organic matter in coffee farms is fresh coffee pulp (since 44% of the total coffee harvested is fresh pulp). Managing cover crops and mulching is a significant source of biomass and organic matter in the soil. As a source of organic matter and other nutrients, the management of green manures, such as Tephrosia or Crotalaria, can be implemented. Also, these species and others with similar characteristics could be used as transitory shade during plot establishment.	

	LEVEL	SCORECARD CRITERION
CROP RESILIENCE **FARMS IMPLEMENT GOOD AGRICULTURAL PRACTICES, INCLUDING:**	Gold	Replanting or renovation, implemented to ensure at least 50% of plots in young or middle age (≤ 8 years) trees.
LOCALISATION FOR NICARAGUA	As illustrated in Figure 1, there are local definitions to understand the different interventions that help keep coffee trees young, thereby promoting better productivity and quality. In general, the term "renovation" is used broadly to refer to new plantings and various types of pruning. All these interventions, whether through tissue management or replacing trees with new trees, are equivalent to the concepts of "Replanting and Renovation" in the Rainforest Alliance Regenerative Coffee Scorecard.	

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