REGENERATIVE AGRICULTURE AND CIRCULAR ECONOMY

Practices and strategies for more resilient cocoa production

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FOREWORD

The main objective of this booklet is to provide practical examples and simple principles of circular economy with a focus on regenerative agriculture, encouraging you, as a cocoa producer, to reflect, engage in dialogue, and make informed decisions.

Rather than presenting ready-made solutions or rigid models, this material combines international scientific research with successful regional experiences and practices, seeking to strengthen understanding of how regenerative and circular strategies can contribute to more resilient cocoa production systems in Rondônia.

Here you will be able to deepen your knowledge of regenerative and circular agriculture, understanding the connection between theory and practice, while also discovering opportunities aligned with your own reality.

TARGET AUDIENCE

Small and medium-sized cocoa farmers, especially family farmers located in Rondônia, in the Amazon biome.

KEY TAKEAWAYS

Strengthening resilience in cocoa production requires a combination of actions at both farm level and within supportive policy environments. The main takeaways include:

- The principles of regenerative agriculture and circular economy have the greatest impact when translated into everyday practices: small adjustments, simple choices, and collective action.
- Producing cocoa in a regenerative and circular way means thinking beyond the next harvest. It means strengthening the productive base so that it remains fertile, resilient, and economically viable in the long term. By integrating healthy soils, nutrient cycling, diversified production, and responsible water use, agricultural systems become more stable in the face of climate and market uncertainties. In Rondônia, where production and forest share the same territory, this perspective takes on strategic importance: regenerating the land also means securing the future of families and rural communities.
- Regenerative agriculture and circular economy do not replace local knowledge; rather, they offer guidance to strengthen it. Local knowledge is therefore the foundation of a successful regenerative and circular model. These concepts do not substitute it, but reinforce it through principles and practices that help bring it into action.

INDEX

INTRODUCTION

Agriculture, land use and current challenges in Rondônia

Rondônia is a state deeply shaped by agriculture. Over the last decades, agricultural production has ensured income, food, and economic development. At the same time, it has also transformed landscapes, soils, and ecosystems. Large areas of native vegetation have been converted into productive land, and many rural families depend directly on the health of their properties to secure income and well-being.

Today, cocoa producers face longer periods of drought, more intense and concentrated rainfall, increasing climate unpredictability, and soils showing signs of degradation such as loss of fertility, compaction, and erosion. These challenges are not exclusive to Rondônia, but they are particularly relevant in tropical regions, where soils and ecosystems respond rapidly to disturbances.

In this context, a central question arises: How can productivity be maintained while also restoring and protecting the natural balance that sustains production?

Cocoa as part of the landscape

Cocoa holds a special place in Rondônia's agricultural systems. Unlike many crops, cocoa adapts well to diversified and tree--based systems.

When cultivated in agroforestry systems, it can:

- Protect the soil
- Regulate the microclimate
- Conserve biodiversity

- Generate income for families

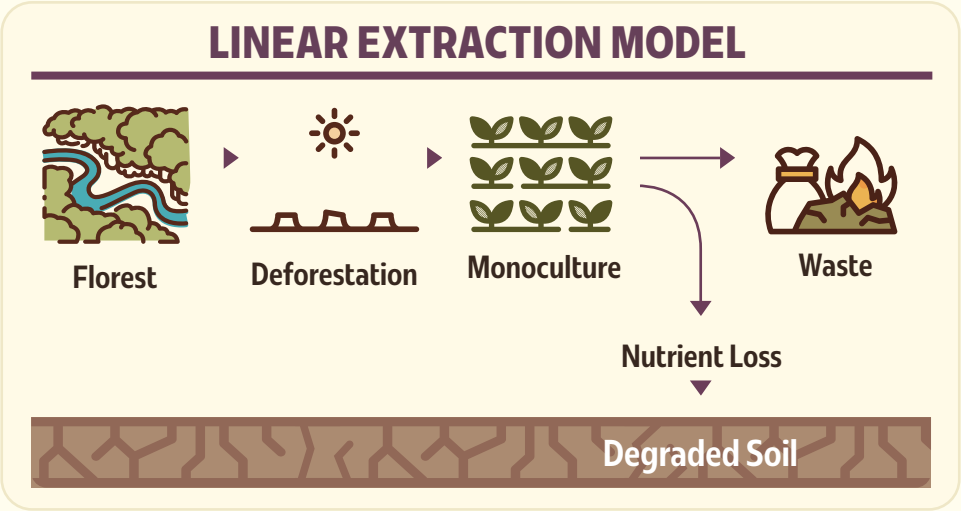
In Rondônia, cocoa has shown strong potential to combine production with forest conservation. It can contribute to restoring degraded areas, reducing pressure on remaining forests, and strengthening the rural economy. However, cocoa production also depends directly on how the system is planned and managed. Productivity, quality, and long-term viability are closely linked to the decisions made on the farm.

For this reason, the future of cocoa in Rondônia is directly connected to discussions on sustainability, resilience, and land use.

Why new strategies are gaining ground

For a long time, many agricultural models have operated in a linear way:

Natural resources are used → Inputs are added →
Products are harvested → Waste is generated and discarded

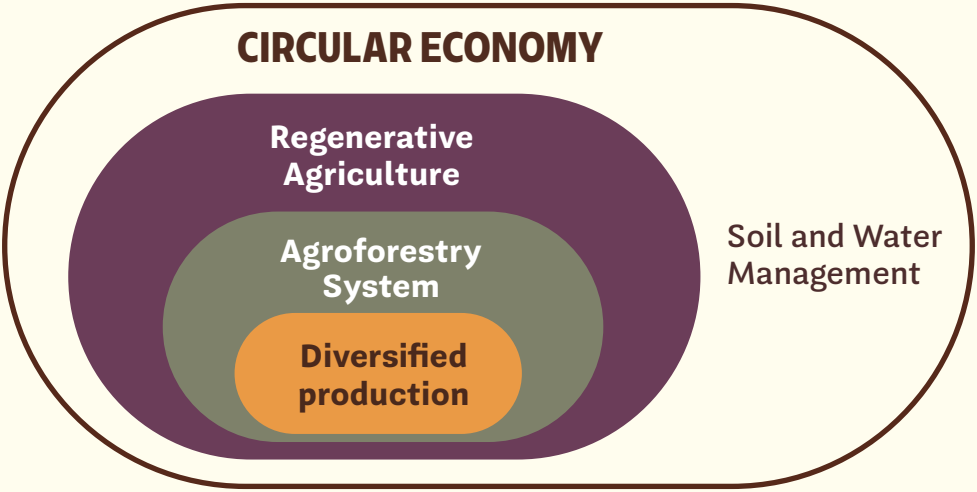


In tropical regions, this model has often led to nutrient loss, soil degradation, increased dependence on external inputs, and greater vulnerability to price fluctuations. With rising input

costs and increasingly evident climate risks, the limitations of this model have become even clearer — especially for small and medium-sized cocoa producers.

It is increasingly recognized that maintaining productivity over time requires more circular systems that work with natural processes rather than against them.

In this context, two complementary approaches are gaining importance: **regenerative agriculture and the circular economy.** Regenerative agriculture applies circular economy thinking to agricultural production. It uses strategies such as agroforestry systems and production diversification to restore soil health and improve water management, thereby increasing the system's capacity for regeneration and resilience.



They are not fixed recipes or specific technologies. Rather, they are ways of thinking and organizing agricultural systems that aim to:

- Restore ecological functions

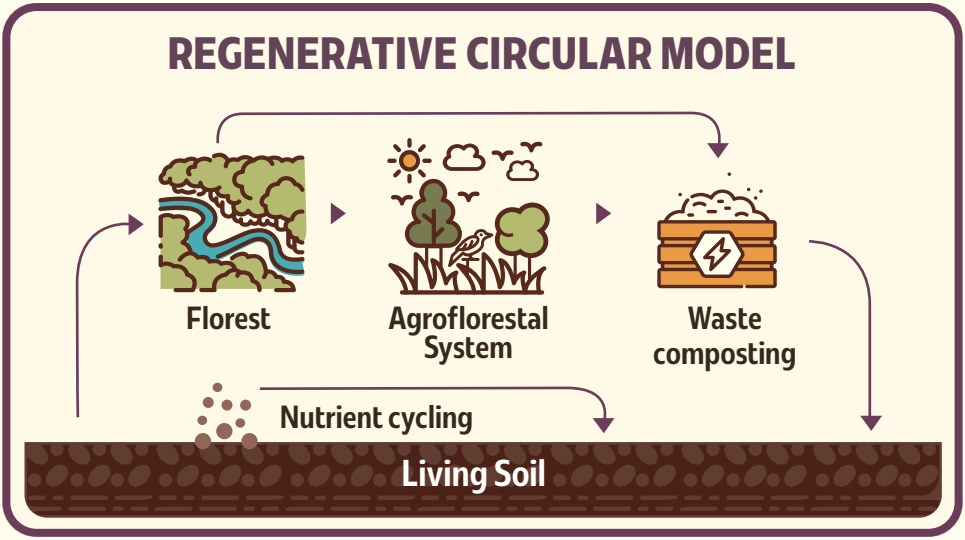
- Reduce waste
- Decrease dependence on external inputs
- Strengthen local autonomy

Regenerative agriculture and circular economy as complementary strategies

Regenerative agriculture seeks to restore and strengthen the ecological functions of production systems, with a focus on soil health, biodiversity, and the water cycle.

This means going beyond "producing with less damage." It involves reducing impacts such as soil erosion, soil loss and compaction, decline in organic matter, water contamination from agrochemicals loss of biodiversity and increased vulnerability to droughts and intense rainfall. At the same time, the goal is to continuously improve land conditions, increasing its capacity to sustain production more stably.

The circular economy, when applied to agriculture, emphasizes efficient resource use, nutrient cycling, and waste reduction.



In this model, organic waste — such as pruning residues, husks, manure, and compost — is treated as a valuable input that can be returned to the soil in a planned way. This allows for gradual reduction of dependence on external inputs, strengthening of soil health and increased resilience of the production system.

In cocoa production, these two strategies naturally intersect: Agroforestry systems, composting of residues, the use of biological inputs ("bioinputs"), and production diversification are examples of practices that integrate regenerative and circular principles, strengthening both ecological balance and economic viability (Ellen MacArthur Foundation, 2019; FAO, 2022)..

WHAT IS REGENERATIVE AGRICULTURE?

In many discussions about agriculture, sustainability is understood as the ability to maintain production over time while reducing negative impacts.

Regenerative agriculture goes one step further: its focus is not only on avoiding further degradation, but on restoring and strengthening the ecological processes that sustain agricultural production — especially soil life, water cycles, and biodiversity (Rhodes, 2017; Lal, 2020).

> "Agroecology is part of our daily life: we produce our own fertilizers, work with composting and biofertilizers, and avoid external inputs."

Antônio, 61 years old, farmer and agricultural technician, in Rondônia since 1984

In tropical regions such as Rondônia, this distinction is especially relevant. Soils that are sensitive to disturbance can quickly lose their fertility when organic matter and biological activity decline.

For this reason, regenerative practices prioritize rebuilding soil functions, enhancing its natural capacity to sustain production continuously by developing systems that resemble natural forests in both structure and functioning, while maintaining the viability of agricultural production (EMBRAPA, 2018; FAO, 2021).

CORE PRINCIPLES OF REGENERATIVE AGRICULTURE

Regenerative agriculture is not a single technique or a fixed recipe. It is a set of principles that can be adapted to different production contexts. Among the most common are:

Soil as a living system

Soil is understood as a complex ecosystem composed of organisms, roots, organic matter, and minerals. Regenerative practices aim to increase organic matter, stimulate biological activity, and improve soil structure. This supports water infiltration, nutrient cycling, and greater climate resilience (Lal, 2020; IPCC, 2019).

Diversity above and below the soil

Biological diversity contributes to system stability. The integration of different plant species, trees and intercropping systems promotes positive ecological interactions, reduces pest pressure, and strengthens the balance of the agroecosystem (Altieri & Nicholls, 2020).

Permanent soil cover and reduced disturbance

Keeping the soil covered with vegetation or organic residues reduces erosion, conserves moisture, and protects against extreme temperatures. Avoiding excessive soil disturbance helps preserve soil structure and biological life (EMBRAPA, 2020).

Integration instead of separation

Regenerative systems value the integration of crops, trees, animals, and people. The focus is on interactions that strengthen the whole system, rather than treating each component as isolated.

AMAZONIAN CONTEXT

In the Amazon region, regenerative agriculture is often associated with agroforestry systems and diversified production. Trees play an essential role in regulating the microclimate, cycling nutrients, and maintaining biodiversity. Experiences in the Amazon show that productive landscapes can coexist with forest elements while maintaining important ecological functions.

For cocoa, these principles are particularly relevant. The cocoa tree is adapted to shaded environments and develops best when integrated with different types of vegetation. Cocoa agroforestry systems help to reduce stress caused by heat and water scarcity, protect and improve soil (through increased cover and organic matter) and support the recovery of degraded areas increasing the long-term resilience of production.

COCOA CULTIVATION: FROM THEORY TO PRACTICE

In practice, regenerative cocoa systems may include:

- Cultivation under different shade species, including native and fruit trees
- Reuse of organic residues within the farm
- Use of biofertilizers and biological inputs
- Reduction of agrochemical use whenever possible
- Diversification of production to reduce economic risks

These practices do not function in isolation. What works in one place may need adjustment in another. Continuous observation and adaptive management are therefore essential parts of the process. Regenerative agriculture is also a process of ongoing learning.

Regeneration as a long-term process

Regeneration does not happen immediately. Improvements in soil health, biodiversity and system stability are gradual. The goal is to build systems that, over time, become more productive, resilient, and autonomous (FAO, 2021; Lal, 2020).

In Rondônia — where many agricultural areas have already undergone degradation — regenerative agriculture offers pathways to maintain cocoa production, while improving land conditions. It is an approach that strengthens production in the face of climatic and economic uncertainties.

CIRCULAR ECONOMY IN COCOA PRODUCTION

Organizing flows and reducing losses

When applied to cocoa production, the circular economy focuses on how resources circulate within the production system. While regenerative agriculture emphasizes restoring ecological processes, the circular model helps organize the system by examining what enters and leaves the farm, identifying losses, reducing waste, and making better use of available resources to increase autonomy.

This way, instead of relying continuously on external inputs, circular systems aim to reorganize existing flows. Waste is no longer seen as something to discard, but as a potential resource.

In the context of cocoa production, this involves asking practical questions such as: what enters the farm? What leaves it? Where are nutrients or economic value being lost? What can be reintegrated into the system?

Practices such as reusing cocoa husks, composting pruning residues, and applying biofertilizers are examples of strategies that reduce costs and strengthen production autonomy (EMBRAPA, 2020; FAO, 2022).

More than a set of isolated techniques, the circular economy functions as a logic for organizing the production system. By closing loops and reducing external dependencies, it contributes to greater economic predictability and long-term stability.

Circularity, diversification and economic stability

The circular economy is also closely linked to production diversification. Agroforestry systems allow for the production of different products throughout the year — fruits, timber, seeds, in addition to cocoa.

This contributes to:

- Greater income stability
- Reduced dependence on a single product
- Greater capacity to adapt to market fluctuations

When part of processing or value addition takes place locally, income remains in the region, strengthening the local economy (SEBRAE, 2021).

WATER, MICROCLIMATE AND RESILIENCE IN COCOA LANDSCAPES

Water is one of the most decisive elements in cocoa production. It connects soil, vegetation, and climate, directly influencing productivity, plant health, and system stability.

In Rondônia, increasing climate variability — already observed in the region — has intensified periods of drought and extreme rainfall events, directly affecting production systems (INPE, 2022; IPCC, 2022). These changes increase the vulnerability of agricultural systems that depend on exposed or poorly structured soils.

In regenerative and circular models, water is not treated in isolation. It is understood as part of an integrated system, where soil health and vegetation diversity determine how water infiltrates, circulates, and is stored in the landscape.

Healthy soil, greater infiltration

The way water behaves in the system depends directly on soil conditions. Soils rich in organic matter and with active biological life present a better structure, higher porosity and greater infiltration capacity.

> "We need to produce for many years and leave the soil better than we received it."

Antônio, 61 years old, farmer and agricultural technician, in Rondônia since 1984

HOW TO IDENTIFY:

HEALTHY SOIL

- Dark organic matter
- Active roots
- Earthworms
- Mycorrhizae
- Good water infiltration

DEGRADED SOIL

- Light-colored soil
- Compacted layers
- Cracks
- Surface runoff
- Erosion

When soil is covered by vegetation or organic residues, rainfall is absorbed more gradually. This reduces runoff, erosion, and nutrient loss, while increasing moisture retention for drier periods.

In contrast, exposed and compacted soils tend to show higher surface runoff, leading to erosion and progressive degradation.

Microclimate and the role of trees

Vegetation plays a fundamental role in regulating the microclimate. Trees reduce direct solar radiation, lower soil temperatures and help maintain more stable moisture levels.

Because cocoa is a shade-adapted species, it responds positively to systems with diverse vegetation. Agroforestry systems create more stable environments, buffering temperature extremes and protecting the soil from the direct impact of rainfall.

Studies in tropical cocoa systems show that agroforests can maintain productivity while also providing important ecosystem services such as carbon sequestration, biodiversity conservation, and local climate regulation (Rice & Greenberg, 2000; Schroth et al., 2015).

It supports:

- Greater thermal stability
- Reduced evaporation
- Improved nutrient cycling
- Increased resilience to extreme climate events

Protection of springs, rivers and streams

Many cocoa-producing properties in Rondônia are located near springs, streams, and small watercourses. The way soil is managed directly influences the quality and availability of these water resources.

Maintaining vegetation cover around springs and riverbanks helps to:

- Stabilize the soil
- Reduce sedimentation
- Filter particles and nutrients
- Preserve water quality

Regenerative and circular practices, such as maintaining vegetation areas, reducing excessive soil disturbance, and decreasing the use of agrochemicals, contribute to the protection of water resources and to maintaining the balance of areas that feed springs, streams, and small watercourses, also known as micro-watersheds (EMBRAPA, 2019; FAO, 2021).

Water and climate resilience

As climate variability increases, water management becomes a central factor for production stability. Systems that rely heavily on artificial irrigation or have degraded soils tend to be more vulnerable to droughts and extreme rainfall.

In contrast, regenerative and agroforestry systems — by combining healthy soil, permanent soil cover and, structural diversity, are better able to buffer climate impacts and maintain stability over time (IPCC, 2022; FAO, 2021).

AGROFORESTRY SYSTEM	EXPOSED PASTURE
• High water infiltration with continuous groundwater recharge • Stable, perennial spring flow • Living, porous, well-structured soil protected by litter (organic matter) • More humid and regulated microclimate • Slower and more balanced water cycle	• Low water infiltration with accelerated surface runoff • Limited groundwater recharge • Exposed and compacted soil • Erosion and nutrient loss • Hotter and drier micro-climate • Fast and unstable water cycle

Water management cannot be separated from soil regeneration and system design. Soil, vegetation, and water are constantly interacting. In Rondônia, this integrated perspective is especially important. Sustaining cocoa production in the long term means recognizing that resilience does not depend on a single practice, but on how the system is organized as a whole.

> "Cocoa farming protects springs and soil. If it was only pasture, it would already be degraded."

Assis, 50 years old, cocoa producer and agroforestry farmer in Rondônia

AGROFORESTRY SYSTEMS AS A STRATEGY

Agroforestry systems represent an integrated way of organizing cocoa production, combining regenerative principles and circular dynamics within a single production design.

By integrating different tree species, complementary crops, and permanent soil cover, agroforestry creates a structure that distributes light, biomass, and ecological functions across space and time. This organization promotes production stability and greater capacity to adapt to climatic and economic variations.

Circular dynamics of nutrients and biomass

In agroforestry systems, trees capture nutrients from deeper soil layers and redistribute them through leaf fall and organic residues. The biomass generated — leaves, branches, husks, and pruning residues — remains within the system, feeding natural cycles of decomposition.

Among the circular processes present in these systems are:

- Continuous input of organic matter
- Reuse of pruning residues
- Maintenance of soil cover
- Integration of complementary crops

These dynamics reduce nutrient losses, decrease dependence on synthetic fertilizers, and contribute to greater production autonomy (FAO, 2021; EMBRAPA, 2020).

Diversification and economic stability

Beyond ecological benefits, agroforestry strengthens the economic organization of the farm. The presence of fruit trees, timber species, or other crops alongside cocoa enables diversification of income sources and a better distribution of production throughout the year.

This contributes to:

- Greater income predictability
- Reduced vulnerability to price fluctuations
- Opportunities for local value addition

In regions like Rondônia — where many families depend directly on agriculture — agroforestry systems offer a strategy that combines environmental regeneration, circular resource management, and economic viability (SEBRAE, 2021).

Rather than being a single technique, agroforestry can be understood as a transition strategy towards more integrated, resilient, and tropical-adapted systems.

FROM KNOWLEDGE TO ACTION

Transformation starts with what already exists

The transition toward more regenerative and circular systems always begins with what is already being practiced. Even if not labeled as such, many practices associated with regenerative agriculture and the circular economy are already part of local producers' experience. The implementation of soil cover, reuse of organic residues intercropping and protection of springs are examples of forms of knowledge that often span generations.

Before thinking about changes, it is worth reflecting

1. What are we already doing that strengthens the soil?
2. Which practices have we learned from our parents and grandparents that respect the rhythms of the land?
3. Where are we already closing cycles on the farm?
4. In which areas are we already reusing residues or minimizing external inputs?

If you already feel ready to reflect on these questions, there is space for your notes at the end of the booklet.

Identifying opportunities on the property

Recognizing what already exists is the first step toward regenerative agriculture. Each farm is unique — there is no single transition model.

The following questions are more specific and are intended to guide reflection on the content presented in this booklet. Considering factors such as soil type and water availability on your farm, as well as the history of land use and labor, can guide your next steps:

- How can the return of organic matter to the soil be increased through composting or mulching? Are there residues not yet being reused?
- How can shade trees or associated crops be diversified to reduce risks?
- How can water infiltration be improved by maintaining soil cover? Does the soil remain covered throughout the year?
- How can local value be added to production? Are there degraded areas that could be converted into agroforestry systems?
- How can collaboration with neighboring producers be strengthened?

Remember: small adjustments in management can make a big difference from one harvest to the next.

REAL CHALLENGES OF THE TRANSITION

Every change initially brings discomfort and may present challenges. During the adoption of regenerative and circular practices, common obstacles include:

- The need for specific technical knowledge
- Adjustments in management and work organization
- Financial investments for system restructuring

Recognizing these challenges helps to understand the transition as a gradual process. Time is a key factor in achieving results, as regeneration is built over years.

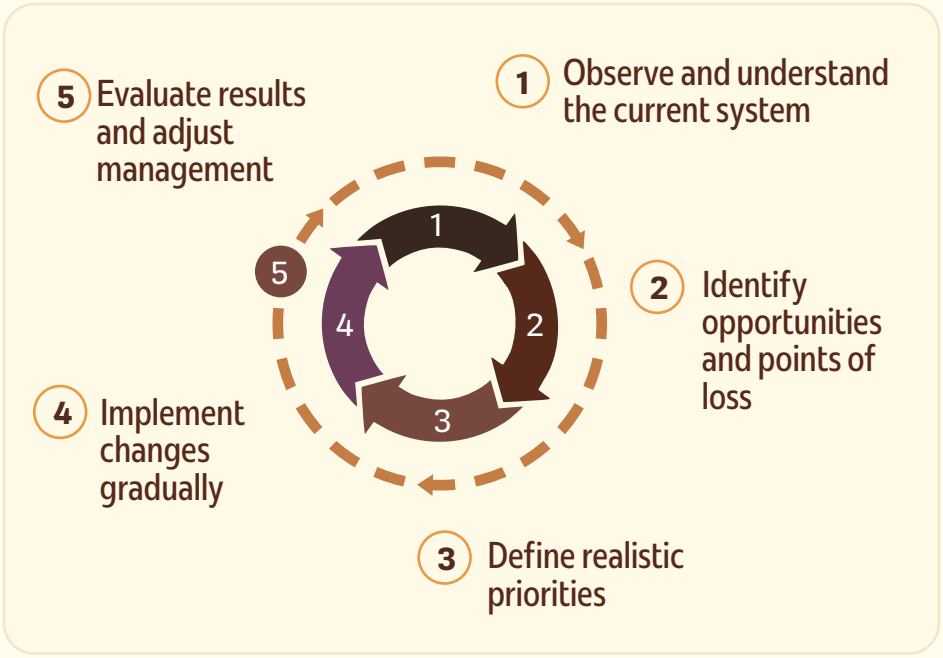
*DID YOU KNOW?

This booklet is the last in a series of three.

The first focuses on **transparent value chains** in the context of the EU Deforestation Regulation (EUDR). The second addresses the need for **climate adaptation** in the Brazilian cocoa value chain. Both include a section titled “SUPPORT”, listing contacts for **technical and financial assistance.**

BUILDING AN ACTION PLAN

Just like regenerative and circular systems themselves, the transition process can be understood as a continuous cycle of improvement. These are simple steps that support gradual transformation while keeping track of progress and generating long-term sustainable results:



"We learned what sustainability truly is — it's a tripod: social, environmental, and financial. Without balance between the three, you cannot sustain yourself."

Estevam, cocoa producer and sustainability advocate in Rondônia

FINAL REFLECTIONS

In light of all the knowledge shared in this booklet, we invite you to reflect. These questions do not have a single answer — they are meant to encourage dialogue, exchange of experiences, and the collective construction of possible pathways.

REFLECTIONS FOR A REGENERATIVE AND CIRCULAR AGRICULTURE

- Which regenerative practices are already present on your farm?

- Where do you see the greatest potential for improvement?

- What type of technical or institutional support could facilitate change?

- How do you imagine your farm in 10 years?

After answering these questions, **how about drafting an action plan?** On the next page, you are invited to visualize the future of your business based on the knowledge you have acquired.

PATHWAYS TO ACTION	
What can be done in the **short term** (1 year)?	What is needed to achieve this?
What can be done in the **medium term** (2–5 years)?	What is needed to achieve this?
What can be done in the **long term** (+5 years)?	What is needed to achieve this?

SPACE FOR NOTES

Use this space to record your reflections.

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