
UNIT 2 SHRINKING AGROBIODIVERSITY: CAUSES AND CONSEQUENCES

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2.0 INTRODUCTION

We know that agricultural biodiversity is a subset of general biodiversity. It includes all forms of life directly relevant to agriculture. In the past five decades, intensification and the homogenization of agroecosystems have led to significant losses in agrobiodiversity, including the loss of crop and livestock species, genetic diversity, as well as crop associated biodiversity. Intensification and the homogenization of agricultural ecosystems have led to significant losses in agrobiodiversity, including the loss of crop and livestock species and genetic diversity, as well as crop-associated biodiversity. The loss of agrobiodiversity is perceived as potential threat to long term sustainability of agricultural systems and on food security, especially of poor populations living in marginal lands.

The present Unit gives a comprehensive picture of different aspects of agrobiodiversity loss. While exploring different factors that are responsible for depleting status of agrobiodiversity, the present unit identifies intensification of agriculture as the dominant force which has drastically reduced agrobiodiversity. Effects of different agricultural practices on agrobiodiversity have been explained in fair details. At the end of the unit, existing gaps in the current knowledge have been identified.

2.1 OBJECTIVES

After reading this unit, you will be able to:

- describe the magnitude by which agrobiodiversity is shrinking;
- explain the causes and consequences of shrinking agrobiodiversity; and
- underline the gaps in present knowledge about agrobiodiversity loss.

2.2 SHRINKING AGROBIODIVERSITY: AN OVERVIEW

Biodiversity is vital for human survival. The major challenge of agricultural development in the twenty first century is, to secure food for all peoples while protecting the agricultural biodiversity on which both we and future generations largely depend. The Millennium Ecosystem Assessment concluded that human activities have led to a more rapid loss of biodiversity on Earth over the past 50 years than ever before in human history. The assessment argued that the loss of species and the progressive homogenization of many ecosystems continue to be one of the main threats to the survival of our natural as well as socioeconomic systems. Intensification and the homogenization of agricultural ecosystems have led to significant losses in agrobiodiversity, including the loss of crop and livestock species and genetic diversity, as well as crop associated biodiversity such as pest suppressive biodiversity pollinators, soil biodiversity etc.

Agrobiodiversity loss chiefly comprises erosion of genetic diversity. Genetic erosion in agrobiodiversity is the loss of genetic diversity, including the loss of individual genes, and the loss of particular combinants of genes (or gene complexes) such as those manifested in locally adapted landraces. The term genetic erosion is sometimes used in a narrow sense, such as for the loss of alleles or genes, as well as more broadly, referring to the loss of varieties or even species. Without proper management of agricultural biodiversity some key functions of the agroecosystem may be lost, such as maintenance of nutrient and water cycles, pest and disease regulation, pollination and hand erosion control. Erosion of agricultural biodiversity has negative impacts on the long term sustainability of agricultural systems and on food security, especially of poor populations living in marginal lands.

There are a number of factors that are responsible for agrobiodiversity erosion. Replacement of local varieties by high yielding or exotic varieties or species is one such factor. A large number of varieties are dramatically reduced when commercial varieties (including GMOs) are introduced into traditional farming systems. Many researchers believe that the main problem related to agroecosystem management is the general tendency towards genetic and ecological uniformity imposed by the development of modern agriculture. Pressures for that ecological uniformity on farmers and breeders are caused by the food industry demand for more and more raw materials consistency.

Agricultural intensification, and its corollary, the simplification of agricultural landscapes, are the major factors responsible for the loss and profound modification of biodiversity, in particular over the last few decades. Agricultural areas represent a majority of the land area of many countries. It holds the key to

the conservation of world's remaining biodiversity. Innovative biodiversity rich farming systems can potentially be high yielding and sustainable, and thus support persistence of wild species by limiting the adverse effects of agriculture on natural habitats. Adoption of farming practices that utilize and conserve biodiversity may ultimately improve environmental quality and limit agricultural expansion.

2.3 PATTERN OF AGROBIODIVERSITY LOSS

Since the 1900s, some 75 percent of plant genetic diversity has been lost as farmers worldwide have left their multiple local varieties and landraces for genetically uniform, high-yielding varieties. 30 percent of livestock breeds are at risk of extinction; six breeds are lost each month. Today, 75 percent of the world's food is generated from only 12 plants and five animal species. Of the 4 percent of the 250 000 to 300 000 known edible plant species, only 150 to 200 are used by humans. We know from the previous units that only three species rice, maize and wheat, contribute nearly 60 percent of calories and proteins obtained by humans from plants. Animals provide some 30 percent of human requirements for food and agriculture and 12 percent of the world's population live almost entirely on products from ruminants.

More than 90 percent of crop varieties have disappeared from farmers' fields; half of the breeds of many domestic animals have been lost. With the disappearance of harvested species, varieties and breeds, a wide range of unharvested species also disappear. In fisheries, all the world's 17 main fishing grounds are now being fished at or above their sustainable limits, with many fish populations effectively becoming extinct. Loss of forest cover, coastal wetlands, other 'wild' uncultivated areas, and the destruction of the aquatic environment exacerbate the genetic erosion of agrobiodiversity. Locally varied food production systems are under threat, including local knowledge and the culture and skills of farmers. Of a total of 7616 livestock breeds studied by FAO, around 20 percent breeds are classified as at risk.

2.4 REASONS OF DECLINE IN AGROBIODIVERSITY

Throughout the twentieth century the decline has accelerated, along with increased demands from a growing population and greater competition for natural resources. There are many reasons for the decline in agrobiodiversity. The major factors leading to agrobiodiversity erosion are rapid expansion of industrial and green revolution, globalization of food system and marketing, replacement of traditional varieties by improved or exotic varieties and species, land clearing, overexploitation of species, population pressure, environmental degradation, overgrazing, and changing agricultural systems and policies.

The rapid expansion of industrial and Green Revolution agriculture is one of the major driving force that led to remarkable decline in crop diversity. This also includes intensive livestock production, industrial fisheries and aquaculture. Some production systems use genetically modified varieties and breeds. Relatively few crop varieties are cultivated in monocultures and a limited number of domestic animal breeds, or fish, are reared or few aquatic species cultivated.

Globalization of the food system and marketing are the other major driving forces. The extension of industrial patenting, and other intellectual property systems, to living organisms has led to the widespread cultivation and rearing of fewer varieties and breeds. This results in a more uniform, less diverse, but more competitive global market. As a consequence there have been changes in farmers' and consumers' perceptions, preferences and living conditions; marginalization of small scale, diverse food production systems that conserve farmers' varieties of crops and breeds of domestic animals; reduced integration of livestock in arable production, which reduces the diversity of uses for which livestock are needed; and reduced use of 'nurture' fisheries techniques that conserve and develop aquatic biodiversity.

Replacement of local varieties by improved or exotic varieties and species is the main cause of the genetic erosion of crops as reported by almost all the countries. Frequently, genetic erosion occurs as old varieties in farmers' fields are replaced by newer. Genes and gene complexes, found in the many farmers' varieties, are not contained in the modern varieties. Often, the number of varieties is reduced when commercial varieties are introduced into traditional farming systems. While FAO (1996) states that some indicators of genetic erosion have been developed, few systematic studies of the genetic erosion of crop genetic diversity have been made. Furthermore, in the FAO Country Reports (1996) identified that nearly all countries confirm genetic erosion is taking place and that it is a serious problem.

2.5 THREATS TO ANIMAL GENETIC DIVERSITY

FAO's Global Databank for Animal Genetic Resources for Food and Agriculture contains information on a total of 7616 livestock breeds. As far as livestock breeds are concerned around 20 percent of reported breeds are classified as at risk. Of even greater concern is that during the last six years 62 breeds became extinct amounting to the loss of almost one breed per month. These figures present only a partial picture of genetic erosion. Breed inventories, and particularly surveys of population size and structure at breed level, are inadequate in many parts of the world. Population data are unavailable for 36 percent of all breeds. Moreover, among many of the most widely used high output breeds of cattle, within breed genetic diversity is being undermined by the use of few highly popular traits for breeding purposes.

A number of threats to genetic diversity can be identified. Probably the most significant is the marginalization of traditional production systems and the associated local breeds, driven mainly by the rapid spread of intensive livestock production, often large scale and utilizing a narrow range of breeds. Global production of meat, milk and eggs is increasingly based on a limited number of high output breeds those that are most profitably utilized in industrial production systems. The intensification process has been driven by rising demand for animal products and has been facilitated by the ease with which genetic material, production technologies and inputs can now be moved around the world. Intensification and industrialization have contributed to raising the output of livestock production and to feeding the growing human population. However, policy measures are necessary to minimize the potential loss of the global public goods embodied in animal genetic resource diversity.

Acute threats such as major disease epidemics and disasters of various kinds (droughts, floods, military conflicts, etc.) are also a concern particularly in the case of small, geographically concentrated breed populations. Threats of this kind cannot be eliminated, but their impacts can be mitigated. Preparedness is essential in this context as adhoc actions taken in an emergency situation will usually be far less effective.

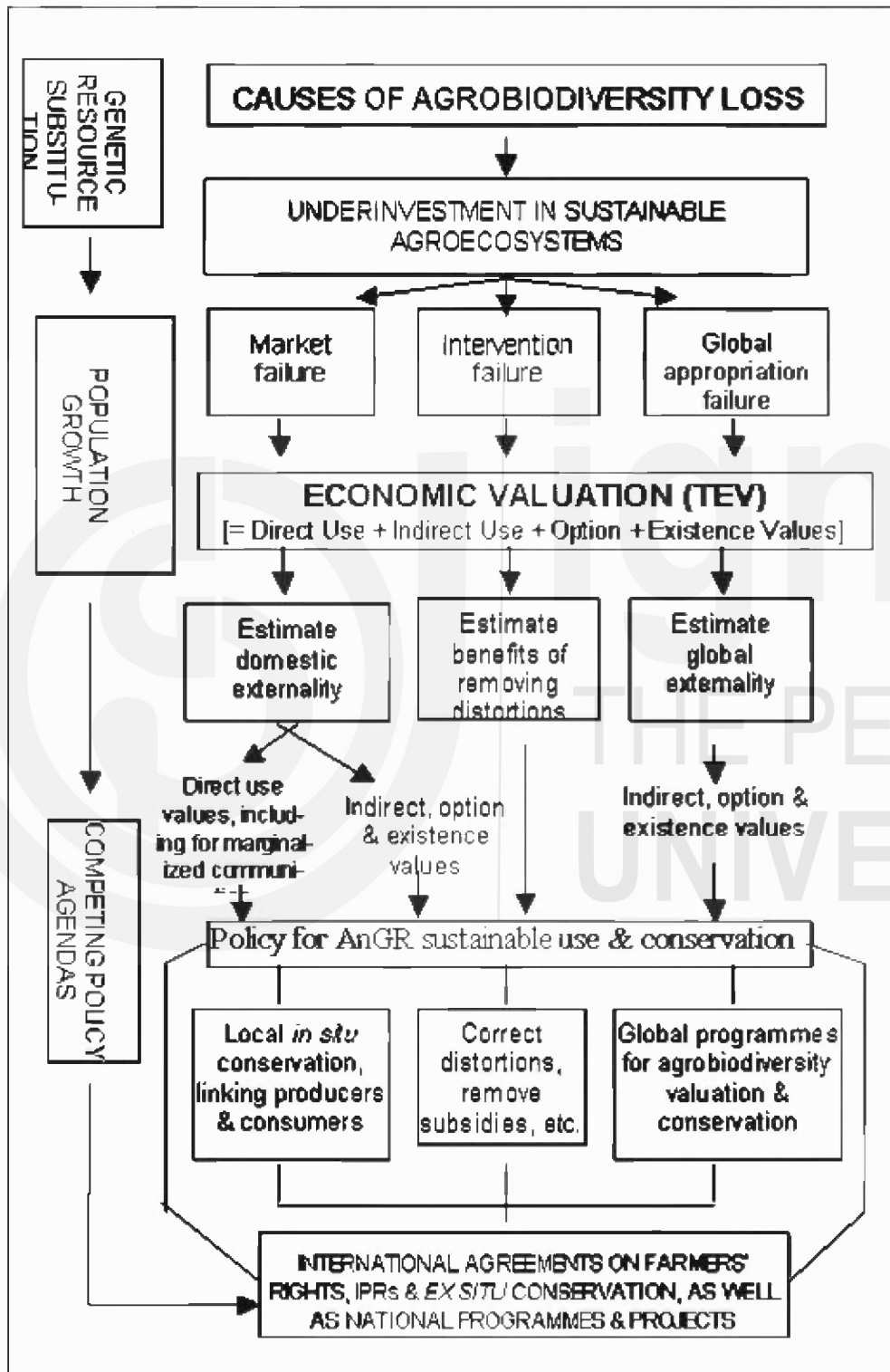


Fig. 2.1: Schematic summary of factors affecting global agrobiodiversity loss. TEV = total economic value. Source: Adapted from Brown et al. (1993)

Policies and legal frameworks influencing the livestock sector are not always favourable to the sustainable utilization of animal genetic resources. Overt or hidden governmental subsidies have often promoted the development of large scale production at the expense of the smallholder systems that utilize local genetic resources. Development interventions, disease control strategies and post-disaster rehabilitation programmes can also pose a threat to genetic diversity, if they do not ensure that the breeds used are appropriate to local production environments and the needs of the intended beneficiaries. Implementing appropriate strategies for the low external input production systems of the developing world is a great challenge. Pastoralists and smallholders are the guardians of much of the world's livestock biodiversity. Their capacity to continue this role may need to be supported for example, by ensuring sufficient access to grazing land. It is essential that conservation measures do not constrain the development of production systems or limit livelihood opportunities. Achieving such a balance itself is a challenge.

Check Your Progress 1

Note: a) Use the space given below for your answer.

b) Compare your answers with those given at the end of the unit.

1) Why did Green Revolution led to loss of agrobiodiversity?

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2) How has globalization affected agrobiodiversity?

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2.6 EFFECTS OF AGRICULTURE ON AGROBIODIVERSITY

Agriculture is the dominant anthropogenic factor controlling biodiversity. Agricultural areas represent a majority of the land area of many countries: 75% in England, 60% in France, 57% in India etc. While recent preoccupations with biodiversity losses are mostly focused on the destruction and transformation of natural habitats, numerous human managed landscapes also contain species diversities comparable to those of natural ecosystems, with in particular the persistence of numerous threatened species. If the conservation of biodiversity is to be based on the protection of 5% of currently existing natural habitats, to be

successful, it will also require the recognition of the remainder of the area of a country.

The agricultural regions of numerous countries are over 2000 years old. Over time, a large number of wild species have become adapted to these landscapes, with the result being the development of species rich, human modified landscapes. In parallel, continued growth of human populations and their resulting occupation of space have resulted in the destruction of natural habitats. Some species have thus lost their initial habitat and have become almost entirely dependent on secondary habitats, primarily agricultural, to survive.

Studies have quantified the influence of agricultural management on biodiversity, both in terms of the equilibrium between natural and managed areas and of the quality of areas managed by agriculture. Evaluating and understanding the effects of agriculture on biodiversity is a major challenge in the establishment of generic knowledge useful for stakeholders in this domain of scientific research. By definition agricultural activity seeks to manage and control biodiversity, but in very different manners depending on the agroecosystem. The effects of different practices on biodiversity have been briefly discussed in the following subsections.

Available knowledge in the literature shows that the ability of landscapes to provide for different species depends both on their structure and the quality of each of their components. These factors are determined by the agricultural mosaic, and by the suite of agricultural practices employed by farmers. Increased landscape complexity, represented in agricultural landscapes by the proportion of cropped areas to semi natural elements and by their spatial arrangement, favours biodiversity overall, as does the use of non intensive agricultural practices.

Agriculture exerts an influence on biodiversity via a complex network of mechanisms. These include the impacts of agricultural practices at the plot level on the environmental conditions experienced by organisms, and also the impact of agriculture on habitat heterogeneity, in terms of the diversity of agroecosystem elements (cropped areas, field margins, wooded areas, irrigation canals etc.) and the diversity of agroecosystems and natural ecosystems at larger scales such as the landscape (and in particular, the region).

2.6.1 Effects of Annual and Perennial Crops

Cropped fields generally have specific ecological characteristics including: large fluxes of materials and a strongly human constrained trophic structure, which creates systems in permanent disequilibrium requiring constant human intervention. Cropped fields are subject to intense disturbance (interventions for the control of pest species, massive removals of primary production), relative spatial uniformity and a periodic “resetting”. The use of synthetic phytosanitary products and repeated deep ploughing, as well as fertilisation, appear as major factors in the decline of the species richness and abundance of numerous organisms (soil microorganisms, soil fauna, insects, plants, amphibians, birds). These effects are at the same time both intentional, when acting to favour the crop, and non-intentional when they exert negative effects on populations of crop pest natural enemies or earthworms.

In woody perennial crops (e.g., orchards, vineyards), due to the permanence of their host plant, numerous pest species remain continually present and their control

requires the repeated application of phytosanitary products, which consequently is the major factor affecting biodiversity in these systems. Apple orchards, for example, are subject to up to thirty pesticide applications per year, and are treated for long periods of 6 to 8 months per season (from budding up until harvest). There are direct effects (mortality, decreases in fecundity), of greater or lesser severity depending on the products used, on the target organisms (arthropod pests) as well as for other species present in the orchard (other arthropods, birds, small mammals etc.). There are also indirect effects for these same groups due to the suppression of resources (weedy plants, prey species), and the alteration of trophic chains. The chemical protection of an orchard has significant negative effects on insect functional diversity and compromises the natural regulation of some pests of apples.

2.6.2 Effects of Soil Cultivation, Crop Rotation and Water Management

Ploughing when used in a repeated manner has a negative effect on the species richness or abundance of many organisms. It selects for weedy species depending on the ability of their seeds to survive in the soil. The abundance of soil macrofauna, and in particular earthworms is significantly reduced by deep ploughing. In the case of repeated ploughing and unfavourable conditions (low organic resources, constraining microclimatic conditions), the species richness of macrofauna communities can also be reduced. While the abundance of microfauna and mesofauna is less affected than the macrofauna by the different techniques of soil cultivation, the profound modifications of trophic and microclimatic conditions resulting from these interventions strongly modify the composition of their communities.

While it is often stated that crop rotations induce higher densities and diversities of soil organisms than continuous cropping, observations indicates that this is only the case where a perennial is introduced into the rotation. Where this is not the case, the opposite result is often observed. Nevertheless, the use of any form of rotation, breaks the developmental cycle of pest species and weeds specific to some crops, and is useful for the control of other pests. Rotation can thus allow for a reduction in pesticide use, with consequent positive effects on biodiversity.

Water management at the plot level, through drainage or irrigation, can have variable effects on biodiversity. Drainage can have a negative effect on groups found in wetlands, for which recent major declines pose a problem for biodiversity conservation. Irrigation has an overall favourable effect on soil fauna but leads to a decrease in plant diversity. Soil fauna biodiversity is particularly affected by soil moisture conditions.

2.6.3 Effects of Application of Fertilizers and Pesticides

Crop fertilisation has globally positive results on the abundance and growth of living organisms in the soil and vegetation, as long as this does not reach toxic levels. However, effects on the species richness of plants and insects are generally negative. Increasing fertiliser application has effects mainly at two levels: firstly on the communities of soil organisms directly affected by changes in the physical and chemical environment with consequent effects on species richness and composition, and secondly on the biodiversity of organisms linked to the nutritional status of plants, through modifications of trophic chains.

In general, the increase in fertilisation allowed by the use of synthetic fertilisers, has resulted in the homogenisation of many environments in terms of resource availability, and has led to the disappearance of species adapted to low nutrient environments (a well documented phenomenon for arable weeds), and the replacement of specialist species by generalists (birds). Mineral nitrogen fertilisation appears as one of the main factors responsible for the decrease in species richness of cropped fields and in adjacent boundary areas. Organic fertilisation appears to have more subtle effects, in particular in microbial communities. It is worth noting that beyond these effects at the plot scale, increased fertiliser use has effects on aquatic ecosystems both continental and coastal (eutrophication resulting from the leaching of nutrients, nitrogen and phosphorus in particular), and on the totality of terrestrial ecosystems due to volatilisation and the accumulation of mineral deposition of atmospheric origin (nitrogen in particular).

Pesticides or synthetic phytosanitary products are considered as one of the major factors responsible for the decline of biodiversity in the agroecosystems of industrialised countries. In general, the effects of phytosanitary products on arthropods, and in particular on crop pests and their natural enemies, depends on their life history, demographic parameters and developmental stage at the time of application. Insecticides that are non-toxic for particular useful species (natural enemies, pollinators) are in reality very rare. Most pesticides have a more or less global effect on arthropod communities. Insecticides can be more toxic than herbicides for soil fauna and in particular earthworms and soil arthropods. Fungicides are even more toxic. The impact of herbicides on soil food webs is generally indirect (reductions of vegetation and soil organic matter). Effects on vertebrates are in particular known for birds and amphibians. These can be direct, due to the use of high doses, or indirect, sometimes even with low doses (for example due to bioaccumulation).

Herbicide use induces a major reduction in the number of plant species and of their biomass in cropped fields, and also in their margins. The continued utilisation of the same herbicide molecules has caused the development of some species populations resistant to the applied molecule. Such phenomena may be accentuated with the establishment of crops of herbicide resistant genetically modified organisms.

2.6.4 Effects of Grass Cover, Grazing, Fallowing and Abandonment

Permanent grasslands, characterised by a perennial multi species, or at least multi year, vegetation cover, do not in general receive pesticides (some cases of the use of selective herbicides against specific species do however exist). While the term permanent grassland covers a large variety of situations, from those heavily fertilised and intensively exploited to rangelands and summer pastures experiencing low stocking rates, these areas generally have a biodiversity considerably greater than that of cropped fields and are often considered as semi-natural areas. The major factors influencing their biodiversity are grazing regimes and the practices of mowing or hay cutting and fertilisation.

In general, a high grazing intensity tends to have a marked negative effect on the species richness of different types of organisms: plants, arthropods, small

mammals and soil fauna. However, bird richness may be high in heavily grazed pastures, even if the abundance of each species is reduced. Moderate levels of grazing lead to an increase in plant species richness and in the abundance of some soil organisms. For plants, species richness tends to decrease when grazing pressure is very low, especially in productive grasslands (with productivity more than 2 t/ha). It is worth noting that the number and functional diversity of some soil organisms (earthworms, some nematodes, amoebas, mycorrhizal fungi) is positively related to plant species richness. Consequently, moderate intensities of grazing can increase the species richness of numerous groups of organisms. In functional terms, an increase in grazing pressure selects for plants with shorter life spans, smaller size and with efficient resource acquisition abilities (photosynthesis, mineral element absorption).

The weedy flora found in fallows is made up of species whose seeds were contained in the soil seed bank. Consequently, these are the same species as normally found in the plot and no additional biodiversity (for example rare arable weeds) is to be expected from the simple placing of a plot in fallow. However, the lower management pressure experienced in a fallow can allow the recruitment of some rare species. The absence of soil cultivation also results in annual species becoming replaced by biennials or perennials. Fallows established to benefit the environment and wild animals can be sown with mixes of species that are more or less diverse (cereals, legumes, buckwheat etc.). Their faunal richness depends on the nature and botanical complexity of their vegetation.

The effect on biodiversity of the abandonment of a previously exploited area depends strongly on its initial state. In the case of cropped fields (cereals, vineyards, orchards etc.) characterized by an environment initially poor in species, species richness increases during the first few years following abandonment for practically all groups of organisms including microorganisms. In functional terms, abandonment leads to a replacement of plant species with a short life span, small size, wind dispersal and high resource acquisition abilities, by species with opposite characteristics and which are often animal dispersed (birds in forested stages).

2.6.5 Effects of Modifications of Landscape Complexity and Fragmentation

Historically, the development of agriculture has been accompanied by major transformations of landscapes and the destruction of natural habitats. More precisely, land use change and the modification of agricultural practices towards greater intensification, since the 1950's, has resulted in a major modification in the structure of landscapes which can affect biodiversity. These structural modifications have mainly included reductions in the heterogeneity or complexity of landscapes, emphasized by the effects of successive agricultural policies. In parallel, the abandonment of marginal agricultural areas has led to a homogenisation of vegetation cover which can also affect biodiversity.

Increasing heterogeneity in agricultural landscapes has, in general, a positive effect on biodiversity. It increases the species richness of the majority of animal and plant groups and contributes to increases in the abundance of most of these. Recent landscape transformations in regions of intensive agriculture, by favouring open areas often to the detriment of semi-natural elements, have led to decreases

in biodiversity. At the landscape scale, poorly represented landscape elements and non-agricultural elements play a major role as refuge habitats for numerous species, and thus play a large role in increasing biodiversity.

The presence of grasslands in a landscape, and in particular low productivity grasslands, is favourable for biodiversity whether this is, for example, for birds, earthworms or soil microfauna. The effects of landscape structure are generally more pronounced for above-ground arthropods and vertebrates than for plants, soil fauna and microorganisms. From a functional point of view, landscape heterogeneity favours insects that are pollinators or natural enemies of crop pests and limits insect pests. Landscape homogenisation leads to a simplification of communities by decreasing the presence of rare species and increasing that of common species.

Landscape heterogeneity, agricultural practices, and production systems act simultaneously on biodiversity, sometimes in synergy and sometimes in opposition, with the effect of one limiting the potential effects of others. There also exists, in the majority of cases, a strong correlation between the intensification of conventional agriculture and landscape homogenisation, with increasing plot sizes and the fragmentation of semi-natural elements.

The fragmentation of semi-natural habitats, with associated effects of decreases in the total number of effectively favourable habitats, a decrease in patch size and increases in fragment isolation, has a generally negative effect on biodiversity. Such fragmentation leads to a decrease in the species richness of most taxonomic groups, even for some low mobility species such as collembolans or soil microarthropods, and the decline of isolated plant populations. The response of different groups to landscape fragmentation depends on their scale of perception and mobility. As a general rule, specialist species are more sensitive to fragmentation than generalists.

2.6.6 Effects of Organic Agriculture and Genetically Modified Organisms (GMO)

Impacts of conventional and organic agriculture on biodiversity have been compared by some studies. Changing from conventional agricultural production to an organic one often has an overall positive effect on biodiversity. The richness of plants, soil microorganisms, vertebrates and arthropods increases. The abundance of invertebrate predators also increases, while the responses of soil fauna are either positive or neutral. Organic agriculture is more favourable to predator species which are often involved in the biological control of pests. For soil fauna, the beneficial effects of organic agriculture occur not only in cropped fields but also in the neighbouring margins and hedgerows. Adopting organic agricultural practices will have few effects on biodiversity in simplified, intensively managed landscapes, due to a lack of source populations. However, in landscapes which retain some semi natural habitats and source populations, organic agriculture has a particularly positive effect.

The impacts of GMO's on biodiversity are specific to the varieties cultivated and to the genes introduced. In general this consists of varieties resistant to a non-selective herbicide, or made tolerant to an insect pest. In the case of resistance to a herbicide, the effects include more complete vegetation removal, including

at field boundaries. The consequences of this may include decreases in populations dependent on weedy species as trophic resources and selection for populations of weeds resistant to the molecule used. The case of varieties producing Bt toxins, which confers tolerance to some insect pests, has been the subject of numerous eco-toxicological studies and the interpretation of these results remains controversial. Finally, the possibility of the transfer of genes to other species in the field depends on the genetically modified species considered and its capacity to hybridise with wild species.

2.7 GAPS IN KNOWLEDGE ABOUT AGROBIODIVERSITY AND ITS DEPLETION

Studies of the effects of agriculture on biodiversity are numerous. However, it is apparent that few of these studies have developed generic hypothesis and theory capable of efficiently guiding public policy. There are certain reasons for this; these have been explained in the following sections.

The term biodiversity covers different biological components. The spatial scales and the levels of organization at which the effects of agriculture on biodiversity are considered, are numerous. While the theoretical frameworks exist, their capacity to structure current knowledge into general principles has rarely been tested, and they are rarely used. The ways in which agriculture, human stakeholders and their environmental interactions are taken into account is, rarely sufficient to lead to useable recommendations.

Current knowledge of the effects of agriculture on biodiversity is overwhelmingly from ecological or agroecological models and studies. Both stakeholders and socio-economic factors, despite the fact that they are often powerful drivers of biodiversity changes, are largely ignored in studies investigating the effects of agriculture on biodiversity. An understanding of sociological, economic, legal and technical processes, determinants and constraints associated to various stakeholders is desirable in order to fully appreciate dynamics of these changes.

Although there is an emerging consensus among civil society, the research community and policy makers that concrete steps must be taken to promote sustainable use of agrobiodiversity, scientific controversy remains over its meaning and how to achieve it. The International Treaty on Plant Genetic Resources for Food and Agriculture requires contracting parties to devise policy mechanisms and measures to support sustainable use. The Convention on Biological Diversity refers to use of the 'components' of biological diversity 'in a way and at a rate' that does not lead to a biodiversity decline.

Though intuitively appealing, this concept is far from operational. Biological diversity has many components whose interactions are still poorly understood; policies supporting the sustainable use of one component without full recognition of these interactions could have unintended consequences. There are at least two reasons why it is essential to integrate research about components of agrobiodiversity from a landscape or habitat perspective.

Without doubt, a holistic approach to valuing the components of agrobiodiversity will advance scientific knowledge. In addition, applied research that takes interactions among components into account could lead to estimates of costs

and benefits that differ in important ways from those that do not. Ignoring interactions among components could bias policy recommendations. For example, many small-scale farmers address multiple objectives simultaneously, such as producing grains that provide food for humans and forage for animals. By doing so, they integrate the production of two or more agrobiodiversity components i.e. crops and livestock.

In intensive farming systems too, crop products serve as inputs for both livestock and fish production, and manure and animal power also serve as an input to crop production. Planted alongside crops or intermingled within fields, some tree species contribute to favourable growing conditions in addition to supplying primary products. Thus, economic policies and development interventions that affect one component often affect another, with implications for agrobiodiversity conservation. Such connections between agrobiodiversity components become even more complex when the scale of observation and analysis shifts from farm to landscape. Habitats, both agricultural and proximate to agricultural areas, serve as focal points where multiple components of biodiversity converge and interact. Researchers have recognized that some of the most significant forces driving change in diversity levels within components are also the same across components such as the processes of agricultural intensification and the spread of market infrastructure.

Check Your Progress 2

Note: a) Use the space given below for your answer.

b) Compare your answers with those given at the end of the unit.

1) How does use of fertilizers affect agrobiodiversity?

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2) What are the major gaps in our understanding about agrobiodiversity loss?

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2.8 LET US SUM UP

- Agrobiodiversity loss chiefly comprises erosion of genetic diversity of crops, livestock and associated biodiversity.
- The loss of agrobiodiversity and the progressive homogenization of many ecosystems can be said as one of the main threats to the survival of our natural as well as socioeconomic systems.
- Since the 1900s, some 75 percent of plant genetic diversity has been lost as farmers worldwide have left their multiple local varieties and landraces for genetically uniform, high-yielding varieties.
- Of a total of 7616 livestock breeds studied by FAO, around 20 percent breeds are classified as at risk.
- The major factors leading to agrobiodiversity erosion are rapid expansion of industrial and green revolution, globalization of food system and marketing, replacement of traditional varieties by improved or exotic varieties and species, land clearing, overexploitation of species, population pressure, environmental degradation, overgrazing, and changing agricultural systems and policies.
- Agricultural intensification, and its corollary, the simplification of agricultural landscapes, are the major factors responsible for the loss and profound modification of biodiversity, in particular over the last few decades.

2.9 KEY WORDS

Millennium Ecosystem Assessment	:	A global project conducted by UNO under CBD framework to assess impact of changing ecosystems on human wellbeing.
Intensive agriculture	:	Agriculture which is based on the principle of high input and high output.
Genetic diversity	:	Diversity within a species due to variation in genetic make up.
Exotic varieties	:	Species that is not native of an area and is taken from outside region.
Organic agriculture	:	Agriculture based on use of biological resources as inputs.

2.10 REFERENCES AND SUGGESTED FURTHER READINGS

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Relevant Websites:

- <http://en.wikipedia.org/wiki/Agrobiodiversity>
- <http://www.cbd.int/agro>.
- <http://www.agrobiodiversity-diversitas.org/>
- <http://agrobiodiversityplatform.org/>
- <http://www.fao.org/biodiversity/en/>

2.11 KEY TO CHECK YOUR PROGRESS

Check Your Progress 1

- 1) Your answer must include the following points:
 - Relatively few varieties of crops or breeds of livestock are used
 - Intensive use of fertilizers which also reduce agrobiodiversity
- 2) Your answer must include the following points:
 - IPR and patenting has led to the widespread cultivation of fewer varieties and breeds
 - Marginalization of small-scale, diverse food production systems that conserve farmers' varieties of crops and breeds of domestic animals

Check Your Progress 2

- 1) Your answer must include the following points:
 - Fertilizer application has positive results on agrobiodiversity as long as this does not reach toxic levels
 - Fertilization results in disappearance of species adapted to low nutrient environments
- 2) Your answer must include the following points:
 - Human stakeholders and their environmental interactions are not adequately understood
 - Biological diversity has many components whose interactions are still poorly understood