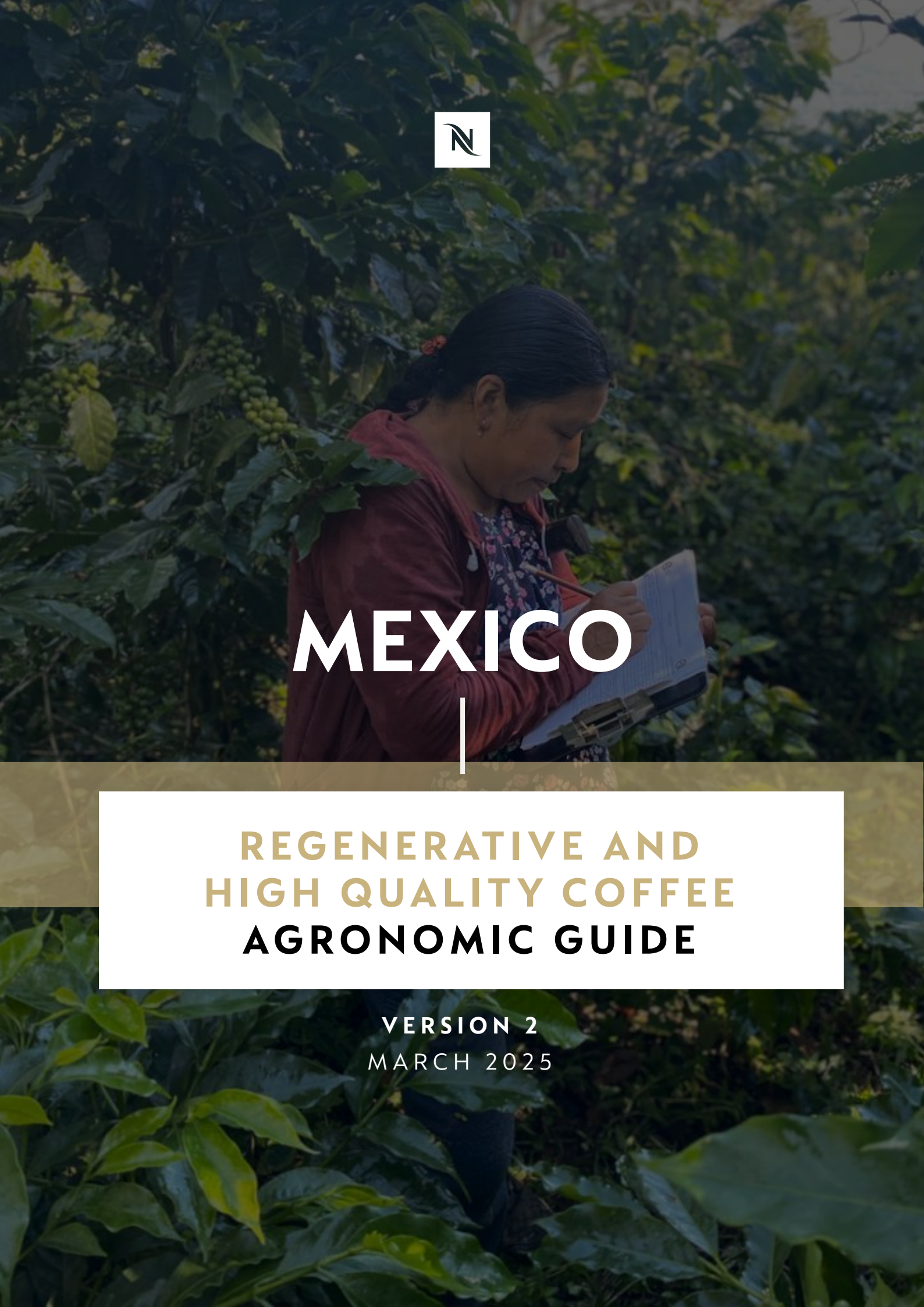


MEXICO

REGENERATIVE AND HIGH QUALITY COFFEE AGRONOMIC GUIDE

VERSION 2

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.

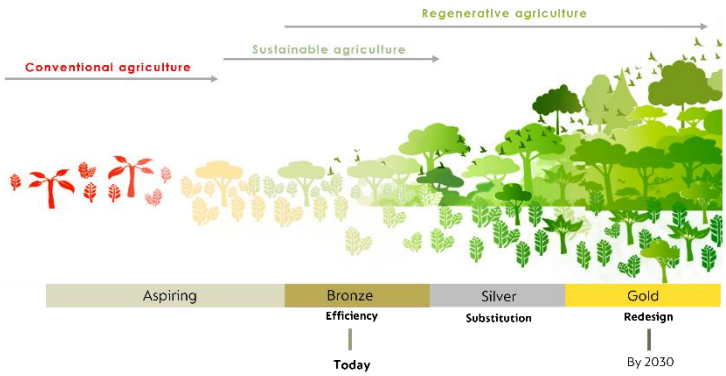
In this new chapter, Sustainable Quality will further integrate high quality coffees with healthy ecosystems, quality of life and thriving communities.

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, heathy ecosystems and thriving communities.

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

MEXICO

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 Mexico.

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 in Mexico. 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 Mexico; 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 from the producers to the coffee partners with whom Nespresso works.

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 may be confusing in their translation and technical description.

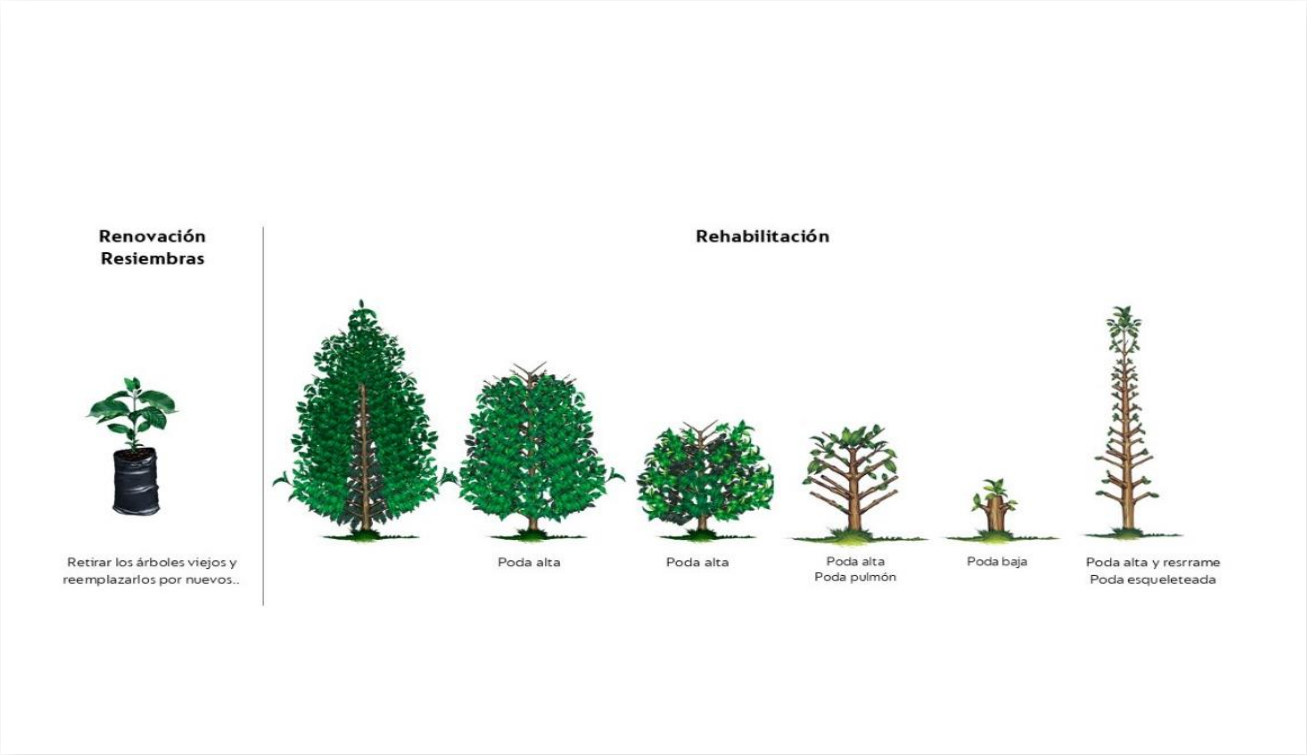


Figure 1. *Conditions of renovation and rehabilitation*

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" RA Scorecard – Gold Level. [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 yearly to maintain stable production.

c. Coffee 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 different 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 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 Level.[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. The necessary corrections are applied one month before planting using options such as calcium carbonate, magnesium carbonate, calcium hydroxide, calcium sulfate, or agricultural gypsum[15].

[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.
[15] Instituto del Café de Costa Rica, 2020, p 84.

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, which involves spreading the substrate in a thin layer and covering it with transparent plastic for 4-6 weeks, 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. [16]

d. The main varieties grown in Mexico in ECOM supply chains are Costa Rica 95 (28%), Colombia (14%), Catimor (12%) and Marsellesa (9%). However, other varieties are available for plantation renewal[17].

e. AAA Agronomists will advise and encourage farmers to choose a suitable variety or cultivar (hybrid) based on an analysis of local variables. All varieties and cultivars listed in Table 1 fit the Nespresso quality profiles associated with each group.

CULTIVAR	PERFORMANCE AGAINST COFFEE LEAF RUST	PERFORMANCE AGAINST NEMATODES
Colombia	Tolerant	Susceptible
Marsellsa	Tolerant	Susceptible
Sarchimor (T5296)	Tolerant	Unknown
Oro Azteca	Tolerant	Susceptible
ANACAFE 14	Tolerant	Susceptible
Obatá Rojo	Tolerant	Unknown
EC16 (Mundomaya)	Tolerant	Resistant to some species of Meloidogyne
H1 (Centroamericano)	Tolerant	Susceptible
Romex*	Tolerant	Tolerant

* The only Robusta variety present in the AAA Cluster and accepted by the AAA Program in terms of quality.

Table 1. *Improved coffee cultivars planted in México*[18] [19]

f. Nurseries can be built on the ground in planting beds (1.5 m wide, 10-15 cm high, maximum 40 m long) or individual biodegradable bags. The bag size depends on the length of the nursery stage: 15 × 20 cm for 6-10 months and 18 × 23 cm for 12 months[20]. Nespresso and 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.

[16] World Coffee Research. 2021.
[17] Servicios de Manejo Sostenible, 2024
[18] Servicios de Manejo Sostenible, 2024
[19] World Coffee Research, 2023.
[20] Instituto del Café de Costa Rica, 2020.

g. In the medium term, regular renovation and rehabilitation can significantly improve productivity and generate positive cumulative cash flow for the farmer. Since lack of funding is the main obstacle to investment in this practice, it is best to implement it gradually, reseeding or rehabilitating between 10 and 20% of the plantation annually[21].

h. Intercropping is especially important during coffee establishment or renovation when it can protect young coffee trees and bare soil from erosion and adverse weather conditions (heat and drought) while also helping to control weeds[22]. This practice allows farmers to diversify and intensify production. It improves the resilience of rural households and coffee-growing communities by providing a greater variety of food and income sources[23]. SMS Mexico recommends coffee-corn intercropping through the Cultivating Better Lives (Cultivando Mejores Vidas - CMV) project for the AAA cluster area.

i. The recommended density/spacing depends on technical criteria, such as climatic conditions, soil fertility, length of the renovation cycle, and agronomic practices. Different planting distances between coffee trees and lines can be applied, with some models based on the prevalence of the dry season throughout the year. Currently, there are no studies available on optimal planting densities in Mexico. The densities outlined below are derived from the practical field experience of ECOM SMS (Tables 2 and 3)[24].

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.

CONDITION	DISTANCE BETWEEN LINES (M)	DISTANCE BETWEEN TREES (M)	PLANTS PER HECTARE
Adequate sunshine and rainfall	*2*	*1.5*	*3,333*
	2	*1.25*	*4,000*
Limited sunshine and high rainfall	*3*	*1*	*3,333*
	2,5	*1*	*4,000*

Table 2. *Some planting distance alternatives for the renovation of Arabica coffee in Mexico*

[21] Pulleman et al., 2023, p. 54.
[22] Pulleman et al., 2023, p. 72.
[23] Pulleman et al., 2023, p. 69.
[24] Sustainable Management Services, 2024.

CONDITION	DISTANCE BETWEEN LINES (M)	DISTANCE BETWEEN TREES (M)	PLANTS PER HECTARE
Adequate sunshine and rainfall	*3*	*3*	*1,111*
	4	*3*	*833*
Limited sunshine and high rainfall	*4*	*2.25*	*1,111*
	4	*2.5*	*1,000*

Table 3. *Some planting distance alternatives for the renovation Robusta coffee in Mexico*

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, pruning, cycle, and productivity performance. Each farm defines the renovation plan with the advice 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." [25]

RECOMMENDATIONS

a. Establish a shade management plan with the farms in the cluster.

b. The choice of design and specific shade density will depend on an agroclimatic analysis of the farm carried out with the support of the AAA Agronomist. Higher tree densities exceed the recommended level of shade, so it is necessary to implement a management plan to optimise the level of shade on the farm and thus avoid productivity negative effects.

c. In the cluster's area of influence, more than 70 shade tree species have been identified, with the predominant species listed in Table 4.

COMMON NAME	SCIENTIFIC NAME	NATIVE – NON NATIVE
Encinos	*Quercus* spp.	Native
Vainillo	*Vanilla planifolia*	Native
Ixpepe	*Trema micrantha*	Native
Xochicuahuitl	*Cordia alliodora*	Native
Cedro	*Cedrela odorata*	Native
Guarumbo	*Cecropia peltata*	Native
Jonote	*Heliocarpus appendiculatus*	Native
Aguacate	*Persea americana*	Native
Ocozote/Liquidámbar	*Liquidambar styraciflua*	Native
Zopilote	*Oreomunnea mexicana*	Native
Chalahuites, Jinicuiles	*Inga* spp.	Some native species in the gender

[25] Rainforest Alliance, 2022 a.

Fresno	*Fraxinus* spp.	Some native species un the gender
Naranjo y Limón	*Citrus* spp.	Non-native
Grevilea	*Grevillea robusta*	Non-native

Tabla 4. *Especies más comunes en arreglos agroforestales en los clústeres de Nespresso en México*

d. *Inga* spp. stands out among young trees (less than five years old) as an ideal shade species in coffee plantations due to its environmental services, biomass production, host fauna diversity, and timber use[26].

e. Nine tree species have been chosen to promote diversification (non-limiting suggestion). Depending on their characteristics, their location is recommended (Table 5).

ZONE IN THE FARM	SPECIES	SHADE STRATUM
1. Boundaries of the plot/farm	Zopilote (*Oreomunnea mexicana*)	High
2. Roadsides and bodies of water	Oozote/liquiambar (*Liquidambar styraciflua* L.)	High
2. Roadsides and bodies of water	Pomarrosa (*Syzygium jambos*)	Medium
3. Interleaved with coffee	Vainillo/chalahuite (*Inga vera*)	Medium
3. Interleaved with coffee	Frijolillo (*Cojoba arborea*)	High
3. Interleaved with coffee	Naranja (*Citrus sinensis*)	Medium
3. Interleaved with coffee	Jinicuil (*Inga jinicuil*)	High
3. Interleaved with coffee	Limón (*Citrus limon*)	Low

Table 5. *Recommendation for tree species distribution by specific areas on the farm.*

Below is a description of the agroforestry designs proposed for the context of clusters in Mexico.

DESIGN 1

The first model corresponds to the areas where the producer prefers to maintain the plantations with greater sun exposure. The shade level is less than 75 trees/ha. In this design, trees are concentrated on the edges and the banks of rivers and roads. Within the farms, 57 trees are established per hectare, and the rest are distributed on the boundaries with a distance of approximately 7 m.

DESIGN 2

[26] Sánchez et al., 2017.

The second agroforestry design is for already established plantations. It has a density of shade trees between 75 and 127 trees/ha. In this case, the distribution of the species proposed to be interspersed directly with coffee is more significant than in the previous case.

In this design, shade trees are mainly distributed inside the farm, so the producer has greater availability to increase the level of shade inside and on the edges of roads and bodies of water.

DESIGN 3

This design corresponds to areas in the renovation stage. Table 6 shows the distribution of species recommended for placing on borders and intercropping with coffee.

SPECIES	SHADOW STATE	DISTRIBUTION (%)	TREES NEEDED PER HECTARE
Vainillo/chalahuite (*Inga vera*)	Medium	25%	32
Frijolillo (*Cojoba arborea*)	High	25%	32
Limón (*Citrus limon*)	Low	20%	25
Zopilote (*Oreomunnea mexicana*)	High	15%	19
Total		**100%**	**127**

Table 6. *Agroforestry design for new or plantations under renovation*[27]
Source: ECOM – SMS, Mexico. 2024

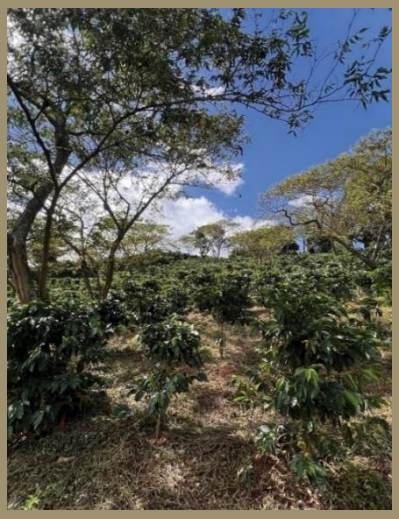
f. In the cluster, intercrop plants such as bananas, palm trees, lemons and, lately, corn (Cultivando Mejores Vidas -CMV Project) are common in supplementing income. In addition to commercial coffee-banana polyculture, forest plantations with the native pine species (*Pinus chiapensis*) have recently been established in association with the coffee plantation[28].

[27] Sustainable Management Services, 2024.
[28] López & Díaz, 2020.

"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 the RA standard 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 IN THE CLUSTER ACTION PLAN

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 foundational principle of regenerative agriculture. Soil Health is defined as the continued capacity of the soil to function as a vital living ecosystem that sustains plants, animals and humans. Important functions are: retaining and cycling nutrients, sequestering carbon, allow infiltration, facilitating storage and filtration of water, suppressing pests and diseases, 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. While laboratories are still in early days of providing such integrated analysis 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 total functioning capacity, if it is degrading, or if it is regenerating.

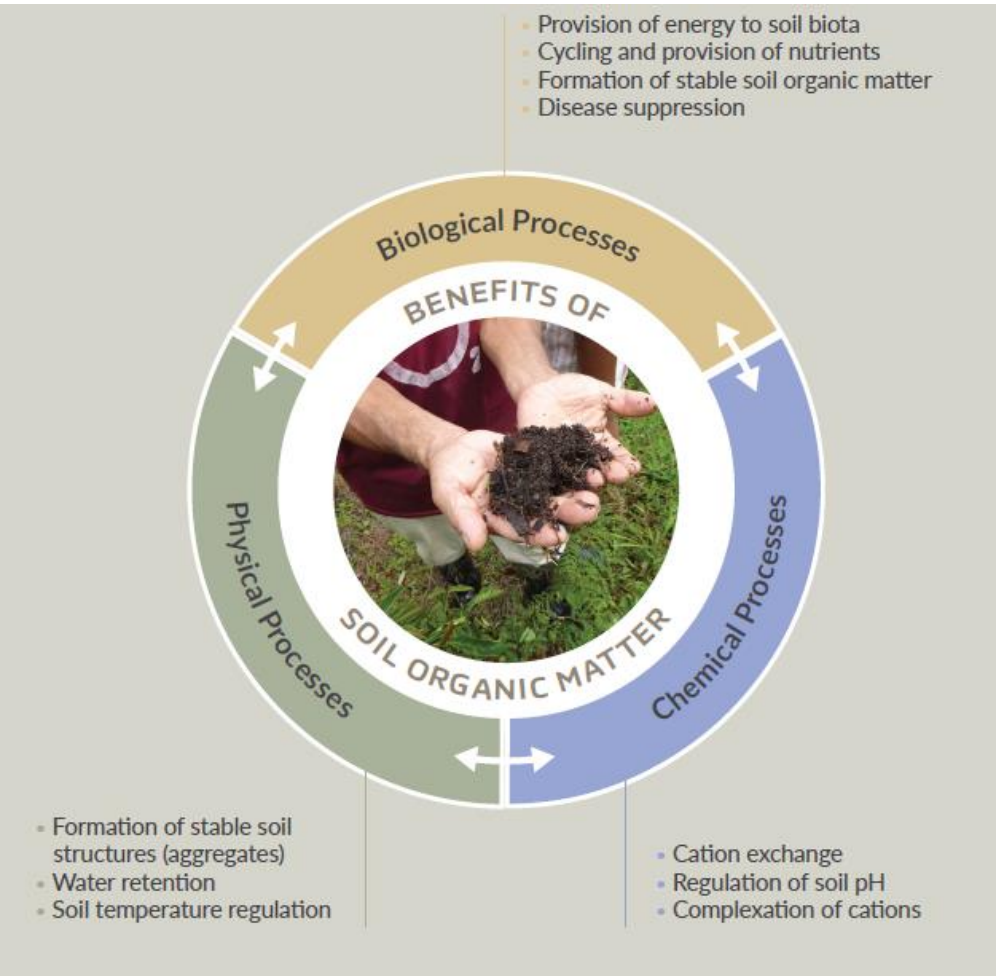


Figure 2. *The benefits of soil organic matter through its effect on biological, chemical and physical processes.* Source: Pulleman et al., 2023, p. 23.

RECOMMENDATIONS

a. Healthy soils are essential for high-quality and resilient agricultural production at scale. Agricultural practices such as pesticides and fertilisation applying 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, among others.

   Maintaining healthy soils is an investment into 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, more than this short-term horizon is required 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 instantly. A new approach to fertilisation should focus on improving the functional capacity of the soil. Guidance of the soil health analysis and practice recommendations will continue to evolve and be available for informed decision-making.

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.

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." [35]

"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." [36]

Mexico ranks first in coffee plantations with systems established under permanent shade[37], which has favoured soil conservation by the natural cover for more than 200 years. Coffee production systems in Mexico are classified as rustic, traditional polyculture, and commercial polyculture, with less diversity of trees, integrating introduced and specialised species, characterised by monospecific shade[38]. Knowledge of these production systems allows a better understanding of the characteristics and qualities of the soil covers of coffee plantations (Figure 3).

[35] Pulleman et al. , 2023. p. 82
[36] Rainforest Alliance, 2022 a.
[37] Consejo Consultivo Nacional de Desarrollo Sustentable (CCNDS), 2004.
[38] Moguel and Toledo, 2024.

Figure 3. *Coffee Growing Systems in Mexico*

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 study and according to the land 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.[39]

e. Locate the coffee trees by planting them in contour lines transverse to the slope[40].

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[41].

g. Whenever possible, prioritise the plant solution over the construction of physical structures, 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.

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

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. [42]

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

RA Scorecard – Gold Level. [43]

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 species.

c. Identify farms with naturally established living covers.

d. Identify the capacity for attention and correct management of producers' living covers.

e. ECOM has evaluated the following species of live cover in the field: Vigna radiata, Crotalaria juncea, Crotalaria spectabilis, *Brachiaria ruziziensis, Brachiaria brizantha*, Rye Grass/Mega, Rye Grass/Tetillo, *Panicum maximum* (mombaza), *Panicum maximum* (massai), with management information[44] (Table 7).

[42] Pulleman et al., 2023, p. 85.
[43] Rainforest Alliance, 2022a.
[44] Sustainable Management Services-ECOM, 2024.

SPECIES	CHARACTERISTICS	MANAGEMENT RECOMMENDATIONS
Crotalaria spectabilis	*Annual coverage* *Slow growth rate* *Fixation of 200-240 Kg Atmospheric N/year* *It is recommended that the cover is pruned before flowering to extend its life.* *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 plantation density due to ant and bird attacks.*
Vigna radiata	*Annual coverage* *Nitrogen fixation.* *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 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.*
Lolium multiplorum (Rye grass)	*Annual herb.* *Medium growth.* *It does not compete with the crop.* *It does not produce stolons.* *Low demand for labour.* *It may have tolerance/ resistance to herbicides.* *It does not allow the development of other weeds.*	***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 7. *Live cover species assessed by ECOM in the SMS programme*[45].

f. 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 can compete with the coffee plants for 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[46].

g. Keep the leaves of shade trees that remain on the ground (mulching)[47].

h. Consider the species *Oplismenus burmannii*, which develops naturally in the coffee plantations of Mexico.

[45] Sustainable Management Services-ECOM, 2024.
[46] Pulleman et al., 2023, p. 81.
[47] Farfán, 2014, pp. 146, 159.

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.

(Mandatory criteria)[48]

Arvense: (For the difference in Spanish with the term weed). Spontaneous or adventitious companion plants are associated with crops in spaces modified by agricultural activities[49].

RECOMMENDATIONS

a. 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 8 categorises the main weeds affecting coffee crops [50] [51].

b. Coffee plantations free of weeds for prolonged periods can have problems just as serious as if they were kept completely weeded[52].

c. Abrupt changes in weed population dynamics promote the appearance of less common weeds that are more difficult to control[53]. The greater the intensive weed management, the lower the diversity of these plants[54].

d. Maintaining a balance in the diversity and quantity of weeds in the coffee plantation promotes a healthy soil ecosystem, reducing the need for intensive management, reducing production costs, and promoting more sustainable practices.

[48] Rainforest Alliance, 2022a.
[49] Chacón and Gliessman, 1982.
[50] Virginio et al., 2021 a.
[51] Virginio et al., 2021 b.
[52] García-Mayoral et al., 2024.
[53] García-Mayoral et al., 2024.
[54] García-Mayoral et al., 2024.

LEVEL OF INTERFERENCE	WEED SPECIES		
Noble weeds: **GOOD COVERAGE**	*Arachis pintoi* *Borreria laevis* *Borreria sp.* *Commelina difusa* *Commelina elegans* *Commelina erect* *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 COVERAGE**	*Ageratum conyzoides* *Amaranthus hybridus* *Amaranthus viridis* *Arachis hypogaeaMexican* *Argemone* *Asclepias sp..*	*Bidens hairy* *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 pudica* *Momordica charantia* *Plantago major* *Pseudelephantopus spicatus* *Rumex crispus*
VERY COMPETITIVE 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 8. *Common weed species in coffee crops and their level of interference.*
Source: Adapted from Virginio et al., 2021 a.

e. 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 to prevent soil erosion[55].

f. Identify the most competing weeds within the coffee plots.

g. 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.

h. 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.

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

i. 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)[56] [57]. Table 9 shows the herbicides available in Mexico. Only products marked as belonging to the risk mitigation list should be used, and only one of them, according to the Gold Level of the Rainforest Alliance Regenerative Coffee Scorecard.

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

ACTIVE INGREDIENT	CAS Number	RAINFOREST ALLIANCE CATEGORY
Saflufenacil	372137-35-4	Without restrictions
Clethodim	99129-21-2	Without restrictions
Aminopyralid	151114-71-9	Without restrictions
Thifensulfuron-methyl	79277-27-3	Without restrictions
Metsulfuron methyl	74223-64-6	Without restrictions
2,4-D,2-Ethylhexyl ester	1928-43-4	Risk mitigation
Bromacil	314-40-9	Risk mitigation
Diuron	330-54-1	Risk mitigation
Flumioxazine	103361-09-7	Risk mitigation
Glyphosate, isopropylamine salt (1)	38641-94-0	Risk mitigation
Ion Diquat	2764-72-9	Risk mitigation
Metolachlor, (S)	87392-12-9	Risk mitigation
Oxyfluorphene	42874-03-3	Risk mitigation
Atrazine	1912-24-9	Prohibited
Paraquat dichloride	1910-42-5	Prohibited
Glufosinate ammonium	77182-82-2	Prohibited

Table 9. *Herbicides used in coffee in Mexico. (Updated: April 30-2024)*

(1) Not promoted by ECOM SMS Mexico

[56] Rainforest Alliance, 2022 b.
[57] Rainforest Alliance, 2022 b.

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 actions with producers to protect and conserve the soil, 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. [58]

"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. [59]

"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." [60]

[58] Pulleman et al., 2023. pp. 107-108
[59] Rainforest Alliance, 2022 a.
[60] Pulleman et al., 2023. p.113

RECOMMENDATIONS

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

b. Soil evaluation should be conducted at least every two years using a representative sample of the coffee-growing area.

c. 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 visual symptoms of nutritional deficiencies and foliar analysis[61] . The chemical analysis of the soil is the primary diagnostic tool to evaluate its nutritional status and make management decisions[62].

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

STEPS IN THE CLUSTER ACTION PLAN

STEPS	CLUSTER MANAGER	AAA AGRONOMIST
Identify the soil's chemical, physical, and biological composition with soil analysis.		☑
Identify limitations of the fertilisation response; consider the correction of soil acidity, crop age, shade level, compaction, and soil 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.		☑

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

3.2 EFFICIENT, LOW-CARBON FERTILISATION

The analysis of CO_2 equivalent emissions on farms in Mexico, carried out with the Cool Farm Tool methodology, reveals that 53% of the GHG footprint at the farm level is related to the production and use of fertilisers. The efforts will focus on three principles to reduce this footprint:

(I) Healthy soil is fertile soil. Its improvement will favour the entire ecosystem, which will benefit coffee production.

(II) The choice of nitrogen source (nitrate, ammonium or urea) is critical, as each has a different reaction and GHG emission factor[63].

(III) Nitrogen is the primary source of GHG emissions, so its use must be optimised concerning production.

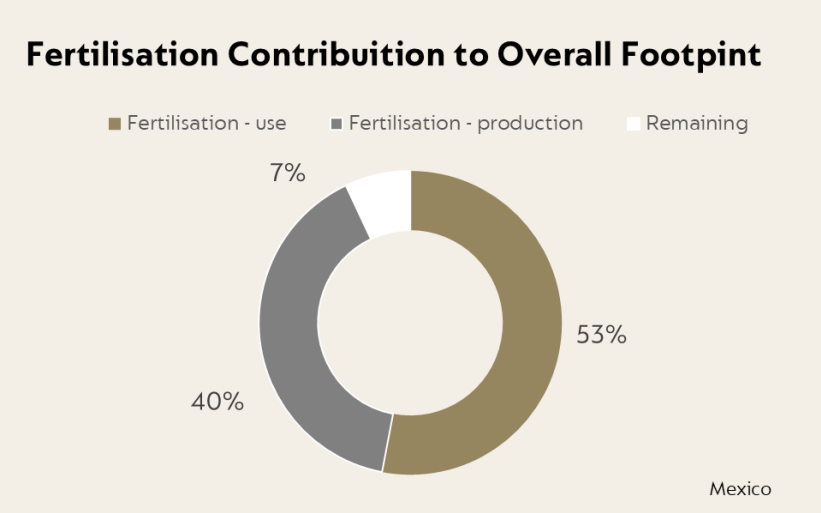


***Figure 4**. Contribution of fertilisation to the GHG footprint – Mexico*
Source: Nespresso, 2023/2024 cycle

There are several sources of nitrogen fertilisers with different percentages of nitrogen input. Table 10 details some fertilisers that provide nitrogen in various chemical forms[64] [65]. As for nitrogen losses related to fertiliser sources, the most significant differences relate to volatilisation and leaching processes. Nitrogen losses by volatilisation are more substantial in urea than in ammonium nitrate; the opposite is true for leaching[66]. 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.

[63] YARA International, 2011.
[64] YARA, 2023, p. 4.
[65] Sustainable Management Services, 2024.
[66] Sadeghian & Gonzáles-Osorio, 2022.

NITROGEN SOURCE	NUTRIENT CONTENT (%)			
	N-Total	$CO(NH2)_2$ N-Ureic	N-ammonium NH_4	N-Nitrate NO_3
Urea	46	46		
Ammonium Sulfate	21		21	
Ammonium nitrate	33,5		16,9	16,9
MAP (Ammonium Monophosphate)	10-11		10-11	
DAP (Ammonium Diphosphate)	16-21		16-21	
M.F. SMS Production	15		8.2	6.8
Yara Bela Nitromag	27		13,3	13,7
Yara Mila Star	21		13,5	7,5
Yara Mila Hydran	19		9.6	9.4
Yara Liva Nitrabor	15,4		1,0	14,4

Table 10. *Nutrient content of commonly used fertilisers and the produced by YARA*

RECOMMENDATIONS

a. Following the concept of the 4Rs, we seek to apply efficient levels of synthetic fertiliser for 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[67]. The nutrient source will be supplemented by organic fertilisation (see section 3.3)

b. Use balanced formula fertilisers designed to meet the nutritional requirements of coffee with nitrate-based nitrogen sources. This choice optimises fertilisation by minimising losses due to ammonia volatilisation and favours rapid absorption by the plant. SMS Production and Yara Mila Hydran fertilisers fertilisers meet these characteristics for the production stage.

c. Dose fertilisation considering plant density, shade level, expected yield, and soil analysis.

d. Once the fertilisers have been selected, it will be necessary to define their application times. To do this, aspects such as the amount and distribution of rainfall, the phenological seasons of the crop, and the amount and type of fertiliser must be considered[68]. Use the SMS-Mexico regenerative package as a guide.

[67] Pulleman et al., 2023, p. 114.
[68] Sadeghian S. 2022, p. 190.

e. High soil acidity (pH <5) is a common limitation affecting fertilisers' effectiveness in all coffee regions, reducing the availability of essential nutrients such as phosphorus, calcium, and magnesium. In addition, it can induce aluminium and manganese toxicity, negatively affecting root development and crop productivity. Liming is usually effective in raising the pH of acidic soils and mitigating the toxicity of aluminium and manganese while providing calcium and magnesium[69]. It is recommended that the doses be applied approximately two months before or after fertilising and adjusted according to the stages of renovation, after rehabilitation and harvest, respectively[70].

f. Complement with applying beneficial microorganisms to the soil, also called biofertilisers, to stimulate plant production. Beneficial microorganisms, except for nitrogen-fixing bacteria, do not directly add nutrients to the system; instead, they improve plant health and growth by increasing the availability and uptake of nutrients already in the soil[71]. ECOM SMS offers alternatives to these biofertilisers that have shown promising results in the cluster area.

STEPS IN THE CLUSTER ACTION PLAN

STEPS	CLUSTER MANAGER	AAA AGRONOMIST
Recommend fertilisation sources with the best efficiency in using nitrogen and adequate planning of the dose, time and place of application.		☑
Define interventions to promote and incentivise the adoption of the efficient use of nitrogen fertilisers based on the above recommendations.	☑	
Collaborate with producers to implement organic-mineral fertilisation practices, validating their effectiveness through demonstration plots on farms.		☑

[69] Pulleman et al., 2023, p. 110-111.
[70] Sadeghian S. 2022, p. 79-80.
[71] Pulleman et al., 2023, p. 119.

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."[72]

"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 [73]

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[74].

b. Cover crop management and mulching are important sources of biomass and organic matter in the soil.

c. When incorporated into the soil, decomposed coffee pulp improves fertility by raising the pH, reducing aluminium toxicity and increasing the content of organic matter and nutrients such as potassium, calcium, and magnesium. Although its use can match the

[72] Pulleman et al., 2023, p. 121.
[73] Rainforest Alliance, 2022a.
[74] Pulleman et al., 2023, p. 23.

production obtained with chemical fertilisers, the high demand for pulp (more than 20 tons per hectare per year) limits its large-scale application on many farms[75].

d. With organo-mineral fertilisation, it is possible to achieve similar or better productions than chemical synthesis fertilisers, which is 100% of the recommendation according to soil analysis. In many cases, it will be sufficient to use 75% of the recommended dose of chemical fertilisers and between 1,500 and 1,700 kg-ha per year of decomposed pulp with 60 to 65% moisture. These quantities can be obtained by producing close to 2,875 kg-ha per year of dry parchment coffee[76].

e. Considering the information in paragraph d and the successful experiences of producers in the AAA cluster, it is recommended that composted coffee pulp be used, with doses adjusted according to the crop's phenological stage, as indicated in Table 11 below.

CROP STAGE	Recommendation to replace approximately 25% of chemical fertilisation		Recommendation to reach approximately 100% of the nutritional requirements of coffee	
	Arabica coffee*	Robusta coffee**	Arabica coffee*	Robusta coffee**
Renovation (Sowing)	Mix 3 to 4 kg of composted pulp with the soil to fill the planting holes.	Mix 3 to 4 kg of composted pulp with the soil to fill the planting holes.	-	-
Renovation (planting established)	Apply 0.15 kg/plant in the drip area.	Apply 0.45 kg/plant to the drip area.	Apply 2.25 kg/plant to the drip area.	Apply 7.5 kg/plant to the drip area.
Production	Apply 0.5 kg/plant to the drip area.	Apply 1.5 kg/plant to the drip area.	Apply 7.5 kg/plant to the drip zone.	Apply 25 kg/plant to the drip area.

* Considering a density of 3,333 plants/ha and a pulp dose of 25 t/ha.
* * Considering a density of 1,000 plants/ha and a pulp dose of 25 t/ha.

***Table 11**. Recommendations for the use of coffee pulp compost*[77].

f. In Mexico, coffee is processed in the wet mill of Ixhuatlán del Café, where the coffee pulp is transformed into compost under aerobic conditions. This centralised process controls the quality of the composting process (aeration, humidity, and temperature).

[75] Salazar and Sadeghian, 2023.
[76] Salazar and Sadeghian, 2023.
[77] Sustainable Management Services, 2024.

The compost should have a final humidity level between 25-60%. The stabilised compost can be distributed back to coffee farmers and applied to crops[78].

g. In other regions of Latin America, farmers apply biol, made from coffee mucilage, as a complement to organic stabilised. Biol results from the aerobic fermentation of different organic and mineral materials transformed by microorganisms. In addition to the mineral component, bioles may contain plant hormones to stimulate growth. It can provoke the plant's response to pest and disease attacks and contribute to unifying ripening[79].

h. AMSA (ECOM) is developing a project to produce bioles at an industrial level with standardised quality and commercial grade, made from coffee mucilage, minerals and beneficial microorganisms. This product is recommended as a source of micronutrients, promoter of nutrient solubilisation in the soil and stimulant of ripening uniformity. The recommendation for using bioles based on ECOM field experience is to apply 5 litres per hectare via foliar spray at any phenological stage, up to 4 times per year. For soil applications (drench), mix 5 litres of biol in 200 litres of water and apply 0.1 litres per plant, preferably at the start of the rainy season, with a maximum of 2 applications per year and an interval of 2 months between them.

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 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.		☑

[78] Hafner et al., 2018.
[79] COMSA, 2020.

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) [80]

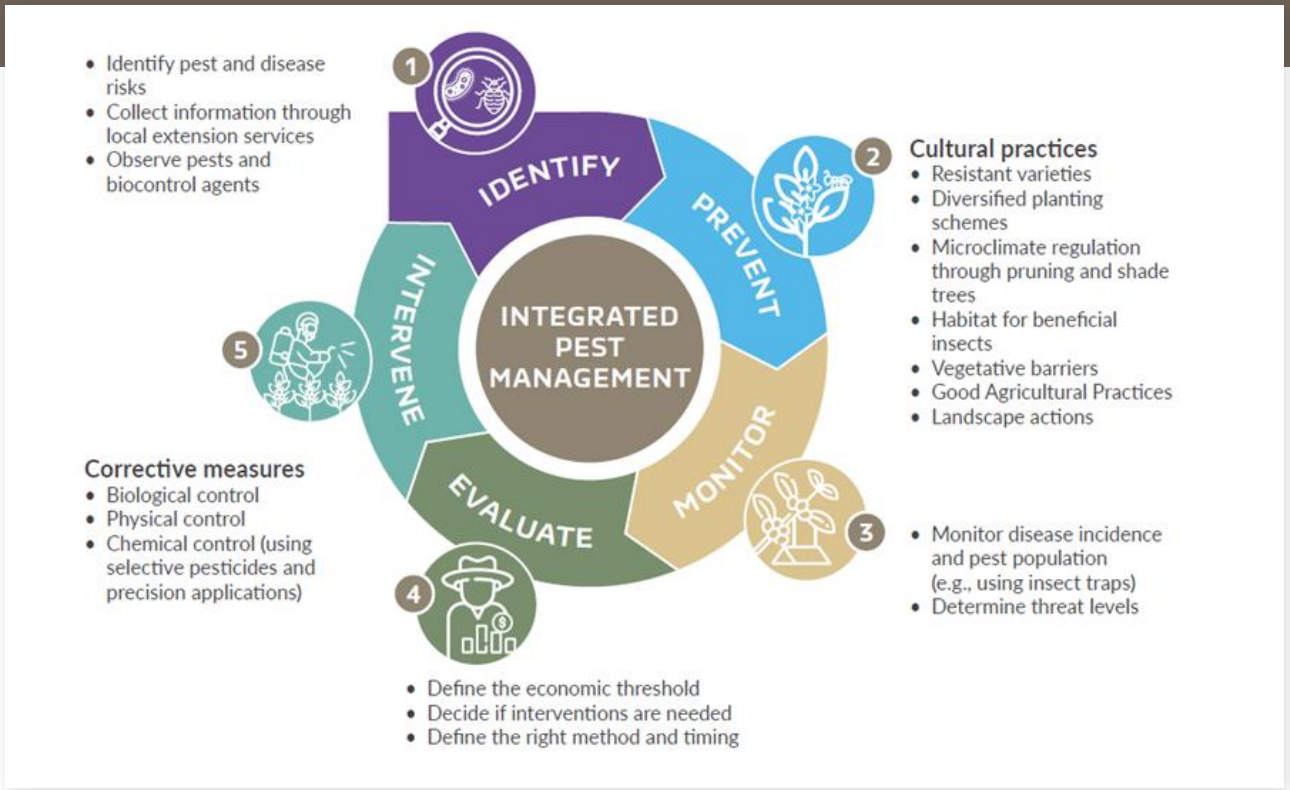


Figure 5. *Key components of an Integrated Pest Management Approach.*
Source: Pulleman et al., 2023, p. 97.

RECOMMENDATIONS

For all phytosanitary problems:

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

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

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

[80] Rainforest Alliance, 2022a .

d. Apply agrochemicals only to the impacted coffee areas/plants.

e. 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 Rainforest Alliance risk mitigation list) following directions for usage, as described on the label, in line with Chapter 4 of the Rainforest Alliance Standard Annex[81].

COFFEE BERRY BORER

f. Cultural control is a 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 measures include:

   (i) The crop age and sowing distance are needed for a good harvest.
   (ii) Renovate and rehabilitate coffee plantations on time to prevent the spread of the coffee berry borer.
   (iii) Integrated weed management to promote the presence of beneficial fauna and natural control.
   (iv) Good control of the coffee picking during the harvest and at the end of the season to reduce the borer population in the coffee plantation[82] [83].
   (v) Ninety days after the main flowering, implement ethological control using attractant-based traps (mixture of ethanol and methanol 1:1). The BROCAP trap is recommended due to its higher efficiency.

g. Insecticides are only applied when infestation in the field exceeds 4%; the economic threshold is 2% infestation. No control measures below this level are needed[84]. 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.

h. 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[85].

COFFEE RUST

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

j. 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.

[81] Rainforest Alliance, 2022 b.
[82] Benavides et al., 2013.
[83] Constantine, 2023.
[84] Instituto del Café de Costa Rica, 2021.
[85] Martínez-Salinas, et al., 2022.

(iii) Integrated weed management to avoid excessive humidity.
(iv) regulate shade trees, keeping around 40% of shade;
(v) carry out good fertilisation fertilisation at the appropriate times 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).

AMERICAN LEAF SPOT (OJO DE GALLO).

k. Management recommendations for IPM also effectively control leaf spots. 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

l. For the adequate control of anthracnose, it is necessary to establish an integrated management of the disease:
   (i) Carry out fertilisation at the correct time, according to the soil analysis and production results.
   (ii) Use shade and living barriers to reduce high temperatures, brightness, and wind.
   (iii) Properly manage weeds and avoid bare soils.
   (iv) Prune exhausted plants.
   (v) Prune twice yearly, leaving two shafts per planting point.
   (vi) Use fungicides during the flowering phase, after the heat wave (July-August) and before the rainiest month (October).
   (vii) It is recommended that *Bacillus subtilis* (Best Ultra F) be used as part of biological monitoring[86].

NEMATODES

m. Carry out control treatments on the seedbed substrates with biological products, especially decomposed organic matter. Eliminating the use of synthetic chemical nematicides on farms is essential. ECOM recommends the use of 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.

n. Given the confirmed presence of nematodes on the farm, grafting is recommended, using the Robusta species as a rootstock. This practice has been used in the AAA cluster area for over twenty years.

[86] Instituto del Café de Costa Rica, 2020, p.60.

STEM BORER

The following control methods are suggested to reduce the attack of the borer *(Hammuderus spp.)* before *(Plagiohammus)*:

(i) Remove weeds from the drip area and clean moss from the stems of coffee trees to expose the larvae to their natural enemies or remove them mechanically.
(ii) Perform sanitary pruning in unproductive plants (sanitary pruning).
(iii) Prune or renew adult plants that are infested, depending on the condition.
(iv) Applying entomopathogenic fungi such as *Beauveria bassiana* and *Metarhizium anisopliae* is effective with a syringe in the borer's gallery.
(v) Inject an insecticide solution with a recent borer attack into the hole where the sawdust comes out and immediately plug the hole. This is the last resort once cultural, mechanical, and biological methods have been inefficient[87].

STEEM CANCER OR MACANA SORE

a. Steem cancer *(Ceratocystis fimbriata)* is a common disease in *Coffea canephora*. Once infected, the plant usually dies. The main route of infection occurs during pruning. It is necessary to implement the following phytosanitary measures to prevent the disease:

(i) Use only saws or pruning shears disinfected with 3% hypochlorite[88].
(ii) Do not use tools that have been in contact with the ground, such as machetes.
(iii) Sealants or pastes should be applied to cuts made; for example, Bordeaux paste, Cura Bien®, and Vinimex® paint.

b. Diseased plants should be removed and burned immediately. It is suggested that lime be applied inside the holes where new plants will be planted.

These practices, adopted by AAA Producers for over twenty years, have significantly reduced the economic losses caused by this disease in robusta coffee plantations.

o. The active ingredients of phytosanitary products are registered in Mexico and benchmarked with the Rainforest Alliance 2020 Standard (Table 12). The safety conditions in the application, the times of re-entry to the field, and the safety periods before harvest must be respected.

[87] Constantino Chuaire, L. M., & Benavides Machado, P. (2015)
[88] Instituto del Café de Costa Rica, 2020, p.58

GROUP	ACTIVE INGREDIENT	CAS NUMBER	RAINFOREST ALLIANCE CATEGORY
Fumigant	1,3-Dichloropropene	542-75-6	Risk mitigation
Fungicide	Azoxystrobin	131860-33-8	Risk mitigation
Fungicide	Copper hydroxide	20427-59-2	Risk mitigation
Fungicide	Copper oxychloride	1332-40-7	Risk mitigation
Fungicide	Pyraclostrobin	175013-18-0	Risk mitigation
Fungicide	Copper Sulfate (Anhydrous)	7758-98-7	Risk mitigation
Fungicide	Trifloxystrobin	141517-21-7	Risk mitigation
Fungicide	Flutriafol	76674-21-0	Without restrictions
Fungicide	Tebuconazole	107534-96-3	Without restrictions
Fungicide	Epoxiconazole	133855-98-8	Prohibited
Insecticide	Ciantraniliprole	736994-63-1	Without restrictions
Insecticide	Chlorantraniliprole	500008-45-7	Without restrictions
Insecticide, acaricide	Cyhalothrin, lambda	91465-08-6	Risk mitigation
Insecticide, acaricide	Cypermethrin, alpha	52315-07-8	Risk mitigation
Insecticide, acaricide	Malathion	121-75-5	Risk mitigation
Insecticide, acaricide	Imidacloprid	138261-41-3	Prohibited
Insecticide, acaricide	Thiamethoxam	153719-23-4	Prohibited

Table 12. *Active ingredients are registered in Mexico ,following Rainforest Alliance Standard 2020 and its requirements. (Updated: April 30-2024)*

Table 13 shows some available biocontrol products with registrations for use in coffee in Mexico (Table 12).

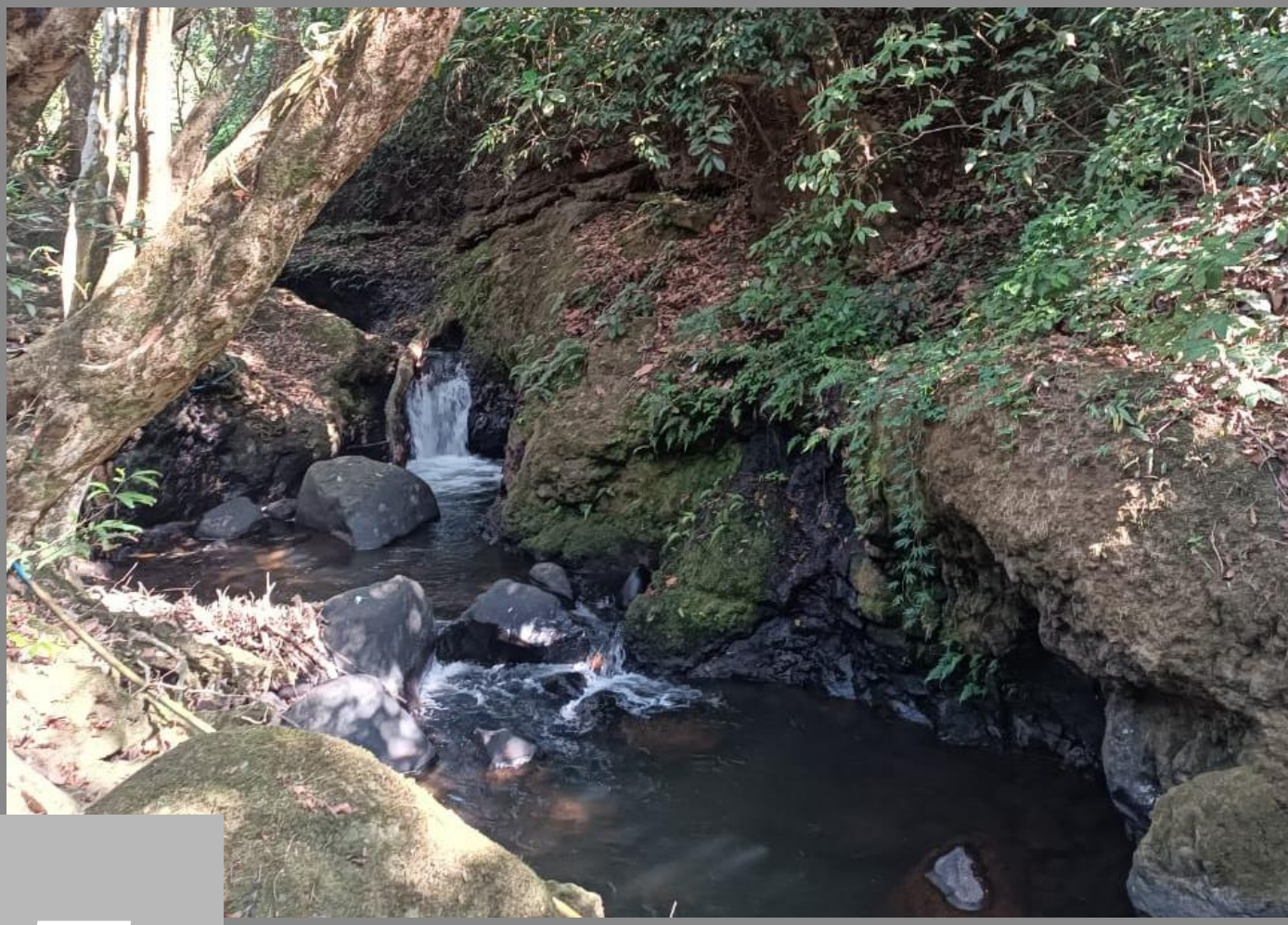
BIOLOGICAL CONTROL PRODUCT	TYPE	ACTIVE INGREDIENT	PEST TARGET
Roya Out	Microbial	Clove oil *Bacillus subtilis* (1×108 cfu/ml)	Coffee rust
Best Ultra F	Microbial	*Bacillus* spp. (1×107 cfu/ml) *Azotobacter* spp. (1×105 cfu/ml) *Pseudomonas* spp. (1×105 cfu/ml)	Coffee rust
Zinathron	Natural substance	Garlic extract Cinnamon extract Potassium salts of fatty acids	Coffee Berry Borer
Timorex® ACT	Natural substance	Tea Tree Extract	Coffee rust
Serenade ASO	Microbial	*Bacilllus amyloliquefacie* NS strain QST 713	Coffee rust

Table 13. *Biocontrol products that are available with registration for use in coffee plantations in Mexico*[89]

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. To promote the application of biological or low-toxicity products, such as the products of the CABI Bioprotection Portal.		☑
Eliminate the use of banned pesticides		☑

[89] Portal de Bioprotección CABI, 2024.



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." [90]

"Ensuring that aquatic ecosystems are surrounded by riparian buffers of natural vegetation following the RA standard width parameters. RA Scorecard – Gold Level."[91]

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 metres horizontally across both sides of waterways 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 meters on both sides.
   (ii) 8 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.[92]

b. In Mexico, coffee is processed in a centralised wet mill. The economy of scale of the water and the technology used make it possible to achieve less than 2 litres of water/kilo of dry parchment coffee.

[90] Rainforest Alliance, 2022 a.
[91] Rainforest Alliance, 2022a.
[92] Rainforest Alliance, 2022 a.

5.2 WATER TREATMENT

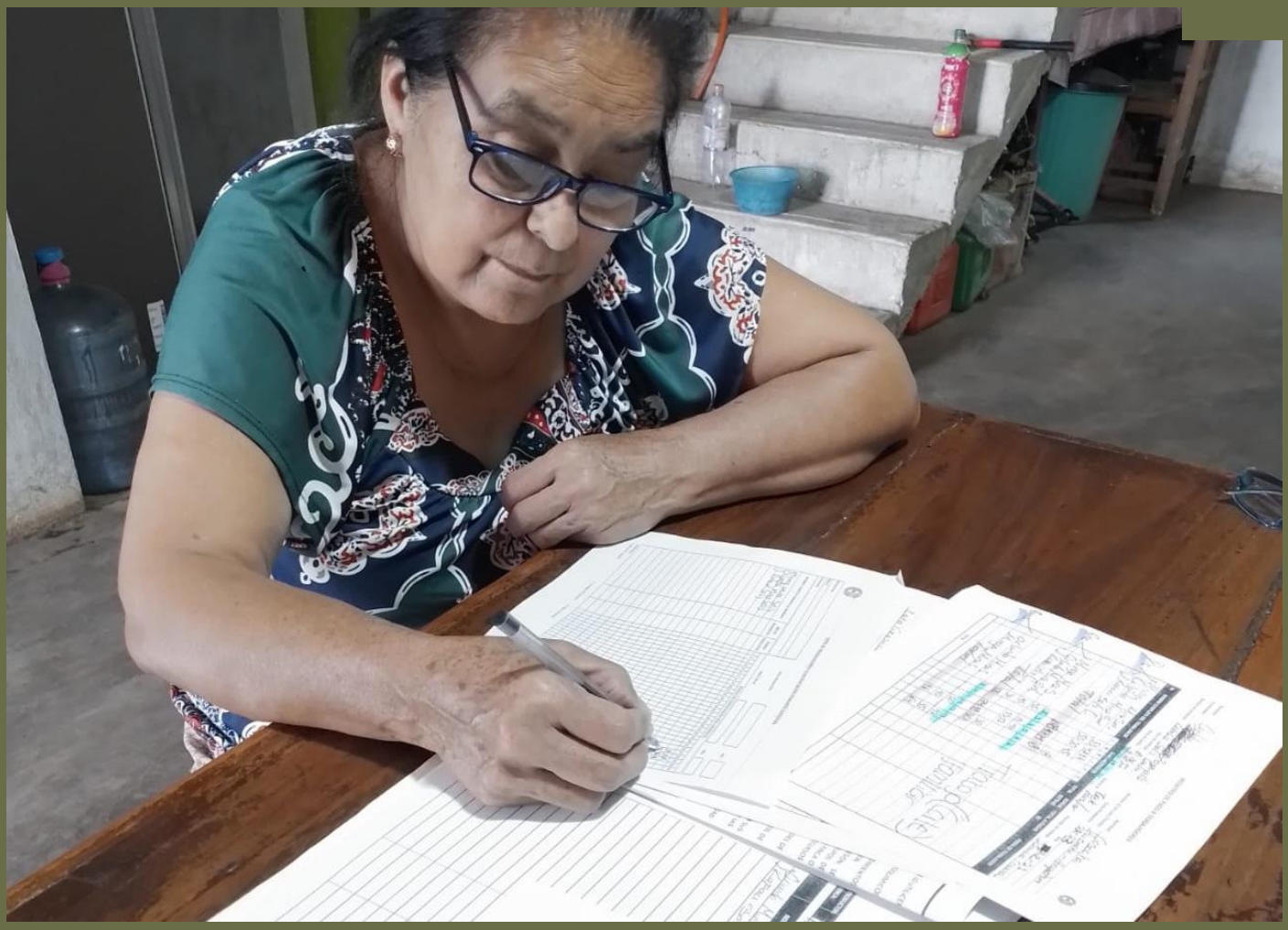
Coffee farming is associated with significant water consumption for domestic use and wet coffee processing. If wastewater is not managed correctly, these activities can contaminate water. Therefore, treating the water before it is discharged into aquatic ecosystems is essential to mitigate environmental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

RECOMMENDATIONS

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

b. b. In Mexico, national legislation NOM 001 SEMARNAT 2021 prohibits wastewater discharge without prior treatment into any water resources. Coffee Processing plants must ensure wastewater treatment as a condition of being able to operate.

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."*** [93]

"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. [94]

The main income drivers of family income are annual coffee production, sales price, and other family income (Figure 6). All variables contribute, but when considering small producers' limited land, productivity changes increase the risk of a low household income (net income).

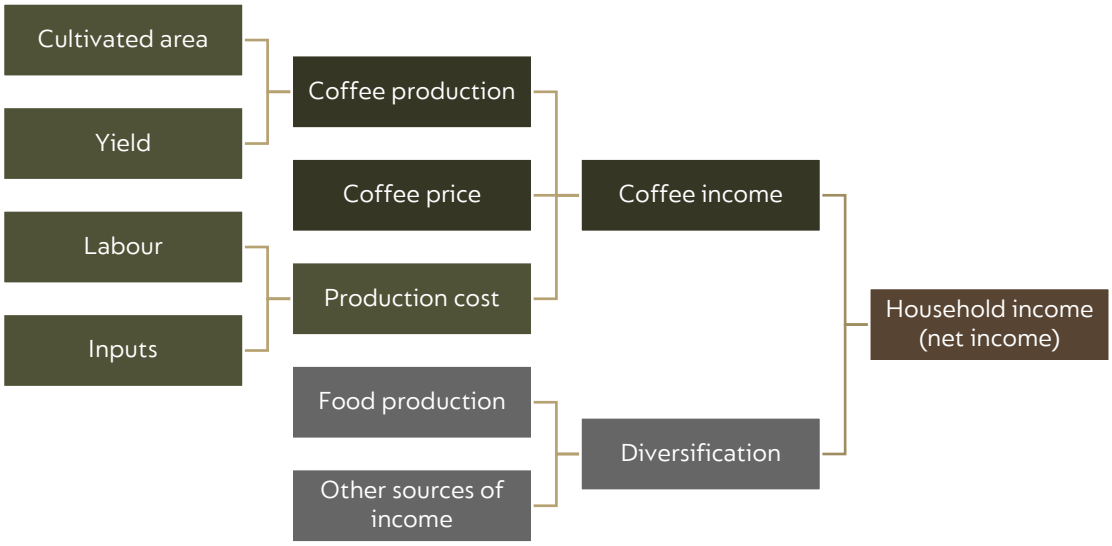


Figure 6. *Household income drivers.*

[93] Pulleman et al., 2023, pp. 34-35
[94] Rainforest Alliance, 2022 a.

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

- Current income risks
- Risks to your future income
- Availability of resources for investment.
- Market access.
- Uncertainty about expected outcomes.
- 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, 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. [95]

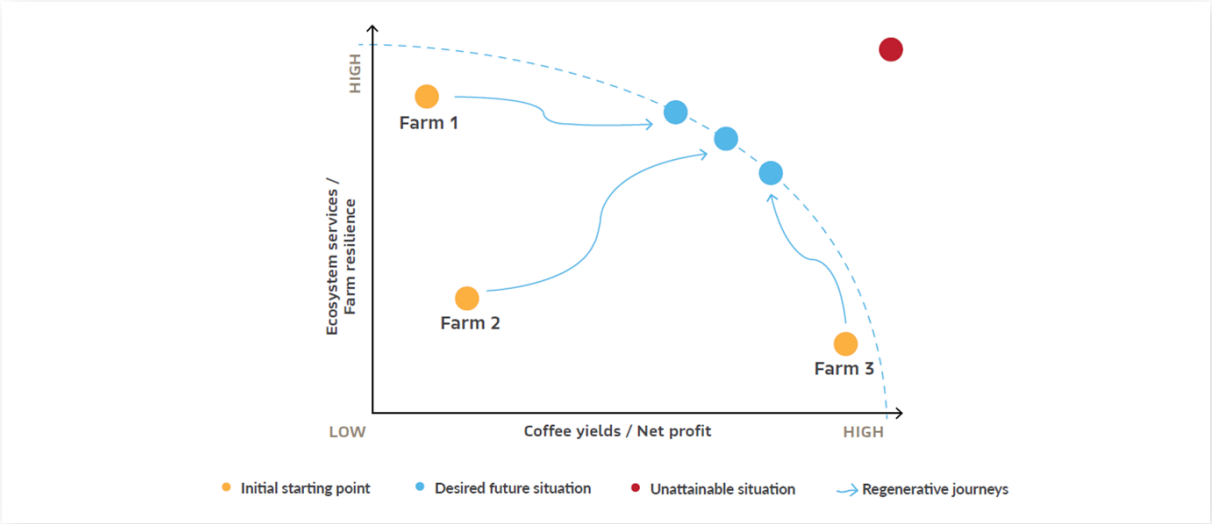


Figure 7. *Possible trajectories for coffee farms seeking to improve the balance between two objectives: productivity and sustainability. Source: Pulleman et al., 2023, p. 46.*

[95] Pulleman et al., 2023.

In Table 14, we foresee some impacts of adopting the agronomic guide on income, resilience, and potential risks. As described in Figure 7, the same technology can yield different outcomes depending on the initial conditions of the production model.

	HIGHER INCOME	EFFECT ON RESILIENCE	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.
NUTRITION 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 14. *Expected impacts of adopting 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 sustainable expected productivity levels and propose farm management plans.	☑	☑
Promote record-keeping of coffee production, costs, sales, and other revenues.	☑	☑
Promote and encourage income diversification projects.	☑	☑

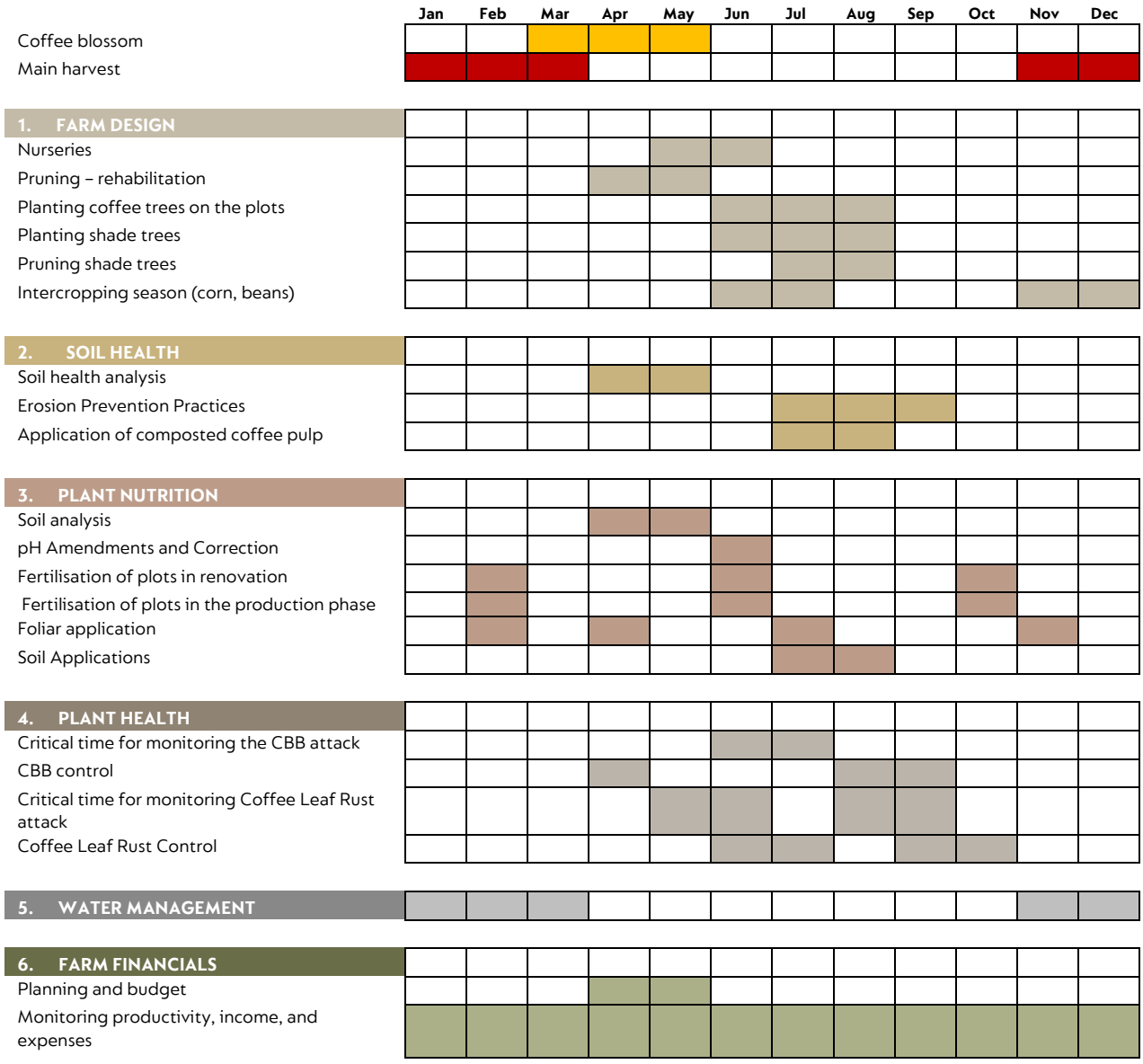
ANNEXES

ANNEX 1

AGRONOMIC REGENERATIVE GUIDE

Calendar for the main activities in Mexico

MEXICO



Source. Sustainable Management Services (SMS) Mexico.

ANNEX 2

LOCALISATION OF IMPLEMENTATION CRITERIA FOR THE REGENERATIVE COFFEE SCORECARD OF RAINFOREST ALLIANCE

The 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 MEXICO	*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 plot in young or middle age (≤ 8 years) trees
LOCALISATION FOR MEXICO	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 the local context, 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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