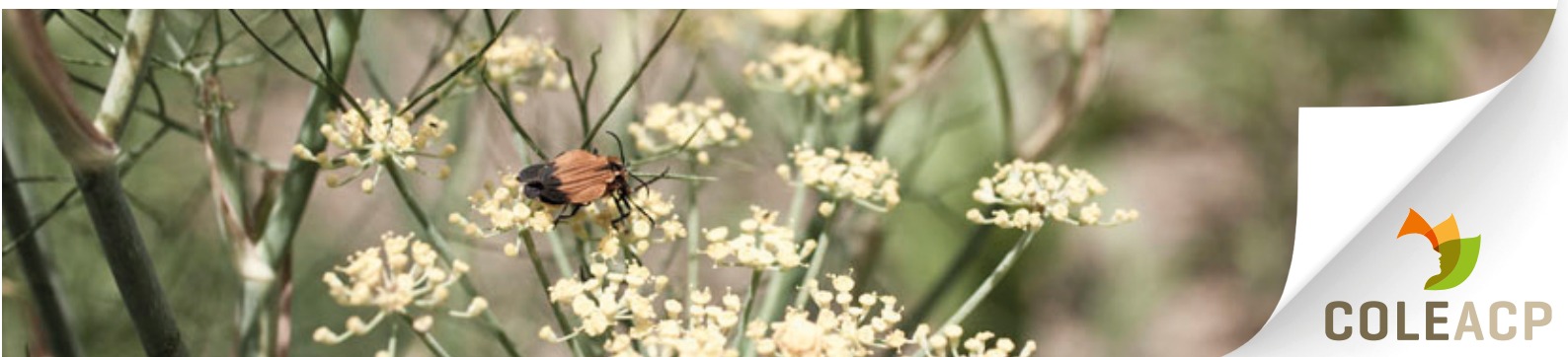




# TRAINING --- NOTEBOOK

- ENVIRONMENTAL MANAGEMENT -

## SUSTAINABLE MANAGEMENT OF BIODIVERSITY



This publication has been prepared by the COLEACP as part of co-operation programmes funded by the European Union (European Development Fund – EDF), the Agence Française de Développement (AFD) and the Standards and Trade Development Facility (STDF).

The COLEACP is solely responsible for the content of this publication, which may in no way be considered to represent the official position of the European Union, the AFD or the STDF.

The COLEACP owns the intellectual property rights to the entirety of the document.

This publication is an integral part of a COLEACP collection, which is made up of educational and technical tools and materials. All of them are suited to different types of learners and beneficiaries and levels of education found in agricultural supply chains, production and sales.

This collection is available online for COLEACP members and beneficiaries.

Subject to certain conditions, the use of all or part of this publication is possible within the scope of specific partnerships. To make any inquiries, please contact the COLEACP at [network@coleacp.org](mailto:network@coleacp.org).



# SUSTAINABLE ENERGY MANAGEMENT

<b>DEAR TRAINERS, SOME ADVICE .....</b>	<b>1</b>
<b>MATERIALS TO BE DELIVERED.....</b>	<b>5</b>
<b>TRAINING LEAFLETS .....</b>	<b>7</b>
• LEAFLET 1 : Biodiversity – Definition and importance	
• LEAFLET 2 : Biodiversity assessment	
• LEAFLET 3 : Valuing biodiversity	
• LEAFLET 4 : Preservation and restoration of biodiversity	
<b>SUMMARY OF THE MANUAL .....</b>	<b>21</b>
• 1. Definition and importance of biodiversity	
• 2. Types of biodiversity	
• 3. Links between biodiversity and agriculture	
• 4. Threats to biodiversity	
• 5. Biodiversity assessment and monitoring at the farm level	
• 6. Valuing biodiversity for the benefit of agriculture	
• 7. Preservation and restoration of biodiversity	







Dear trainers,  
some advice...



## WHY A TRAINING NOTEBOOK?

The 'Manuals' edited by COLEACP are valuable training materials. To write them, COLEACP approached the best experts in the field with the aim of producing a technical document for a large public on a given theme that brings together and structures most of the current knowledge. These manuals are intended to be as accurate and complete as possible, adapted to the ACP context and focused on cross-cutting issues in horticulture. But the objective was also to make them affordable, understandable and enjoyable to read by people who are not necessarily experts in the field. Nevertheless, it is a considerable effort to assimilate all the material collected in a short time.

The training manuals, which are aimed primarily at experts and the most qualified people, are often voluminous and complex, and it was necessary to help the expert trainers to identify the most important elements to retain, and to collect for them a list of 'key messages' to be disseminated to learners during COLEACP training. This Training Notebook is therefore a valuable and practical tool that is at your disposal to help you prepare your training on the topic covered in this Booklet.

## WHAT DOES THE TRAINING NOTEBOOK CONTAIN?

Each Training Notebook contains:

### 1. The list of materials to be delivered to participants during the training

This is a summary table of contents of the Training Manual. This list allows you to have an **overview of all the main points that** will have to be covered during the training. The **order of the list does not necessarily have to be respected**, as the organisation of the sequences is left to your discretion and may depend on other factors (e.g. availability of an expert trainer; timing of the training sequences; space reserved for exercises...).

In some cases, **only certain aspects** (or chapters) of the **subject will be covered** (for example: if the participants have a perfect command of certain parts of the subject covered in the training, it is not necessary to present them in detail; a small reminder may be sufficient and effective to cover the rest).

However, when you cover part of the material (a chapter), the main 'points' listed for each chapter allow you to organise your presentations and animations in a logical and relevant way for the learner. **You are also advised to present all the points of a chapter.**

### 2. Training leaflets

A Training Notebook contains as many 'leaflets' as there are chapters in the training manual (only the 'case study' is not included). Each sheet contains, on the one hand, the **Training objectives** of this part of the subject to be delivered (what the learner must be able to deliver...), and on the other hand, according to the structure of the table, the 'key messages' (what the learner must absolutely have assimilated at the end of the training). It is therefore very important to ensure that **all messages are well distributed during the training sequence.**



### 3. A summary of the content of the manual

A summary of the manual has been included in this Training Notebook. Structured in the same way as the manual, it contains most of the content in 15-20 pages but remains much less complete (the summary does not include figures or case studies).

This summary is **primarily intended for the trainer.**

- **At the beginning of the mission**, when preparing its intervention sequences and supports, it allows you to quickly become familiar with all the content you will need to address and to visualize the links between the different parts of the material to be delivered.
- **During the training**, you can use this summary to **prepare your daily summaries**, reminding participants of the essential elements seen during a day (15-20 minute summary at the end of the day with answers to questions).
- **At the beginning or end of the training**, if you wish, you can give participants a copy of this summary. If the summary is distributed at the beginning of the training, it is advisable to ask participants to highlight the passages mentioned in your end-of-day summary (benchmarks in the subject).

**The summary is also useful for learners at the end of the course:** it will allow them to **remember in a few minutes the main part of the topic covered** (for example, before an assessment of prior learning), whereas reading the entire manual could be tedious.

### HOW CAN THIS TRAINING NOTEBOOK HELP YOU PREPARE YOUR TRAINING INTERVENTIONS?

The intention of making this Training Notebook available to you is to **help you prepare your training sequences and structure your program day by day.**

- **Consider that each leaflet represents a whole:** if there are for example 4 leaflets, it means that there must be 4 distinct parts in your training. Sufficient time must therefore be allowed in the programme for each of these 4 parts. Each part of the subject will also have to be subject to a competency assessment.
- **Then consider the training objectives:** this will help you to choose: (a) the most appropriate training method for achieving your objectives (e.g. should you plan exercises, simulations, group activities etc.); (b) the method for evaluating the learning acquired in this part.
- **Finally, prepare your materials** (e.g. PowerPoint, flipcharts or animation sheets, evaluation questions) by ensuring that all key messages are included ("Have I planned to discuss all these points? Have I planned an evaluation on each key point?").

## DON'T FORGET TO COMPLETE THIS TRAINING NOTEBOOK!

This Training Notebook is made **for you...** It is **a tool that must live!**

At the end of each leaflet, a space was left free to add your personal notes: as a trainer you can note some thoughts on how to get messages across, note your questions, participants' reactions, points that raise difficulties... *i.e.* **capitalise on your experience as a trainer!**

You can also **note the types of media you have used**. This will be very useful when you have a new session to facilitate on the same theme. COLEACP provides you with many tools and materials, but do not hesitate to create others or use other existing materials that may be available... the **rule is to master each of the materials used in training** and to ensure that they help to convey key messages more effectively than in their absence.







# Materials to be delivered



## CHAPTER 1 – BIODIVERSITY: DEFINITION AND IMPORTANCE

- Biodiversity – Definition and importance
- Private legislation and standards
- Biodiversity and agriculture
- Threats to biodiversity
- Impacts of production systems and agricultural practices on biodiversity
- Risks related to biodiversity

## CHAPTER 2 – BIODIVERSITY ASSESSMENT

- Biodiversity applied at farm level
- Scope and level of detail of the evaluation
- The indicators
- Biodiversity valuation methods
- Conclusions and recommendations

## CHAPTER 3 – VALUING BIODIVERSITY

- Wild biodiversity
- Domestic biodiversity
- Landscape biodiversity
- Links between biodiversity and other elements

## CHAPTER 4 – PRESERVATION AND RESTORATION OF BIODIVERSITY

- Land use and cultural practices that promote biodiversity
- How to ensure or improve domestic biodiversity on farms





# Training leaflets

Leaflet 1: Biodiversity – Definition and importance..... 9

Leaflet 2: Biodiversity assessment..... 13

Leaflet 3: Valuing biodiversity..... 17

Leaflet 4: Preservation and restoration of biodiversity..... 17





# LEAFLET 1

## Biodiversity – Definition and importance

### TRAINING OBJECTIVES

At the end of this training sequence, the participant must be able to:

- understand what biodiversity is and its importance;
- understand the different concepts related to biodiversity: ecosystem...;
- understand what biodiversity in agriculture implies (wild biodiversity, domestic and landscape biodiversity);
- state and explain the various threats to biodiversity related to human activity.

### KEY MESSAGES

#### 1) Definition of biodiversity, its importance and the different types of biodiversity

- Biodiversity is the group of living beings that form a given living environment.
- Biodiversity refers to the variety of living things and must consider three levels: ecosystem diversity, species diversity and gene diversity.
- Gene diversity is an important part of life and, from an ethical point of view, preserving and restoring biodiversity is a moral duty.
- Biodiversity contributes to human well-being, protects human health and ensures sustainable food security (through increased resilience).
- Biodiversity promotes technological innovation and more effectively enhances the natural resources of the environment (exploitation of ecosystem services).
- Well-managed biodiversity protects soils from erosion, ensures the future of the forest, functions as insurance and provides ecosystem services.
- In terms of species diversity, there are two types of biodiversity: domestic biodiversity and wild biodiversity (remarkable or ordinary).
- Biodiversity is said to be domestic when it is made up of all species and subspecies domesticated by humans and having been subjected to their selection.
- Wild biodiversity is remarkable when it is made up of living organisms and rare or endangered habitats. Otherwise it is called ordinary.



## 2) Understand the different concepts related to biodiversity

- An ecosystem is composed of an environment (biotope), the living beings present (biocenosis) and all the relationships that may exist or develop in that environment (ecology).
- The diversity of environments: different environments are intertwined and allow species flows.
- Farming is a particular type of biotope in which species diversity and landscape diversity are distinguished.
- Ecosystem services are the benefits that humans derive from the ecosystem.
- The main ecosystem services are: supply services, regulatory services, cultural services and support services.
- Biological diversity supports the provision of services provided by ecosystems, which in turn maintains the conditions necessary for life on Earth.

## 3) Understanding the implications of biodiversity in agriculture

- Agricultural biodiversity includes the components of biological diversity related to food, agriculture and agricultural ecosystems.
- Agricultural biodiversity refers to the variety and variability of animals, plants and micro-organisms, at the genetic, species and ecosystem levels.
- Agricultural biodiversity is the result of the natural selection processes, careful selection and ingenious development of farmers, herders and fishermen.
- Agricultural biodiversity is an essential component of biodiversity and is the foundation of agriculture.
- Biodiversity for food and agriculture is a means to manage the maintenance and enhancement of ecosystem functions.
- Agricultural biodiversity optimises agricultural production and increases the resilience of ecosystems to mitigate risks.
- Wild biodiversity: it plays many roles in maintaining ecosystem balances: oxygen production, CO<sub>2</sub> fixation and temperature regulation.
- Wild biodiversity ensures soil fertility, water purification, pest control and pollination.
- Organic agriculture is a production system that maintains and improves the health of soils, ecosystems and people.
- Domestic biodiversity expresses the decline in species diversity, limited to those that are cultivated or raised.

## 4) The various threats to biodiversity related to human activity

- The rate of biodiversity loss, mainly linked to anthropogenic mechanisms, is accelerating.
- The mechanisms responsible for biodiversity loss are: habitat destruction and fragmentation, biological invasions, overexploitation and pollution.
- Biodiversity loss is also linked to global climate change, hybrid varieties and genetically modified organisms (GMOs).
- The various species extinction crises are due to human action on the environment, mainly through agriculture, deforestation and urbanisation.



- The impacts of agricultural practices on biodiversity are mainly found in deep ploughing, the use of mineral fertilisers and chemical pesticides.
- Agricultural practices, such as land consolidation, gradually and profoundly reduce the heterogeneity of landscapes while fragmenting them.
- The homogenisation of landscapes disadvantages rare species and favours common species, leading to a trivialisation of species.
- The trivialisation of species influences the structure of the landscape, and the structure of the landscape in turn impacts vertebrates and epigeous arthropods (above ground).



## PERSONAL NOTES AND REFERENCES OF THE MATERIALS USED



# LEAFLET 2

## Biodiversity assessment

### TRAINING OBJECTIVES

At the end of this training sequence, the participant must be able to:

- understand the value of biodiversity assessment and monitoring on a farm;
- understand what a biodiversity indicator is and how to choose it;
- understand how biodiversity assessment methods work, the different types and their limitations;
- be able to issue a diagnosis/monitoring of biodiversity within an agricultural holding.

### KEY MESSAGES

#### 1) Value of biodiversity assessment and monitoring on a farm

- The valuation of biodiversity on a farm is of vital interest in the preservation of ecosystems and the agronomic benefits it provides.
- Agriculture is the first anthropogenic factor controlling biodiversity.
- Biodiversity assessment meets regulatory obligations, the requirements of the agri-food sector and improves the producer's image in the eyes of the public.
- Biodiversity assessments are done for both domestic and wild biodiversity.
- Biodiversity assessments are carried out on all parts of the farm, including the areas surrounding the farm.
- Monitoring makes it possible to verify the quantitative and qualitative evolution of biodiversity on an agricultural holding.
- Agricultural practices and their impact must be documented through constant monitoring of biodiversity.

#### 2) Definition of a biodiversity indicator and how to choose it

- Indicators are indices for quantifying biodiversity, its spatial distribution and variations over time.
- An indicator is the summary of complex information that allows different actors to dialogue in a common language.
- Indicators make it possible to assess biodiversity and its 'health status' in relation to the operator's practices for the development of an action plan.
- Biodiversity is assessed by two main categories of indicators: domestic biodiversity indicators and wild biodiversity indicators (para-agricultural and extra-agricultural).
- The choice of indicators is made according to : the objective set, the recipient, the spatial scale of the diagnosis, the available data, and the human and financial resources.



- Biodiversity indicators must be readable, easy to implement, sensitive to changes in agricultural practices, reliable and relevant.

### 3) Biodiversity assessment methods and different types of indicators

- Biodiversity assessment methods operate on the basis of *in situ* observation of condition indicators.
- Condition indicators reflect the result of 'positive' or 'negative' pressures from operating practices.
- The proper functioning of assessment methods also requires the identification and analysis of agricultural practices to define the effects of pressures on biodiversity.
- The effectiveness of biodiversity assessment methods lies in comparing the results of farm observations with data from the surrounding area.
- The evaluation method using agri-environmental diagnostics composed of indicators with scales or scores concerns biodiversity, which is more or less developed.
- The evaluation method known as the 'naturalistic method' is of the species inventory/monitoring type, and requires skills in terms of species and environment identification.
- The methods with more open-ended questions aim to understand the farming system.

### 4) Limitations of biodiversity valuation methods

- Since it is impossible to assess everyone living, the appropriate choice of what to observe in ecosystems is random.
- The need to have an indicator for each aspect of biodiversity being assessed makes it costly to implement biodiversity valuation methods.
- The involvement, more often than not, of several institutions in the assessment makes it more difficult to implement biodiversity assessment methods.
- The choice of indicators requires several steps, a fairly long time and the intervention of several types of actors, with a necessary validation period that extends the time of the diagnosis.
- Biodiversity assessment is only a small part of environmental or sustainability diagnostics.

### 5) To diagnose or monitor biodiversity on a farm

- A diagnosis or a monitoring of biodiversity within a farm includes identifying the biodiversity present on the farm and defining the actions to be taken.
- Knowledge of the factors that really influence biodiversity, on the one hand, and mastery of indicators to measure its condition, make it possible to diagnose and monitor biodiversity within a farm.
- Direct drivers of change (land use, climate change, the emergence of invasive species, overexploitation and land pollution) influence processes in ecosystems.
- Indirect drivers of change (changes in human demographics, income or lifestyle) act by modifying one or more direct drivers of change.





# LEAFLET 3

## Valuing biodiversity

### TRAINING OBJECTIVES

At the end of this training sequence, the participant must be able to:

- understand the functions of biodiversity and be able to cite the services it provides to agriculture;
- identify and understand all the reasons why the biodiversity of the agricultural environment must be taken into account;
- give examples of forms of agriculture that respect nature and production methods that promote biodiversity.

### KEY MESSAGES

#### 1) Biodiversity functions and services in agriculture

- Biodiversity provides regulatory services by addressing: micro- and macro- climate regulation, air quality, hydrology, pests and diseases, erosion prevention, soil fertility maintenance, water purification, waste recycling and pollination.
- Support services, necessary for the production of all other ecosystem services, are: the maintenance of local and global ecological balances, the stability of atmospheric oxygen production and global climate, soil formation and stability, the sustained cycle of the elements and the provision of habitat for all species.

#### 2) Reasons to be interested in biodiversity in agriculture

- Biodiversity is the basis for many natural processes that govern the functioning of agrosystems and ecosystems in general.
- Wild biodiversity is essential to maintaining conditions favorable to life on Earth, through its role in the bio-geo-ecological cycles of the elements.
- In the face of climate change, coupled with population growth, the valuation of biodiversity for agriculture is of paramount importance.
- Changes in natural ecosystems influence climate, both locally and globally, resulting in the reduction of species and varieties.
- Domestic biodiversity allows the reproduction of several wild species, leads humans to control production and apply their own selection criteria.
- The historical dynamics of territorial specialisation, agricultural intensification and decline have an impact on biodiversity.



### 3) Examples of production methods that promote or enhance biodiversity

- Agroforestry is a dynamic, ecological and natural resource management system that respects nature and promotes biodiversity.
- The installation of hedges and windbreaks protects and secures soils and market gardens, crops, animals, buildings, roads and perimeters.
- Conservation agriculture is based on a significant reduction or even elimination of tillage, permanent soil cover and diversified crop successions.
- The installation of grass strips, the addition of organic matter (manure, compost), direct seeding and limited tillage encourage the presence and activity of earthworms in the soil.
- Grass strips also provide a variety of regulation and supply services to the producer (forage resources, building materials).
- Earthworms are 'ecosystem engineers' and one of the essential links in soil functioning through their effect on soil formation, development and fertility.
- Organic agriculture is a production system that preserves the health of soils, ecosystems and people, and is based on ecological methods, biodiversity and crop cycles adapted to local conditions.
- The agricultural practice of encouraging intra-specific mixtures by growing two (or more) varieties of the same species on the same plot of land leads to an increase in genetic diversity that allows biotic and abiotic stresses to be dealt with.
- The combination of crops/varieties reduces the use of fertilisers (e.g. cereal/vegetable combination), but also repels or traps pests by the presence of nearby host plants.
- Permaculture is a nature-friendly agriculture that promotes biodiversity, soil regeneration and resilience to climate change.
- Agro-ecology is a way of designing production systems that are based on the functionalities offered by ecosystems. It promotes biodiversity.
- Smart agriculture is designed to develop the technical, political and investment conditions necessary for sustainable agriculture that meets the challenges of food security in a context of climate change.

### PERSONAL NOTES AND REFERENCES OF THE MATERIALS USED

.....

.....

.....

.....

.....



# LEAFLET 4

## Preservation and restoration of biodiversity

### TRAINING OBJECTIVES

At the end of this training sequence, the participant must be able to:

- cite cultural practices that have a negative impact on biodiversity;
- provide examples of biodiversity-friendly agricultural developments and practices;
- know how to implement these practices, and their environmental, agronomic, socio-economic advantages and constraints;
- implement biodiversity restoration strategies at the farm level.

### KEY MESSAGES

#### 1) Cultivation practices with a negative impact on biodiversity

- At the plot level, the shifting cultivation system has a negative impact on biodiversity: destruction of biomass by fire, which reduces the soil's organic matter content and therefore the soil's water retention capacity.
- At the landscape level, the shifting cultivation system causes significant deforestation of the landscape and silting of river beds.
- The shifting cultivation system also has a negative impact on biodiversity by destroying ecological niches and corridors.
- At the plot level, the semi-permanent cultivation system – polyculture – increases the intensity of erosion if no control measures are put in place.
- At the landscape level, the semi-permanent cropping system causes significant negative landscape changes with limited vegetation regeneration.
- The semi-permanent polyculture system is causing the extinction of many plant and animal species, both aquatic and terrestrial.
- The semi-permanent polyculture system amplifies the damage caused by erosion by destroying ecological corridors and reducing water resources.
- The permanent crop – polyculture system intensifies overexploitation of land leading to land degradation, depletion of water resources, and the erosion of biodiversity through the destruction of habitats and ecological corridors.
- The permanent cropping system – monoculture, characterised by overexploitation of land and an increased use of chemical inputs around industrial or commercial crops results in a significant degradation of water and land resources and biodiversity.
- Commercial fruit and vegetable production is generally intensive (monocultures), uses chemical inputs and is likely to be an important factor in the degradation of biodiversity.



## 2) Agricultural practices and developments that promote biodiversity

- The practice of associating animal husbandry with the crop production system on an agricultural holding is favorable to domestic biodiversity.
- Spatial planning techniques for crop rotation - associations (intra-parcel mixing) and temporal management techniques for rotational and stolen crops are favourable to domestic biodiversity on the farm.
- Techniques such as flowering strips, spatio – temporal diversity of cultivated species, grassing of perennial crops and the choice of selective plant protection products improve wild para-agricultural biodiversity.
- Light tillage, permanent plant cover, rotation, associations of crops with different root systems, and the use of organic amendments have a positive impact on wild para-agricultural biodiversity.
- Wild para-agricultural biodiversity acts at the level of AEI/AEIU and specifically at the level of perennial crops.

## 3) Modalities for implementing biodiversity-enhancing agricultural practices

- Agro-ecological production systems improve domestic biodiversity by promoting the association ‘livestock and plant production’, proposing spatial and temporal crop management techniques and giving space to local species and heritage varieties.
- The ways in which livestock are associated with the production system will depend on socio-economic conditions: livestock farming with conventional agriculture, or with agroforestry, or various combined methods.
- The spatial planning of crops is based on intra-parcel mixes and/or crop rotation, which is the geographical organisation of parcels cultivated on an entire farm during a given agricultural year.
- Intra-parcel mixes consist of combining several species and/or varieties on the same plot, either by sowing in alternating rows or by more complex combinations.
- The modalities of temporal crop management are obtained by diversifying species and varieties on a farm on a time scale by rotating well thought out crops and/or hidden crops.
- The exploitation of local heritage species and varieties is based on the balance and resilience of local species and varieties used in traditional agriculture.
- The development and preservation of the biodiversity of the areas near the farm is mainly achieved through developments that avoid disturbances resulting from the use of inputs (PPPs and fertilisers).
- The implementation of the maintenance of landscape biodiversity requires the rehabilitation of the landscape in spatial planning systems by introducing, in addition to good biodiversity management practices, rules that give legal force to law so that the landscape elements make it possible to preserve the specificity of a place and contribute to strengthening its attractiveness.
- Domestic biodiversity improves total labour and soil productivity through manure production.
- Domestic biodiversity contributes to the simultaneous intensification of agricultural and livestock production, the valorisation of animal excreta to increase soil fertility, and crop residues that can be used as fodder.



- Domestic biodiversity contributes to strengthening the resilience of farms to climate change and to reducing the use of plant protection products and fertilisers.
- Domestic biodiversity is involved in income diversification and the consolidation of household food security.
- The implementation of domestic biodiversity requires a level of knowledge in farm management, the means to ensure food, animal care and leads to competition for land between agriculture and livestock.
- The implementation of domestic and wild biodiversity requires more work, manpower, and domestic biodiversity requires the ownership of animals and a plan for recycling waste and organic discharges.
- Wild biodiversity will take into account wild biodiversity known as para-agricultural and extra-agricultural biodiversity.
- The diversification of living organisms in the implementation of wild biodiversity is a major benefit in ecosystems through the improvement of soil fertility at the AEI/AEU level.
- Wild biodiversity increases the diversity, heterogeneity and tourism of landscapes ,and plays a very important role in carbon storage.
- Wild biodiversity contributes to the reduction of nitrogen pollution and ensures efficient management of water resources.
- Wild biodiversity increases competition between the edge of the plot and the development, and requires land ownership.

#### 4) Implementation of biodiversity restoration strategies at the farm level

- To start an action in favour of biodiversity, it is necessary to draw up an inventory of biodiversity on the farm, and analyse agricultural practices and their impacts.
- The implementation of concrete actions on exploitation is a direct response in favour of species and areas identified as in need of conservation or restoration.
- Implementation requires the identification of possible concrete actions, and the coordinated and integrated organisation of action and management plans, to be carried out at operational level and monitored with well-defined evaluation indicators.
- It is necessary to stop the loss of wild and domestic biodiversity through selected actions.
- It is necessary to restore and maintain the capacity for biodiversity change through the implementation of protection measures, enhancement measures, measures to repair natural environments and species, and measures to compensate for damage.
- Favourable maintenance of ecosystem components helps to maintain or restore ecosystems and species: combining thoughtful agricultural production with agricultural practices that do not impact or benefit biodiversity.





## PERSONAL NOTES AND REFERENCES OF THE MATERIALS USED

# Summary of the manual

## Sustainable management of biodiversity

1. Definition and importance of biodiversity.....	26
2. Types of biodiversity.....	26
3. Links between biodiversity and agriculture.....	27
4. Threats to biodiversity.....	27
5. Biodiversity assessment and monitoring at the farm level.....	28
6. Valuing biodiversity for the benefit of agriculture.....	29
7. Preservation and restoration of biodiversity.....	30



## 1. DEFINITION AND IMPORTANCE OF BIODIVERSITY

Biodiversity is the set of living things in a given environment. It refers to the variety of living organisms studied at three levels: ecosystems, the species that live there, and the genes found in each species.

We could ask ourselves why are there so many species and why are they all so different from each other. The world is constantly changing and transforming through the discovery of new species and scientific work that brings new observations. Biodiversity represents the richness in diversity of all forms of life (ecosystems, species, genes). The ecosystem is a dynamic set of living organisms that interact with each other and with the environment in which they live. Genes are important in the structuring of living organisms and, from an ethical point of view, the survival and preservation of biodiversity depend on them.

Biodiversity is important because it contributes to human well-being, protects human health and ensures food security. It appears that biodiversity is a vital resource for all living beings that take most of their needs, such as food, raw materials and therapeutic needs, from this biodiversity. The diversity of living organisms is involved in the formation of ecosystems, habitats, climate regulation and water quality. A higher level of biodiversity makes for more efficient use of the environment's natural resources. It promotes technological innovation, protects against soil erosion, ensures the deployment of the forest and provides so-called 'ecosystem' services. The main ecosystem services are: supply service, regulatory service, cultural service and support service.

## 2. TYPES OF BIODIVERSITY

Biodiversity is distinguished by gene diversity, species diversity and ecosystem diversity. Genetic diversity is characterised by the diversity of alleles within a species or population. As for specific diversity, it corresponds to the number of living species such as animals, fungi or humans. Ecosystem diversity is the interaction between all natural spaces.

With regard to species diversity, there are several types of biodiversity:

- wild biodiversity (remarkable or ordinary);
- domestic biodiversity;
- Agricultural biodiversity.

Wild biodiversity plays an important role in maintaining ecosystem balances: oxygen production, CO<sub>2</sub> fixation and temperature regulation. Wild biodiversity is considered 'remarkable' when it is made up of living organisms and rare or endangered habitats. Otherwise it is called 'ordinary'.

Domestic biodiversity is that of groups of species and subspecies that have been domesticated by humans and have been selected by them (e.g. to produce more productive, resistant or better conserved animal breeds or plant varieties etc.). Domestic biodiversity also means a decline in the diversity of species in the environment, because, by choosing to favour certain species, human limits diversity to those that are cultivated or raised.

Agricultural biodiversity is one of the components of domestic biodiversity that deals with food and agricultural production. It includes diversity at the intra-, interspecific and ecosystem levels. Agricultural biodiversity includes the components of biological diversity related to food, agriculture, but also those constituting agricultural ecosystems. It refers to the variety and variability of animals, plants and micro-organisms, at the genetic, species and agro-ecosystem level. It is the result of natural selection processes and directed selection.



### 3. LINKS BETWEEN BIODIVERSITY AND AGRICULTURE

Since ecosystem diversity is the interaction between all natural spaces, farming is a particular type of 'biotope' within which species diversity and landscape diversity can be considered.

Biodiversity benefits agriculture at three levels:

- i. productivity,
- ii. adaptation and
- iii. maintenance of ecosystem functions.

In 2008, the SCDB listed six ecosystem services specifically provided to agriculture: pest and disease control; nutrient cycling, such as organic matter decomposition; nutrient capture and conversion; organic matter and soil water retention control; soil fertility and biotope maintenance; and pollination by bees and other wildlife.

In return, agriculture can contribute to higher levels of biodiversity at three levels:

- provision of ecosystem services,
- incentives and
- ecological knowledge.

Agriculture guarantees the conservation and protection of species present on agricultural land. Agriculture conserves and promotes the ecosystem services provided by biodiversity.

### 4. THREATS TO BIODIVERSITY

The notion of remarkable wild biodiversity highlights the issue of biodiversity threat. The rate of biodiversity loss, mainly of human origin, is accelerating. Scientists summarise the anthropogenic mechanisms responsible for biodiversity loss into five main categories: destruction, reduction and fragmentation of natural habitats; biological invasions; overexploitation of certain species and environments; pollution and biocontamination of water, soil and air; and global climate change.

The impacts of agricultural practices on biodiversity are mainly found in deep ploughing, the use of mineral fertilisers and chemical pesticides. The use of hybrid varieties and genetically modified organisms (GMOs) also contributes to the loss of biodiversity.

The large-scale use of mineral fertilisers (N, P, K) contributes to the increasing productivity of agriculture. However, the nitrogen and phosphorus in these fertilisers can have serious consequences on biodiversity. Agricultural practices, such as farm consolidation (exchanging land for more large parcels in one piece), leading to the disappearance of roads and the uprooting of hedges, are gradually and profoundly reducing the heterogeneity of landscapes. However, the homogenisation of landscapes disadvantages rare species and favours common species, leading to a trivialisation of species. The trivialisation of species influences the structure of the landscape, and the structure of the landscape in turn impacts vertebrates and invertebrates such as epigeous arthropods. Invasive alien species often have destructive impacts on native species, causing extinctions and affecting both natural and cultivated ecosystems. The various species extinction crises are due to human action on the environment, mainly through agriculture, deforestation and urbanisation.



## 5. BIODIVERSITY ASSESSMENT AND MONITORING AT THE FARM LEVEL

When agricultural land occupies a large part of a region's surface area, agriculture must be considered as the first anthropogenic factor controlling biodiversity. In South Africa, 80% of the land is agricultural (69% grazing), so maintaining healthy ecosystems is in the hands of South African farmers. In these regions, agricultural areas contain a significant proportion of wild biodiversity, whether 'ordinary' or 'remarkable'. At European level, 46% of the natural habitats of Community interest and 173 priority bird species are located in agricultural areas. In France, 90% of protected plant species are linked to agricultural activities.

It is useful to assess and monitor the level of biodiversity on a farm for four main reasons:

- i. agronomic benefits,
- ii. regulatory obligations,
- iii. requirements of the agri-food sector and,
- iv. the producer's image in the eyes of the public.

There are valuation methods that are applied to assign values for actions on a farm. For the farmer, biodiversity assessment and monitoring work must be carried out on all parts of the farm, including the areas surrounding the farm, and concerns both domestic and wild biodiversity.

Agriculture has a positive or negative influence on biodiversity, and its impact on biodiversity is determined by several factors, the most important of which are agricultural production systems and the marginality index of agricultural land. While agricultural production systems are the result of demographic pressure on land or technological development, the agricultural land marginality index is obtained by taking into account several natural environmental factors.

Biodiversity decline is associated with agricultural land, in line with the agricultural modernisation of recent decades. This has led to a specialisation of production at farm and regional level, and to a significant change in production methods. There is an intensification on the most productive lands: massive use of synthetic fertilisers, phytosanitary products (and sometimes land consolidation facilitating mechanisation). These transformations have had a negative impact on biodiversity, and have led to a significant loss and degradation of semi-natural environments in agricultural and pastoral areas. The very important role of agriculture, with its intensive agricultural production methods and their impacts, are strong arguments in favour of maintaining and/or improving biodiversity.

The assessment and monitoring of biodiversity on a farm is most relevant to the preservation of ecosystems and the agronomic benefits provided by agriculture (especially since agriculture is the first anthropogenic factor controlling biodiversity). Biodiversity assessments and monitoring meet not only regulatory obligations, but also the requirements of the agri-food sector, which is very much concerned with production methods and strict in its ethical assessments--increasingly concerned with the producer's image in the eyes of the public.

Biodiversity assessment and monitoring is a tool for verifying the quantitative and qualitative evolution of biodiversity on an agricultural holding that must be based on a methodical approach. This will allow the farmer to make documentary records of his farming practices and assess their impacts. All methods of biodiversity assessment and monitoring must include the identification and analysis of agricultural practices in order to carry out an 'inventory' of the different pressures on biodiversity.





Several methods for biodiversity assessment and monitoring exist, such as: the agro-environmental diagnostic assessment method, the so-called 'naturalistic method' assessment method, methods with open-ended questions or methods that use *in situ* observations with the use of condition indicators. Condition indicators must then be readable, easy to implement, sensitive to changes in agricultural practices, reliable and relevant. These indicators must reflect the result of 'positive' or 'negative' pressures from operating practices. Knowledge of the factors that really influence biodiversity on the one hand and, on the other hand, mastery of the indicators to measure its condition, makes it possible to diagnose and monitor biodiversity within a farm. The diagnosis of farm biodiversity is imperative and must become a common approach for all direct (farmers) or indirect (advisors or technicians) stakeholders in the use and sustainable conservation of ecosystems.

However, all these methods have limitations because it is impossible to make an assessment of all living beings, which is by nature variable; biodiversity assessment is only a small part of environmental or sustainability diagnostics.

## 6. VALUING BIODIVERSITY FOR THE BENEFIT OF AGRICULTURE

Intensive or conventional agriculture, which aims to produce massive amounts of food (plant or animal origin), has many negative effects without being able to meet the planet's food needs. It is therefore urgent to change the agricultural model to support an agriculture that is just as productive, but which respects the environment and health, preserves natural resources sustainably and provides products of high health and nutritional quality. In this context of agricultural production and climate change, coupled with population growth, the valuation of biodiversity for agriculture is of crucial importance in order to meet the challenges of food and nutritional security while respecting the environment.

### Biodiversity functions and services in agriculture

Agricultural production systems are based on a natural physical environment, called agro-ecosystem, based on a set of lands used for agriculture, livestock, fish farming, forestry and grazing. This environment is a set of biotopes and biocenoses, adapted and transformed according to the objectives of agriculture, which influences the characteristics of the environment. Biodiversity is the basis of many natural processes that govern the functioning of agro-ecosystems, which is why the valuation of biodiversity is crucial for the farmer and the community.

The main services provided by biodiversity in agricultural activities are the following.

- Regulatory services: micro- and macro- climate regulation, air quality, hydrology, pests and diseases, erosion prevention, soil fertility maintenance, water purification and waste recycling and crop pollination.
- Ecological services: provided by biodiversity, they include flood prevention through the presence of wetlands, prevention of soil erosion by wind and water through the presence of plants in and around fields, and plant nutrition through the decomposition of organic matter by micro-organisms.
- Support services: these are necessary for the production of all other ecosystem services, such as the maintenance of local and global ecological balances, the stability of atmospheric oxygen production and global climate, soil formation and stability, the sustained cycle of the elements and the provision of habitat for all species.

In Burundi, agro-ecosystems and natural ecosystems maintain intimate relationships through ecological services that each system provides to the other. Indeed, agro-ecosystems, through their soil and water protection services, are involved in mitigating erosion and sedimentation that are harmful to aquatic biodiversity. Agro-ecosystems have also made it possible to conserve biodiversity that has become rare in natural environments, and to facilitate the maintenance and upkeep of soil micro-organisms that could not exist without agricultural activities.

### Production methods that promote or enhance biodiversity

A diversified agriculture, which combines cultivation and livestock, uses legumes, ensures permanent land cover, encourages grassland, and contributes to the enhancement of biodiversity. This type of agriculture makes maximum use of natural and biological processes in its implementation, excluding at best the use of pesticides to optimise the value of biodiversity.

A food sovereignty policy is essential for sustainable development, and biodiversity conservation is one of the challenges for sustainable agricultural production. Thus, smart agriculture could be designed to develop the technical, political and investment conditions necessary for sustainable agriculture to meet the challenges of food security in a context of gradual climate change.

Agricultural practices such as agroforestry, agro-ecology, permaculture, combination of crops or varieties, installation of hedges and windbreaks, conservation agriculture, installation of grass strips, offer various 'ecological' services, grouped into three categories: regulatory services (plant pollination), supply (water supply) and even sociocultural services (landscape beauty).

## 7. PRESERVATION AND RESTORATION OF BIODIVERSITY

As a reminder, biodiversity is the variability of living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems, and the ecological complexes of which they are part. This includes diversity within and between species, as well as ecosystem diversity.

Agriculture, on the other hand, is a process by which humans manage their ecosystems and control the life cycle of domesticated species in order to produce food and other resources for their societies. The impact (positive or negative) of agriculture on biodiversity is determined by several factors, the most important of which are agricultural production systems and the agricultural land marginality index.

### Impacts of cultural practices on biodiversity

While agricultural production systems are the result of demographic pressure on land or technological development, the agricultural land marginality index is obtained by taking into account several natural environmental factors: potential biomass productivity, climatic conditions (aridity, seasonal variability of rainfall), soil properties (soil fertility) and soil slope (erosion risk) (J. Röhrig, 2008).

Taking into account the number of years a plot is under cultivation (C), the number of years it is fallow (F) and the number of years for another use without cultural practices (L), Ruthenberg (1980) determined the crop coefficient R, expressed as a percentage.



$$R (\%) = \frac{C}{C + F + L} * 100$$

This coefficient classifies agricultural production systems into three main categories:

- itinerant cultivation system:  $R < 30$ ;
- semi-permanent cultivation system:  $30 \leq R \leq 70$ ;
- continuous cultivation system:  $R > 70$ .

There are also other production systems such as agroforestry, agropastoralism, perennial crops (tree and shrub), irrigated crops, organic crops. The impact of agriculture on biodiversity is therefore understood on the basis of the following cropping systems:

- itinerant cultivation system – polyculture;
- semi-permanent polyculture cultivation system;
- permanent cropping system – polyculture;
- permanent culture system – monoculture;
- perennial culture system;
- agroforestry system;
- irrigated cropping system;
- organic farming system;
- agro-ecological cultivation system.

Regardless of cropping systems, the way crops are arranged on a plot, farm or region in turn determines another classification of cropping systems, namely **monoculture** and **polyculture**. While monoculture is defined as a system of cultivation of a single plant species on an agricultural holding (season by season), polyculture is a system of cultivation of several plant species on the same plot or on the same holding, or even in the same region. Polyculture includes several cropping systems in different associations. However, it should be noted that there are agricultural production systems where farmers practice both polyculture and monoculture. The definition of monoculture should refer much more to what happens on a plot or field, rather than on the farm. This is the case of farms in northern Benin where intensive cotton cultivation is a monoculture that has completely degraded the region's soils.

The **arrangements** and **cultural practices** of each cropping system differ from one system to another. As a result, their impacts on biodiversity are also different. Whether at the plot or landscape level, for each cropping system, the impact on biodiversity is described by reference to soil, water resources, fauna and flora.

### Agricultural practices and developments that promote biodiversity

The creation of favorable biotopes and 'ecological corridors' are ways to develop the biodiversity of a farm. The choice of a bee fallow with species that flower before or after neighbouring crops is a regular source of food for bees. Or, in the constitution of hedges to be planted, recommend species that will offer their pollen to bees early. Techniques such as flowering strips, spatio-temporal diversity of cultivated species, grassing of perennial crops and the choice of selective plant protection products improve wild para-agricultural biodiversity.



In addition to these basic actions, some agricultural practices that promote biodiversity can be adopted. These agricultural practices include, among others, the following.

- The practice of associating animal husbandry with the crop production system on an agricultural holding,
- Spatial management techniques for crop rotation / associations (intra-parcel mixing), and temporal management techniques for rotational and hidden crops,
- Light tillage, permanent vegetation cover, rotation,
- The associations of crops with different root systems and the provision of organic amendments, have a positive impact on wild para-agricultural biodiversity,
- Organic agriculture: beyond the preservation of soil quality, biodiversity, air and water, the benefits that society can derive from organic agriculture are multiple (creation of activities and jobs, promotion of innovation in agriculture, development of rural areas and also strengthening links between farmers and consumers).

### Modalities for implementing biodiversity-enhancing agricultural practices

When analysing the modalities of implementing agricultural practices that promote biodiversity, the main favourable practices are essentially redrawn around domestic and/or wild biodiversity and landscape biodiversity.

The overall effectiveness of these biodiversity-friendly agricultural practices depends in particular on the implementation modalities.

- **Agro-ecological production systems** improve domestic biodiversity because they promote the association 'livestock and plant production'. Agro-ecological production systems offer techniques for spatial and temporal crop management, and include a focus on local species and heritage varieties.
- The **ways in which livestock are associated with the crop production system** may depend on socio-economic conditions: livestock farming with conventional agriculture, or with agroforestry, or various combined ways.
- **Spatial crop management** is based on intra-parcel mixes and/or crop rotation, which is the geographical organisation of plots cultivated on an entire farm during a given agricultural year.
- The **temporal management of crops** is obtained by diversifying species and varieties on a farm on a time scale by rotating well-thought-out crops and/or hidden crops.
- **Maintaining landscape biodiversity.** Landscapes are often subject to trivialisation and degradation, which are very often irreversible, as the areas, thus modified and weakened, never catch up with their natural functions. Maintaining landscape biodiversity requires rehabilitating the landscape in land use planning systems by introducing, in addition to good biodiversity management practices, rules that are legally binding so that landscape elements make it possible to preserve the specificity of a place and contribute to strengthening its attractiveness.

The implementation of domestic and wild biodiversity (not to mention taking into account the wild biodiversity known as para-agricultural and extra-agricultural) requires more work, manpower, and domestic biodiversity requires the ownership of animals, and the definition of a plan for recycling waste and organic discharges.



## Biodiversity restoration strategies at the farm level

For development to be sustainable, agriculture's commitment to economic, environmental and social performance is inevitable. As such, to start an action in favour of biodiversity, it is first necessary to draw up a 'state of play' of biodiversity on the farm and analyse agricultural practices and their impacts.

In implementing biodiversity restoration strategies at the farm level, the deployment of biodiversity-friendly practices will consider, not each plot independently, but **the entire farm**, in a global approach where actions complement each other, where imbalances offset each other.

Three points to remember when implementing biodiversity restoration strategies at the farm level.

- Implementation requires the **identification of possible concrete actions** and the **coordinated and integrated organisation of action and management plans**, to be carried out at operational level and monitored with well-defined evaluation indicators.
- The implementation of concrete actions on exploitation is a direct response in favour of species and areas identified as in need of conservation or restoration. It is necessary to **stop the loss of wild and domestic biodiversity through selected actions**.
- It is necessary to restore and maintain the capacity for biodiversity change through the implementation of **protection measures, enhancement measures, measures to repair natural environments and species and measures to compensate for damage**.

Favourable maintenance of ecosystem components helps to maintain or restore ecosystems and species: thoughtful agricultural production in terms of potential impacts on the environment, with agricultural practices that do not affect or are favorable to biodiversity.

Safeguarding, restoring, conserving biodiversity as a whole and producing in a sustainable way in agriculture means informing and training all stakeholders / users of the agricultural world.



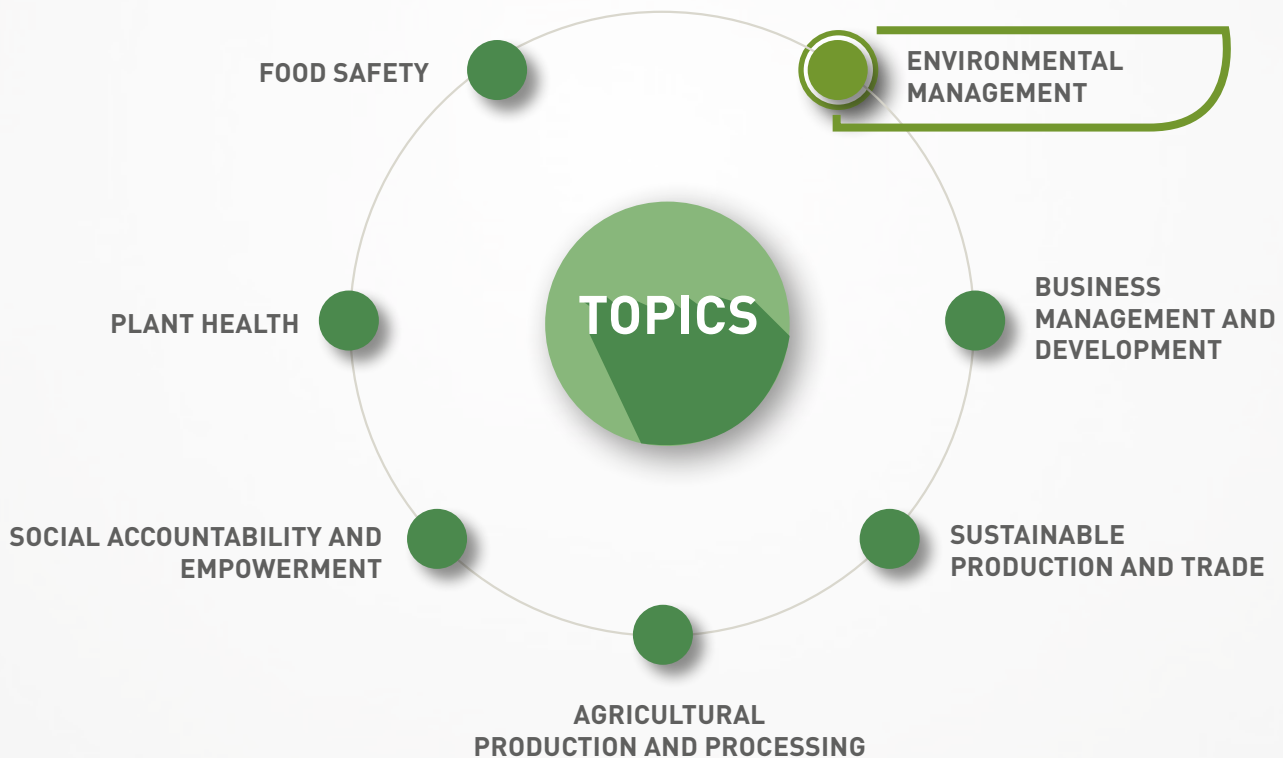




# COLEACP E-LEARNING PLATFORM

RECEIVE YOUR ACCESS TO OUR DISTANCE LEARNING PLATFORM. RESERVED FOR  
STAKEHOLDERS IN THE AGRICULTURAL SECTOR IN AFRICAN, CARIBBEAN AND  
PACIFIC COUNTRIES.

TEST AND IMPROVE YOUR KNOWLEDGE  
AT YOUR OWN RHYTHM!



<https://training.coleacp.org>

SUSTAINABLE PRODUCTION  
AND TRADE

HEALTH PLANT

FOOD SAFETY

AGRICULTURAL PRODUCTION  
AND PROCESSING

SOCIAL ACCOUNTABILITY  
AND EMPOWERMENT

**ENVIRONMENTAL  
MANAGEMENT**

BUSINESS MANAGEMENT  
AND DEVELOPMENT

TRAINING METHODOLOGY