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Teaching agro-ecology
in the transitory period
Agricultural Knowledge Systems

O3 – TEACHING TOOLS AND MATERIALS

HANDBOOK OF MODULES FOR STUDY COURSE AGROECOLOGY

AUSTRIA – FRANCE – ITALY – LITHUANIA - SLOVENIA

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		Saint Guilly (CEZ - Bergerie nationale), Mounia Khachiche (CEZ - Bergerie nationale), Lina Gumbrevičienė (PLŽMMC), Edvardas Makšeckas (PLŽMMC), Ana Vovk Korže (UM) and Janja Lužnik (UM).
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SCOPE

This document is intended to be used as a promotion of innovative agroecological approaches and as a teaching tool to introduce the diversity of agroecological approaches to training. The document summarizes some important information from the intellectual output O1 in O2 as the basis for the understanding of agroecology. In this document modules for an active experimental education of young people are presented with the aim to understand agroecology and to use it as a part of their lives and profession.

AUDIENCE OF THIS DOCUMENT

Teachers and trainers of vocational education and training

ACRONYMS AND DEFINITIONS

ACRONYMS	DEFINITION
AE	Agroecology
UM	University of Maribor, Univerza v Mariboru
EU	European Union
EU-APPB	Agricultural Policy Perspectives Brief of the European Union
Euro-EducATES	Agricultural Alliance for Competence and Skills Based Training
OF	Organic Farming
ERM	Ecoremediation
ES	Ecosystem services
WS	Working sheet
CG	Community Garden

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1 INTRODUCTION

The present document has been prepared by the project partners from five European countries: Slovenia, Lithuania, France, Italy and Austria in the frame of the Erasmus + Euro-EducATES project. The project is intended to assist teachers in disseminating practical skills in the field of agroecology and raising awareness among young people about the importance of sustainable practices in the workplace. The manual contains information about the state of agroecology in the selected European countries as well as some ‘good practice’ examples.

The term agroecology is known worldwide as an integrated system from the food production on traditional basis to alternative forms of food production and processing. Agroecology is a response to the paradox, which we have been experiencing in the recent decades. Conventional agriculture produces massive amounts of food on the expense of negative environmental impacts; nevertheless there are more and more hungry people in the world. Today's famine in the world is not the result of food under-production, but its wrong distribution. One billion people are hungry, but just as many are overweight and consequently have health problems. As the number of population is increasing, the decisive question is how to produce more food, either with chemistry or in a natural, sustainable way and thus reduce the negative impact of livestock farming on climate change in particular. Especially in poor countries poverty is still rising and the most significant climate changes are predicted to happen just there. Classical economic development will no longer be possible. The future of agriculture is in biodiversity, in agroecological farming practices, which include social, economic and environmental objectives as well as natural food production and processing (Gliessman, 2006).

The focus of Handbook is its teaching modules on agroecology. The modules can be helpful in enriching existing curricula as it includes the following topics:

- introduction to agroecology,
- 5 teaching modules focusing on key agroecological topics,
- appendix with the given examples of practical exercises and important literature.

Based on the current state of agroecology in Europe, we can see that the different partner countries have different approaches to the implementation of agroecology in practice; varying country research results are focused on different areas and there is a great diversity within agroecological education itself (link: O1 output AND O4: http: // www .euroeducates.eu / media / files / oep-o1-synthesis-of-national-reports-en-17-03-22.pdf). Therefore, the purpose of this manual is to give access to various successful practices of agroecological education and to transfer such skills and knowledge among young people in such a way that they will incorporate them into their profession or further studies successfully, regardless of the country and the level of agroecological development in their country. With this we wish to develop young ambassadors of agroecology because agriculture needs ecological approaches. This follows the recent global trends showing the importance and interest in sustainable ways of using natural resources and coexisting in nature.

1.1 Agroecological educational approaches used by the partner countries

In Austria Education on related to AE and OF is prolific in Austria at many levels. At the tertiary educational level, The University of Natural Resources and Life Sciences has recently developed the master program Organic Agricultural Systems and Agroecology, designed to offer holistic education related to all aspects of the organic sector and AE.

The College for Agrarian and Environmental Pedagogy strives to educate and prepare students for a life of green teaching or green jobs. They specifically focus on agriculture and environmental education.

There are a variety of vocational training schools and vocational higher-education schools located mainly in the countryside. The Organic Vocational School of Schlägl is dedicated to organic farming and shares AE goals. It was the first farming institute in 1924 in Austria, and in 2002 it was transitioned into a school specifically for organic farming and its connections to regional development as it is located in the BIOREGION Mühlviertel/Oberösterreich. It predominantly houses students from the 9th-11th grades and offers a boarding school option, so students from all regions can partake in the curriculum. There is also a smaller adult program available. The school focuses predominantly on practical examples and learning by doing. These educational methods help prepare technically and professionally trained graduates. The school hosts the Organic centre of excellence, which completes many practical projects. The centre was founded in 2011 by the Alumni Union of the Bioschule and FiBL Austria and is financially supported by the regional government of Upper Austria.

In France the "Teaching how to produce differently" action plan aims to accompany the “agroecological transition”, technical agricultural education and helps school teams to develop adequate tools to ensure this transition. This plan, divided into regions, seeks to involve the country’s whole educational community to: intensify exchanges with the partners and territories; strengthen regional governance in order to engage and coordinate schools and their respective initiatives and ensure the following of the plan and its evaluation. To do so, a network of 130 regional advisors was settled to aid institutions in the implementation of their agroecological projects. To accompany these developments, training facilities have been updated. Indeed, in France, and more specifically in technical agricultural education, training facilities and their educational content favour multidisciplinary approaches to introduce agroecology.

Nevertheless, an important place is also dedicated to organic agriculture, in which the double entry, system and specific techniques are privileged. The focus is on field approaches thanks to the schools’ farms. In the same memorandum are also specified, the conditions for the settlement recognition of the trainings turned towards organic farming. These conditions enable volunteer schools to base some of their courses on organic agriculture relying on the school farm or a nearby farm, as well as on the participation of professional organizations specialized in organic farming related to the school’s relevant institutions.

In Italy the education and training offered in agroecology and organic farming is very high and distributed at all levels of education, from primary schools, secondary ones, up to university careers and the Masters of Science in Agroecology.

The University Sant’Anna of Pisapromotes a course on “applied agroecology” targeted to undergraduate and post-graduate, an international PhD Programme in Agrobiodiversity and research activities on the Management of functional biodiversity at species and habitat level for the provision of agroecosystem services; agroecological management in low external input (LEI) and organic cropping and farming systems; integrated pest and weed management.

University of Florence (UNIFI-DISPAA) offers courses for a number of programs at the School of Agriculture of the University of Florence and other public and private bodies in Italy.

The international Master of Science in Agroecology designed the programme in order to best integrate the skills of the different universities in the field of Agroecology and The Mediterranean Agronomic Institute of Bari (MAIB).

Among the pedagogical initiatives we can highlight the agroecological food garden promoted by Slow Food, during the 2015 Expo in Milan. It was a laboratory that gave visitors plenty of inspiration to create their own food gardens, to learn how to grow raised beds or in manage pots on a balcony. The initiative, which was very successful, continues to expand thanks to the Slow Foods association. The garden is a site for on-going education. Wandering past the beds, you can pick up essential tips on how to create a garden using an agroecological approach, while discovering the functions of different plants, understanding the best techniques for planning and cultivation, seeing how flowers can help protect crops from harmful insects and learning how to naturally enrich the soil.

In Lithuania AE is a topic that has yet to be elaborated at the pedagogical level. There is currently no curriculum directly linked with agroecology at any level of formal and informal education. However, there are few classes and programs within each educational level linked with organic farming and/or ecology (AIKOS, 2016; PLZMMC, 2016).

In Slovenia several institutions deal with education in the field of sustainable forms of agriculture and food production. The agricultural faculties have education programs at all levels of Bologna study programmes, which form the profile of an expert with the necessary general professional as well as completely specific skills. A number of faculties and institutes also perform informal forms of training, education, designed primarily for adults in the context of lifelong learning. Particularly interesting in this context is that these non-formal forms of education attend public institutions with its employees, because they want to gain practical and useful knowledge for their institution as well as for their private life. Although often informal forms are not compulsory, they are attended by young interested individuals who are actively contemplating the creation of their own jobs in which theoretical knowledge often found in school is not enough for them. The students and pupils have opportunities to learn about AE principles mostly within informal educational programmes based on learning by doing methods. A good example experiential education and understanding more sustainable agricultural approaches and AE is the learning polygon Dole for self-sufficiency based on permaculture, as the only one of this kind of approaches in Slovenia, where development of new knowledges based on AE approaches.

1.2 Understanding agroecology in projects countries

As discussed above, agroecology is a multidimensional concept that includes science, social movement and agricultural practices. These dimensions interconnect the knowledge of different technical and social sciences and influences different stakeholders from producers to consumers. The modern trends of teaching agroecology are based on a systemic approach that enables observation and analysis of complex situations in agriculture and food systems. The research and teaching of agroecology stems from sustainable agriculture, which deals with biodiversity protection, concern for fresh pure water, limited natural resources, the availability of agricultural land, food security, social justice and adapting to climate change, among others, which increasingly and drastically affect the production of the quality food. With innovative pedagogical approaches and alternative research methods, the experts in the field of agriculture and food production systems deal with more extensive systemic issues in order to achieve efficient use of renewable resources, food security in modern society, and the resilience of production systems to adverse conditions (Francis et al., 2011).

The systems approach in agriculture is a multi-perspective way of seeing the world, distinct from that employed by single disciplines. Holistic thinking requires a systemic approach to observing and analysing complex situations in agriculture and food systems. While research on individual components of a system is often essential, this work is most valuable when conducted with an appreciation for and the whole system in mind. When looking at the likely impacts of a new high-yielding wheat variety, for example, it is important to consider the prices and long-term availability of needed inputs, the impacts on the local and regional environment, and the social consequences of introducing this variety, such as farm size, concentration of markets, and distribution of benefits. These are factors not often considered by the plant breeder who is closely focused on the goal of increasing genetic production potential. Agroecology provides a framework within which to study the multiple consequences of the new technology introduction (Francis et al, 2011 p. 4,).

Numerous research and experiences in modern teachings of agroecology have shown that pupils learn most from various practical and research activities, which include case studies and collaboration with different stakeholders in the local environment, e.g. teachers, parents, experts, local farmers, etc. This makes it easier for them to understand the complexity of systems that include the environmental, social and economic dimension. It also gives them a sense of responsibility when executing and completing their projects. Learning agroecology is based on the so-called experiential learning in real-life situations, the key approach being " learning by doing " as justified by John Dewey (Francis et al, 2011). This approach enables young people to develop critical thinking skills and the ability make independent decisions on finding solutions and taking measures to solve real problems in their everyday life and the local environment. While the teacher takes up the role of a mentor, mediator and observer through the learning process, he also encourages and directs students to find a solution for themselves (Leiblein at all. 2012).

This handbook is designed in such a way that education of agroecology includes observation, discovery and research, interactive learning, cooperative learning in smaller groups, learning by doing, project design and consequently cross-curricular integration. The learning process is not only acquiring new knowledge, skills, competences and habits, but also the progressive change of each individual based on their own activity, where their already acquired knowledge can be integrated and upgraded with new knowledge.

1.3 Integrating practice in education

Practical education in the field of agroecology can be implemented as a practical lecture (in school), or as a practical work experience (among employers). Schools can connect the content of agroecology to all subjects and offer them as additional options of practical education. The modules in the manual can be used separately and independently by the teachers or parts of the modules can be included in the contents of the treated subjects during the lessons. The contents of the modules are designed to promote practical work, so they can be also used to activate education in nature, for field research, and for connecting schools with the environment.

1.4 Forms and methods of work in the Handbook

In practical training, the emphasis is on cross-curricular integration. We can often organize teaching in the form of project work and it is necessary to predict in advance the scope of this type of work for the preparation of both students and teachers. In this way the learning activities allow the students to develop the elements of learning through research at school, from task planning and collecting data to formulating findings and presenting the results. The approach is based on an independent learning process and also in the form of discussions, team field-activities and interactions with stakeholders on farms and in the community, self-reflection of the learning process and evaluations of the newly acquired knowledge.

The activities are set up so as to encourage learning based on mutual cooperation among students, departments, teachers and the local environment. The contents of the learning modules are designed to enable transfer and can be used in different environments. The emphasis is on the flexible understanding of agroecology and on broad possibilities of using these contents in class, as shown in Figure 1.

Figure 1: Some possibilities of practical agroecological experiences.

1.5 Teaching modules of partners countries

1. Module: France – **Food self-sufficiency in breeding system at a territory scale**
2. Module: Austria - **Community gardens**
3. Module: Lithuania - **Ecovillages**
4. Module: Italy - **Biodiversity**
5. Module: Slovenia - **Secrets of the soil**

The five different modules in the Handbook are based on practical approaches. The main purpose of through the Erasmus+ Euro-EducATES project developed teaching tools, which includes a written document, audiovisual material and e-learning material is to present agroecology as a sustainable approach for ensuring local self-sufficiency through protecting the environment, promoting rural development and the survival of smaller farmers. In terms of content, these practical approaches are also related to everyday life situations, which pupils already know at least partially; these situations enable the exploration of processes, materials, different phenomena and legality. The manner of experiential learning and research depends on the pre-knowledge of students, motivation and the needs, which we want to achieve.

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2 DEFINITIONS OF AGROECOLOGY

The understandings and meanings of AE differ regionally due to varying agricultural, environmental and political contexts (see table 1). Stemming from a healthy scientific debate AE has burgeoned through the mainstreaming of agroecological approaches in recent policies, e.g. the greening of CAP 2014-2020 (EU-APPB Agricultural Policy Perspectives Brief of the European Union, 2013). Its proliferation of use is, however, perhaps obfuscating its various definitions.

Altieri, 1987: 6	"A discipline that defines, classifies and studies agricultural systems from an ecological and socio-economic perspective."
Altieri, 1995: 4	"The application of ecological concepts and principles to the design and management of sustainable agroecosystems."
Francis et al., 2003: 2	"The integrative study of the ecology of the entire food systems, encompassing ecological, economic and social dimensions."
Dalgaard, Hutchings and Porter, 2003: 39	"An integrative discipline that includes elements from agronomy, ecology, sociology and economics", "the study of the interactions between plants, animals, humans and the environment within agricultural systems."
Wojtkowski, 2004: 10	"The interactions among natural processes in artificial systems designed to meet human goals."
Gliessman, 2007: 18	"The science of applying ecological concepts and principles to the design and management of sustainable food systems."

Figure 1: Selected definitions of agroecology (Wibbelmann et al., 2013, p. 3)

Recent literature has helped define and categorize different understandings and definitions of agroecology. In Wezel et al. (2011) the authors systematically categorize different perspectives of agroecological traditions in various key playing countries. They describe the different traditions of AE through examples from these key countries. The three categories given are AE as a scientific discipline, a movement, and a practice and their meanings are described below in Figures 2 and 3.

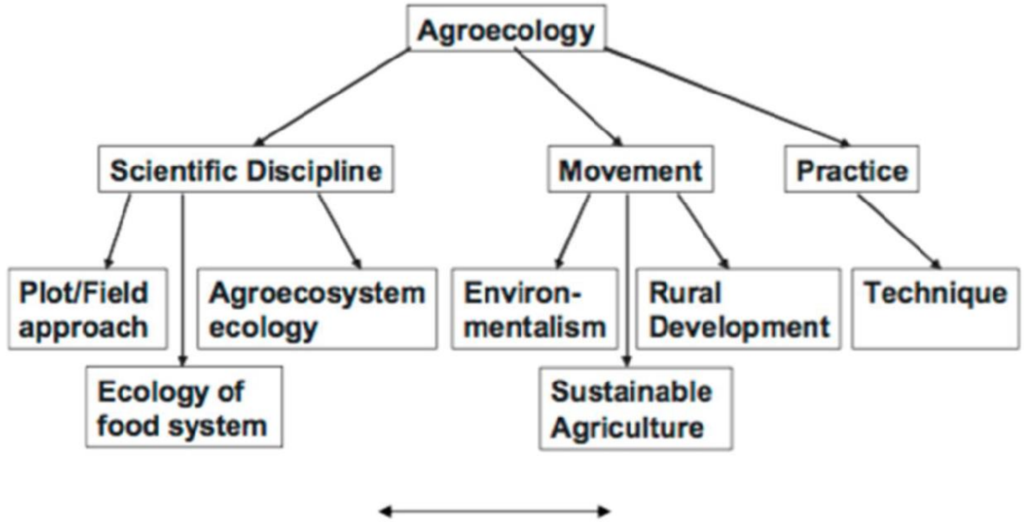

Figure 2: The diversity of current types of meanings of agroecology (Wezel, et al., 2011, p. 3)

2.1 Historical development of Agroecology

Agroecology is recognized as a path to sustainable agriculture. In adapting to climate changes and in implementing sustainable approaches to the economical use of natural resources, agroecology is gaining an important role as a combination of science, practice and sustainable movements. This leads to the decline of conventional farming, which has a negative impact on water, soil, air and the entire natural system.

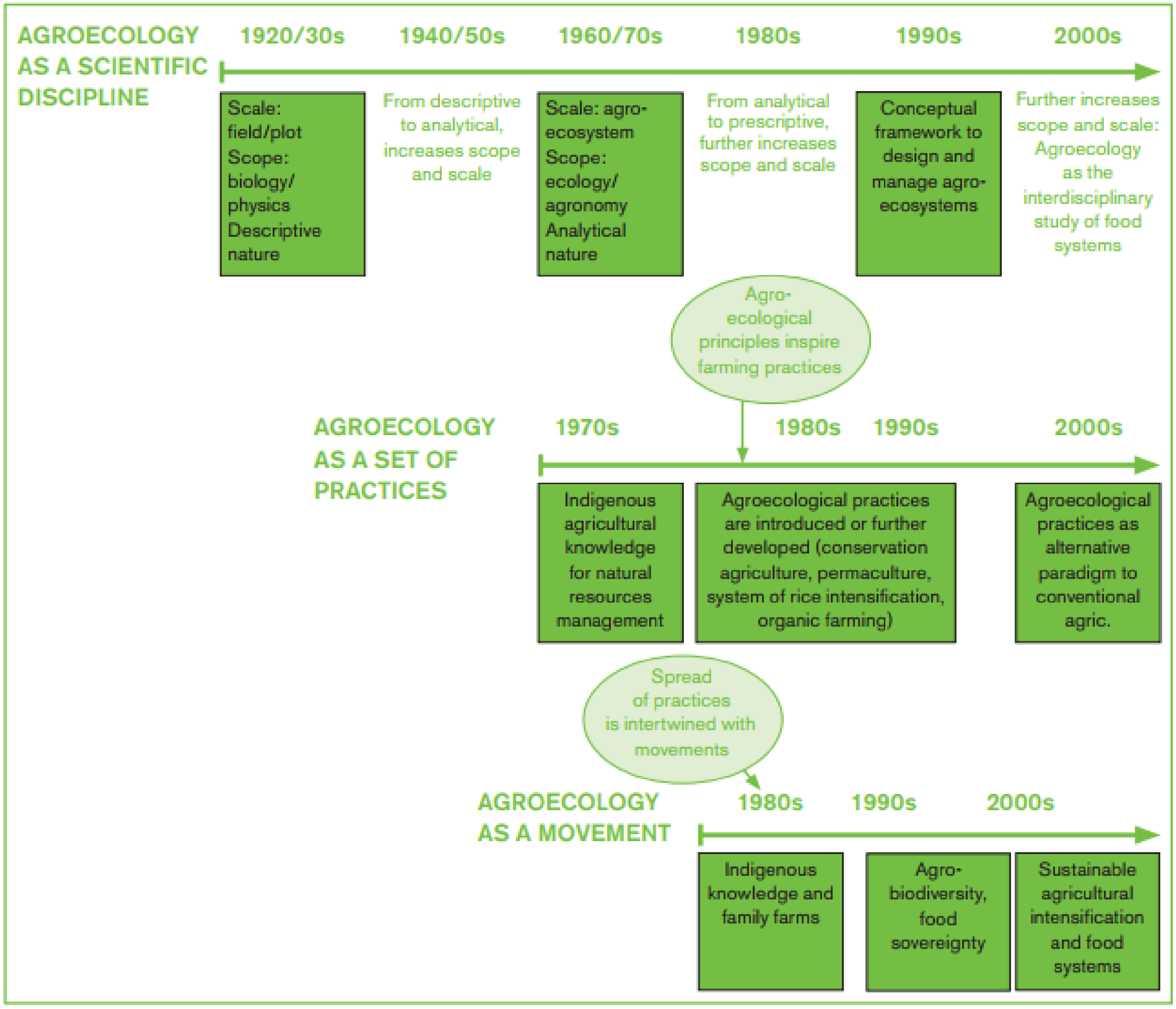

Figure 3: Temporal changes in scale and dimension of the definition of agroecology and in applied researches (Scilici, 2014). Source: http://pubs.iied.org/pdfs/14629IIED.pdf

On the website www.agroecology.org.we can find the interesting representation of agroecology in the world. We find that agroecology today appears in response to emerging conflicts in nature and society, and as a different - alternative way of farming. Agroecological methods should activate traditional practices and link them with innovations, knowledge and new skills as well as people's attitude towards food with emphasis on healthy and locally produced food. The approaches in agroecology are the most developed in France, which is the leading country in planning, education and implementation of such activities in practice. In the French Action Plan, the Ministry of Agriculture noted the importance of agroecology as an all-encompassing process until 2020, when France becomes the leading country in this field and will integrate farmers into the agroecological farming (Loi d'Avenir, 2014). The implementation of agroecology was based on farmers' education, activation of the research and acquired knowledge transfer into practice. They are developing agroecological subsistence systems, including the public and monitoring the effects of agroecology in practice (monitoring and evaluation). They devote a lot of attention to education, especially in the field of professional qualifications. In Italy, in 2016, agroecological approaches were classified as mandatory in the organic food production and agroecology was enacted by regulations. The main emphasis now is on the awareness that farms must function as holistic ecosystems. As science, agroecology is part of ecology or landscape ecology, which deals with ecological conditions and processes in agro-ecosystems and with agricultural ecosystems as whole. It does not apply only to agricultural use, meadows and fields for example, but also deals with forests, swamps and processes of degradation, erosion and the outflow of water (Vovk Korže, pp. 6, 2016).

The definitions of the term agroecology differ greatly in terms of specificity which defines the term 'ecology'. According to this definition agroecologists can study the state of soil health, water and air quality, meso- and micro-fauna, local plants, toxic substances and other natural contents. A more common definition of the term can be found with authors who see agroecology as a study of interactions between plants, animals, people and the environment in agricultural systems (Loi d'Avenir, 2014). Therefore, agroecology itself is a multidisciplinary science including factors from agronomy, ecology, sociology and economy. Agroecology is also differently defined depending on the geographical location. This approach is the result of understanding the ecosystems as elaborated by Eugene Odum (Odum, 1983). His approach is based on the assumption that natural systems with their stability and resistance are the best model for imitation in agricultural ecosystems. Usually the ecosystems of agroecology are not actively involved in social sciences, however, this school is based primarily on the belief that large-scale farming with massive use of chemicals is detrimental to society. The basic approach of agroecology is derived from agronomy including traditional agricultural practice, which is considered as the heritage of the area (Vovk Korže, pp. 7, 2016)

The concept of agroecology appears to be replacing the concept of sustainable development, which has not brought about any significant changes in the recent decades. In agroecology the focus is on using sustainable practices for food production (organic farming). Agroecology is therefore the type of farming that supports nature and does not reduce its ecosystemic benefits and services. It includes ecology also in its products and uses a holistic approach from cultivation to processing. It links ecology with culture, economy and society with the aim of creating a healthy society (http: // www.moreandbetter.org/en/news/a-viable- food-future). Such systems are characteristic of agricultural areas in African and Asian countries, where they provide themselves with food and energy completely. The use of agroecology increases the soil fertility; the soil becomes more resistant to drought and climate changes, the communities are more connected and positively affect the entire ecosystem (water is retained by vegetation not using artificial irrigation and pesticides) (Vovk Korže, pp. 7, 2016).

Agriculture and food production are the basis of life and have multifaceted effects on society. They have an important influence on prosperity and hunger, on climate changes and the environment. They both involve women workforce and offer a variety of jobs. Agroecological production involves the local environment and seeks solutions on the local level (Vovk Korže, pp. 7, 2016).

The concept of agroecology may seem complicated, but in reality it is clearly based on skills and knowledge, efficient use of resources to the maximum, problem solving and reducing the costs (http://www.moreandbetter.org/en/nevs/a-viable-food-future). This requires constant adaptability and innovations. The transition to green agriculture is beneficial to all and allows local communities to plan and create their own development. The quality of food depends on the way how it is produced and directly affects the health of all living beings (Vovk Korže, pp. 8, 2016).

In order to apply the principles of agroecology it is important to know the holistic sustainable production system based on traditional knowledge and local experiences, which needs to be upgraded with modern ecological, social and agronomic knowledge. The purpose of this approach is also to preserve and improve agricultural production, to ensure a healthy natural and living environment and to provide quality food as well as maintaining self-sufficiency of local communities (Vovk Korže, pp. 9, 2016).

The agroecological system can operate on various levels, either on the field, garden or farm level, local community or in the entire region or state. The essential agroecological strategy of creating a stable system is based on the integration of diversity in the agricultural land and the local landscape. The diversity on the field level or farm level is understood as species diversity, crop rotation, polyculture instead of monoculture, forestry, a combination of agriculture and livestock farming, the use of green manure plants and drapes. On the landscape level it is the establishment and maintenance of a system of green infrastructures, which is co-shaped by borders, wind-barriers, ponds, grass belts, bypass and water corridors. These stable and varied agroecological systems boost the improvement of soil quality, resistance to disease and higher productivity of crops as well as preserve the nutrients.

With the help of agroecological arrangements on the micro-level, i.e. in the garden, field or the entire farm, we adapt to the natural factors as much as possible and use natural local renewable sources. We use natural resources such as solar energy for heating water and electricity, we collect and reuse water sources such as spring water or rainwater and use the energy of soil to store seeds and crops. This reduces the need for external energy inputs and reduces the operating costs of farming. (Vovk Korže, pp. 9, 2016).

We use the excess of biomass for composting purposes and return it to beds after a year. Compost will additionally retain moisture and consequently we will improve the quality of the soil. To cover the field surfaces, use a hay or straw mulch, which prevents the growth of weeds, keeps moisture and improves the soil, therefore no earth-working machines are required. As for simple garden arrangements, such as shaft beams and other supporting garden elements, recycled natural materials can be used. We can also include useful organisms in the farming system, which are attracted by properly regulated housing and food sources. With such agroecological approaches we will conclude a series of natural processes in the garden or in the field and strengthen the natural system to remain self-sufficient and resistant to external negative factors such as weather disturbances, pests and diseases. The nature will reward us with the abundance of quality crops that will help us live healthily (Vovk Korže, p. 10, 2016).

At macro level, agroecology is becoming more and more established as a way of living and functioning of the community, and as responsible management of natural resources (Vovk Korže, p. 10, 2016).

Agroecology is based on scientific and traditional knowledge. It is a science that bridges ecological and socio-economic aspects. It can work at various levels – farm, community, national, regional, etc. Biological processes are enhanced using agroecological principles and these principles can be shared via farmer-to-farmer exchanges. Agroecology needs to be built from the bottom up, especially through social movements in rural areas. https://agroeco.org/wp-content/uploads/2015/11/Agroecology-training-manual-TWN-SOCLA.pdf

Agroecologists often see the addition or the umbrella of agroecology to organic agriculture as a possibility to further guide the current organic system by including additional agroecological principles. Because of agroecology's distance from institutionalisation to the extent of organic with standards, regulation, certification, and political agendas, it is also seen as a possibility to circumvent some of the economic and institutional interests and to replace resulting hindrances with possibilities that come from a less manipulative form of sustainable agriculture (Altieri & Nicholls, 2003). Agroecology is seen by some as a possibility to rescue organic farming from the risks of conventionalization.

Climate change, altered global water, cycle, human migration, population growth, urbanisation, food production and food security, energy and natural resource management are interconnected and intertwined and therefore they cannot be addressed separately. Policies are essential instruments for promoting the sustainability of landscapes, agriculture, cities and rural development.

Cooperation is required at all levels and especially among different sectors in order to ensure that agriculture, forestry and fisheries policies are planned and integrated within national development strategies and complimentary to trade, environment, climate and energy policies, to name but a few policy areas. More importantly, policies must reward sustainability and support continuous improvements.

In the EU countries there are different definitions of agroecology, different public policies implemented to encourage the agroecological transition of agriculture and different consequences on research and training activities as summarizes the first intellectual output O1(Basile, S. 2017: O1 - Aggregation). http://www.euroeducates.eu/medias/files/oep-o1-synthesis-of-national-reports-en-17-03-22.pdf

In Austria, agroecology is at a crossroad (from science to movement), it is inherently connected to the organic farming (as in Italy, Lithuania and Slovenia) and there is a significant experience of organic territorial approach in the province of Upper Austria (Bioregion Mühlviertel). The model of Eco (Bio)-region is very popular in Italy, too. An important lever for the development is represented by the "Bio-Aktionsprogramm 2015-2020". The Agri-environmental Programme allowance for less-favoured areas, a "biobonus". Furthermore, agroecology may benefit from the popularity and acceptance of the Organic movement. However, the distance of agroecology as a science to agroecology as a movement must be bridged in order to have successful future.

In France, agroecology is central in public policies (at central and local level), there are specific national programs and action plans. The public policy project "Agroecology, a new production paradigm" aims to promote the evolution of French agriculture into agroecology (the agroecological transition) and the development of practices and innovative systems to achieve the triple performance (environmental, economic and social). This project is accompanied by a second action plan "Teaching agroecology, a new production paradigm". In order to standardize the range of meanings relating to agroecology, an official definition was written. As in Austria and Italy, there is a significant experience of Eco (Bio)-Region, BioVallèe, in the Drôme Valley. The ambition is strong but the "weight" of conventional sector can be an obstacle to the generalisation of the organic.

In Italy, agroecology is considered today a transdisciplinary field of enquiry that is capable of changing our common vision of both agriculture and society (Caporali). There isn't a national programme. The Agroecological transition (in particular with organic farming) started from the farmers, without public support, rather to respond to consumer's demand. The organic sector shows concrete agroecological solutions for agriculture and food systems. The Bio-districts experience, originated in the year 2004 by

AIAB Campania in Cilento area (Province of Salerno), is today spreading across the country (15 Bio-districts in 10 regions).

In Lithuania, the agroecology is not a priority area of the national policies; however the sustainable agriculture and sustainable rural development are defined as a priority. The organic farming has a history of 25 years in the country. The number of organic farms increases due to support by the European Agriculture Fund for Rural Development, mainly. The Lithuanian Institute of Agrarian Economics implemented a project on the ecovillages. The aim of the project is to collect experiences and good practices in the Baltic Sea area and foster the development of ecovillages as a more sustainable way of living in the region.

In Slovenia, the agroecology as a sustainable agriculture concept is not officially applied in the strategic policy, but some sustainable principles linked with agroecology are already carried out, especially at local and regional level, mostly due to the preserved traditional agricultural management and knowledge of small family farms. Organic farming is gaining increasing importance in the Slovenian agricultural area. Alternative sustainable agriculture practices, such as biodynamic and permaculture, have gained a big support mostly among the general public and local farmers.

Despite the variety of definitions of agroecology, it is possible to identify several common principles: harnessing ecosystem functions to the maximum possible extent, maximising functional biodiversity and strengthening biological regulation in agro-ecosystems in order to sustainably reconcile social, economic and environmental challenges

To understand more the interpretation, understanding of different approaches and trends of environmental policies towards agroecology among European project countries, please find a link to the publications page of the Euro-EducATES website: *http://www.euroeducates.eu/en/pages/publications-english.html*

List of typical agroecological principles:

http://www.bartstaes.be/images/bartstaes/AgroEcologie/3.%20Agro_eco_inno_What_is_agro-ecology_BM_13Jul12.pdf

- Recycle biomass, optimise and close nutrient cycles;
- Improve soil conditions. This means in particular improving organic matter content and biological activity of the soil;
- Reduce dependence on external, synthetic inputs;
- Minimise resource losses (solar radiation, soil, water, air) by managing the micro-climate, increasing soil cover, water harvesting;
- Promote and conserve the genetic diversity of crops and animals;
- Enhance positive interactions between the different elements of agro-ecosystems, by (re)connecting crop and animal production, designing agro-forestry systems, using push-and-pull strategies for pest control;
- Integrate protection of biodiversity with production of food;
- Integrate short-term and long-term considerations in decision-making. Aim at optimal yields rather than maximum yields. Value resilience and adaptability;

- Contribute to the transition towards sustainable agriculture and food systems. Identify lock-ins that impede this transition and propose pathways to unlock them. Propose new governance structures that support innovative niches of sustainability;
- Acknowledge the similarities and linkages between agricultural systems in the global North and South. The North can learn from agroecological experiences in the South and vice versa. Because of the increasing globalisation, the transition towards sustainable food systems asks for integrated and simultaneous solutions in North and South;
- Investigate existing power relations, decision-making processes and opportunities for participation in food systems. Investigate the role of citizens and consumers in food systems;
- Valorise the diversity of knowledge (local / traditional know-how and practices, common knowledge and expert knowledge) in the definition of research problems, the definition of the people concerned, and in finding solutions;
- Promote participatory research driven by the needs of society and practitioners, while at the same time guaranteeing scientific rigour.

Develop knowledge and innovation systems that conserve and allow exchange of agroecological knowledge. Special attention should be paid to local knowledge, which is a scarce resource in itself and due to its specificity is difficult to disseminate. Agroecology faces the task of reclaiming ‘innovation’ for knowledge production and policy support. This includes innovation across the entire agro-food chain, linking farmers with other farmers and with inputs of natural resources, as well as consumers who support agroecological methods. Such initiatives act together to challenge the dominant models of innovation and agriculture. Agroecology embraces other forms of innovation, alongside the technological-scientific:

• Know-how innovation: the development of new management approaches and the introduction of both new and traditional knowledge related to methods and practices.

• Organisational innovation: introducing changes to the actual patterns of management and cooperation, right across the agro-food value chains as well as between the farmers that share common landscapes.

• Social innovation: changing the behaviour of groups in society, while maintaining or strengthening cooperation within farmers’ networks, for example empowering primary producers’ vis-à-vis input suppliers and retailers, and altering the relationships between companies and the general public (IFOAM EU Group et al, 2012. p. 34).

http://www.ifoam-eu.org/sites/default/files/ifoameu_policy_ffe_feedingthepeople.pdf

2.2 Innovation in agroecology

Innovation in agroecology seeks to make the best use of biodiversity and other ecological services while contributing to an equitable development of rural areas and establishing trust in the food chain. Farmers, consumers, other actors throughout the food chain and rural communities need to be involved in the whole system and not only be seen as end-users of knowledge.

The development of innovative practices that improve the triple (environmental, economic and social) performance of farms (Alim'agri, 2016) is necessary not to freeze the systems and practices but to resort to agronomic or organizational innovation. This implies the implementation of techniques offering alternatives to those developed during the intensification of agriculture (products plant, chemical fertilizers, grubbing-up of hedges...) and allowing the good functioning of agro-ecosystems. Researchers and farmers are experimenting and imagining new systems based on agricultural innovations such as the use of bio-controls, the search for autonomy.

The innovation needs to be boosted throughout European agriculture and for this reason the European Innovation Partnership for Agricultural Productivity and Sustainability (EIP-AGRI) was established in 2012. The European Innovation Partnership: opportunities for innovation in organic farming and agroecology help to generate new insights and co-ownership. It mobilises scientific and practical knowledge to foster innovation improves the speed of uptake of solutions by practitioners and helps to better target the research agenda towards practice needs. It is about bringing expertise from the worlds of farming and science together to learn from each other and develop ideas, knowledge and innovative actions together. It aims to build bridges between science and practice, in particular through practical innovation projects, bottom-up approaches, partnerships and networking activities. It is about growing an innovation culture in European farming that embraces the sector in all its diversity and which is not blind to the prospects that lie in traditional and practical knowledge.

http://www.ifoam-eu.org/sites/default/files/page/files/ifoameu_research_eip_dossier_en_201402.pdf

A transition towards more sustainable agriculture can only be achieved if the proper policies are put in place. It also requires political interest from the stakeholders and their active engagement in order to implement such policies as presented in Figure 4.

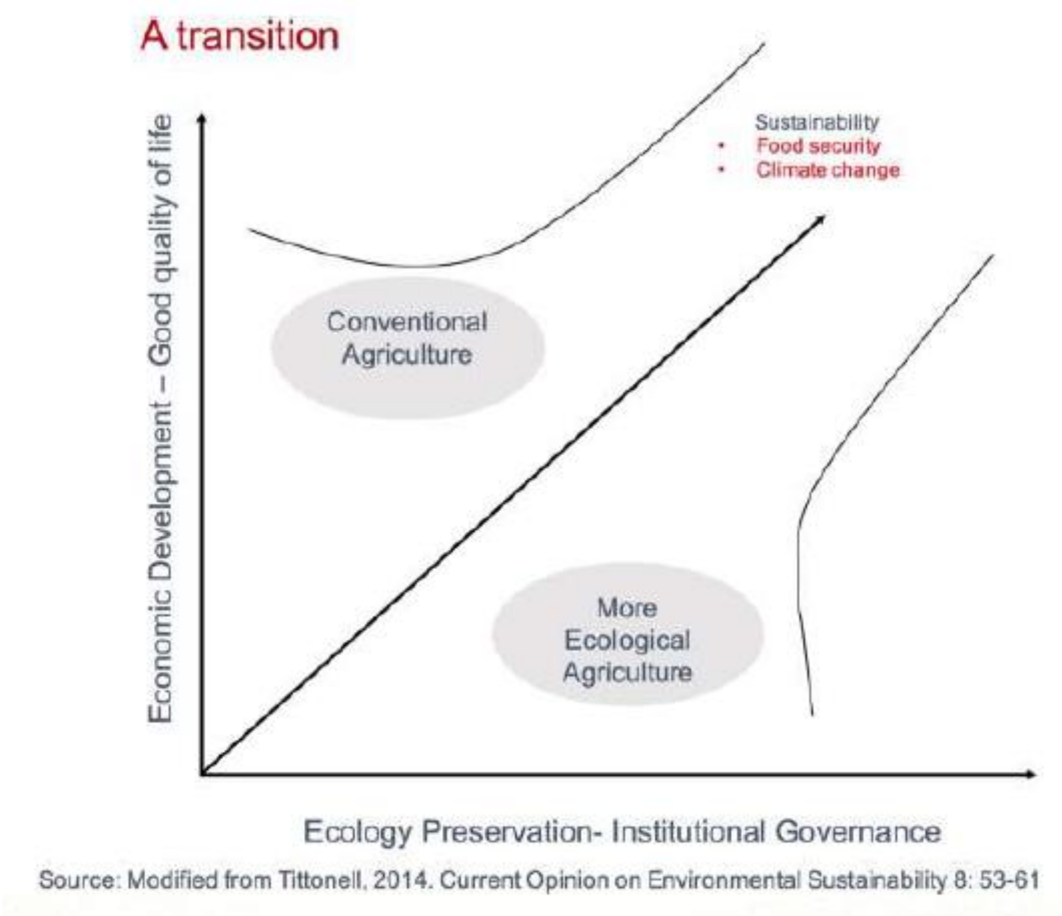

Figure 4: Transition and sustainability

Recommended literature

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Online sources

- Euro-educATES intellectual output O1: O1 - THE VARIOUS APPROACHES OF AGROECOLOGY IN THE DIFFERENT COUNTRIES.SYNTHESIS OF THE NATIONAL REPORTS AUSTRIA – FRANCE – ITALY – LITHUANIA – SLOVENIA. http://www.euroeducates.eu/medias/files/oep-o1-synthesis-of-national-reports-en-17-03-22.pdf
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3 MODULES

3.1 MODULE: FOOD SELF-SUFFICIENCY IN BREEDING SYSTEMS AT A TERRITORY SCALE (FRANCE)

3.1.1. THEORETICAL INTRODUCTION INTO THE MODULE

In the order to become more sustainable and agroecological, farmers want to increase their autonomy. It involves different changes: to buy less input (fertilizers, food…), to diversify the productions, to become more resilient. When they diversify the productions, the farmers can produce by their own the products they need, like food for the herd. It also enhances the possibility to have income from different sources. So the farmers are less dependent of the price volatility. To make farms more resilient facing economic and climate crises, it is important that they develop their autonomy. This can be reflected across the territory.

We can define a territory as a region, an area where the farmer can influence, where he can interact with the other stakeholders (farmers, consumers, representatives…), where the practices impact the environment, the economy and the social relationships.

Thanks to this module, we deal with the concept of autonomy and especially with the food self-sufficiency of the herd.

Farmers can think this self-sufficiency at different levels. At the farm level, farmers can think their practices and their system in order to reach this autonomy. That can involve, for example, an optimization of the pasture, a better quality of the harvested forage and protein production on the farm thanks to legume, protein and meslin (grain or forage) crops. Optimization of rotations (longer and including legumes), implantation of covered soybean, the repurposing of manure and compost can also help. Those practices have both economic advantages (stability, resilience) and environmental (maintainance of the grassland).

The food self-sufficiency of the herd can also be developed at the territory level with different actions: production and purchase of local foods, training of different stakeholders, groups work and exchange with other farmers, trades on the territory. That has both economic advantages (stability, resilience) and environmental (keeping of the grassland).

The scale of thinking should not be limited to the farm but must extend to the territory in order to create a global coherence. Once new practices and systems are tested and knowledge is developed, it is necessary to communicate to the greatest number, in order to promote agroecological transition.

This module also enhances the important of the group work, of the link to the territory and of the complementarity between the different productions on various scales. Students will both work on a technical approach with innovative practices of management of the herd food, and on a social approach with the study of the relationships between the stakeholders of a territory.

In France in the public policy project "Agroecology, a new production paradigm", one of the levers of the agroecological transition is the establishment of economic and environmental interest group

(EEIG), grouping of farmers working together to develop their systems and practices is aiming therefore to promote sustainable and transferable farms through collective action. The EEIG is therefore taking part in two large axes that are:
- Being a collective that allows securing farms and projects that could not emerge individually.
- Improve the autonomy of farms (economic, environmental and social performance).

The agroecological transition means more or less important changes in practices and systems. But these changes should be thought and tested. There is often a real risk to embark on an uncharted path. Collective work, thus, brings an interesting solution for the progress in the research of new systems.

This module is a proposition for the teachers and the trainers. It is possible to use all the module or some parts and activities regarding the context of the teaching. The user can use other resources as supports (article, video…). It can help to work more precisely on relevant issues linked to the context. It can also help to show the diversity of technical aspects linked to this topic.

Resources

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Figure 5: In the order to become more sustainable and agroecological, farmers want to increase their autonomy, especially with the food self-sufficiency of the herd.

Module Title Hours: 30 Lecture: 2 Exercise: 4 Self-study and activities: 10 Preparation for contact time: 10 Report preparation: 4	**Food self-sufficiency in breeding systems at the territory scale**
Interdisciplinary connections	Learning activities connected to agronomy, livestock production, organic approaches in plant production, organic farming, systemic approach, highland areas, less populated areas, experimentation and innovative practices, collective work, links between the different stakeholder of an area.
Results of the module	Students will learn what food self-sufficiency is in breeding system at various levels (farm, municipality). They will understand it is important to consider this self-sufficiency at different levels (farm and territory). They will also be able to detect the impacts of this self-sufficiency in different aspects: ● The environment: to talk about traditional and innovative practices and their impacts on the natural resources, ● The economy: to understand the reduction of the inputs and the resilience of the farms, ● The social: to detect the impact of a collective work between farmers to change the systems. In a more practical way, students identify the different agricultural practices to set up (link to the quality of the harvested forage and to the protein production on the farm). They analyse the food requirement of the herd and the offer on the farm or the territory. They will understand the overall functioning of the farm and the links between the farm and the territory.

<table>
<tr>
<td>Teaching approach and didactics</td>
<td>
In this module, we focus on technical aspects but also on a social approach. How are the innovative practices developing on the territory thanks to a collective work of the farmers?
In agroecology, there is not only one solution to solve a problem. Various practices and changes can be set up regarding on the context. Experimentation and study of the failure help to learn.
So, it may be interesting to start from observations, field visits, and exchanges with farmers, experience of the students. Then, guiding by the teachers, the students can discuss from all the information, work in group and work with case studies.
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<tr>
<td>Contexts

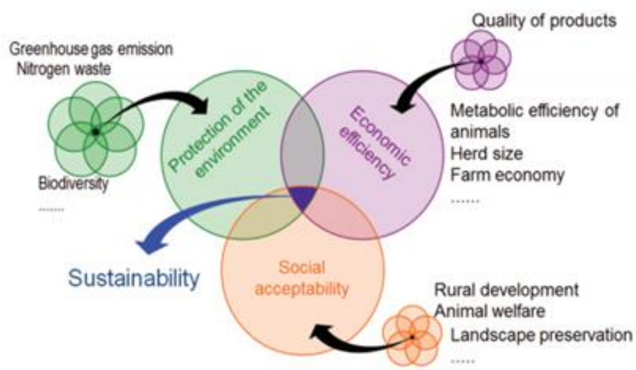

Figure 6: Sustainability of livestock is a multidimensional approach with 3 major dimensions, which result in turn from the aggregation of criteria.</td>
<td>
Working in group allows different things to the farmers, dynamic and motivated stakeholder of the territory. They can share experience and practices and have different points of view on their systems. These interactions help to rethink the systems and to solve the problems. This organization also allows to experiment innovative practices and to share the risks. It is easier to test changes together than alone. If a farmer wants to develop innovative agroecological practices alone, it can be confronted to difficulties on different aspects:

Economic: a change in the system management and in the practices can involve heavy investments.
Acceptability: it can be hard to change the system in a territory if the other stakeholders are not involve in the same change and do not understand it.
Technical: in some case, innovative agroecological practices include new skills and knowledge. Famers have to know experiments and understand them.

Thanks to the groups work, farmers can overcome these difficulties. It allows them to develop together changes and new systems. It also facilitates the communication and the acceptability
</td>
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	of the changes if there is a collective dynamic about the topic. Developing food self-sufficiency has different benefits for the farmers at different scales: 1) On the farm: ● When farmers produce their own food for the herd, they buy less input and become more independent from the prices and the animal feed market. It allows a better resilience of the system. ● In the same time, they can reduce their impacts on the environment if they manage their production of food in this way. They can make a better use of the natural resources of the farm. For example, the herd can graze on lands that cannot be used to produce crops. ● To be food self-sufficient allows enhancing the complementarity between the different productions. 2) On the territory: ● The points concerning the farm are also true on the scale of the territory. ● Developing the complementarity between the production systems on the area can also facilitate the activities and the development on the territory. So when farmers work together on their production area, they can innovate and develop agroecological systems more resilient thanks to the food self-sufficiency of the herds for example. These changes impacts different aspects: environment, economy, social.
Place or classroom and auxiliary accessories needed for the activities	Classroom; computer, projector, working space for practical work Field visit at least on a farm with crops and livestock productions. Interview with a farmer developing food self-sufficiency for the herd and linked to the territory. Ideally a motivated group of farmers working together to develop this topic on their area.
Evaluation	The students have to explain:

	● what food self-sufficiency for the herd (practices, on the farm, on the territory) is, ● how it is developed regarding to the context, ● how it impacts the environment, the farm and the territory. The students search for elements of agroecology in the systems of free-range breeding. The students evaluate the advantages and disadvantages, opportunities and threats of these systems (connected to diseases, climate changes, etc.). They also evaluate the link between the farmers on the territory and the possibility to develop this topic at this scale.
Exercise	1) Understanding the concept of food self-sufficiency of the herd: before all, it can be interesting to question the students about what they think this concept means. It allows starting the discussion, identifying some difficulties and knowing from what the students start. It can be done at the beginning of the introductory lesson. It can also be a time to make the link between practices they know but they don't link to the concept yet. Then, the students can develop the topic, thanks to lecture and presentation and online sources. 2) Study the different practices and understand why there are developed regarding the context: food self-sufficiency of the herds includes different agroecological practices concerning pasture management and the production of proteins. There is not one way to reach the autonomy. In groups, the students can analyse different systems and the practices thanks to various examples (O2, field visit, lecture, online resources…). The teacher/trainer can provide some documents (article, video…) to bring different points of views or to highlight unusual practices like using leaves as complementary fodder. But, it is important that the students learn to search relevant information by themselves. They can make a focus on why the farmers develop these practices and no other and make the link with the context of the farm. Then, the groups present the case and the students can compare the different systems. 2bis) Study various self-sufficient systems to

	understand there are different ways to reach the aim: Teacher/trainer in cooperation with the students can organize different field visits in various self-sufficient systems. The students analyse the systems and compare them. It allows them to study different practices and ways to develop self-sufficiency and to understand the link between the development and he context of the farm. 3) Understand the changes: It is possible to build with the students an Efficiency – Substitution – Redesign model (O2, French case 4). On the basis of examples of various systems developing food self-sufficiency for the herd, the students can analyse what changes of the system are involved and set up. An important point is that the student understands that the change can be a step by step process. It is necessary to think in short and also long terms. 4) Impacts on the environment and on the economy of the farm: developing new practices and changing the system involve a new definition of the system impacts on the environment and on the economy of the farm. The students can analyse and compare the situation on one farm, before and after the evolution of the system to reach food self-sufficiency. Thanks to this analyse, the students also highlight if it is an agroecological system. 5) System level: The aim is that the students understand the importance to think at the system level. The students understand that depending on the system and the context, you can set in place different practices to reach the same goal. On the basis of the lecture and presentation and online sources the students in groups prepare and present a SWOT analysis. They expose the strengths and weaknesses of food self-sufficiency for the herd at the farm level. . An entry by the economic aspect of the system can be helpful to develop the interest of the students about the topic. Then, it is interesting to make them think about the link between the economic aspects and the other aspects of the system. It is necessary to make them realize that the development of food self-sufficiency impacts the whole system.

	6) Understand how a territory dynamic can work around this topic: Working with the other farmers and stakeholders of your territory, it is possible to reach the food self-sufficiency of the herd at the territory scale. Based on field visits and interviews of various stakeholders (not only farmers), the students analyse the different needs of the stakeholders of the territory. Then they study how they can respond to the each other's needs. 7) Understand the concept of self-sufficiency: Like in the exercise 1, it is possible to work with the students on the concept of self-sufficiency. To bring another perspective to the reflexion, the students can work on ecovillages (module 3). They can make the link with self-sufficiency in different ways of life.
Intended learning outcomes	● To understand there is not one solution, there are many practices and various options to set up food self-sufficiency of the herd. ● To identify the different levels of autonomy (farm, territory). ● To understand the importance of the collective work and of the knowledge of the different stakeholders of the territory: help, complementarity, communication => social aspect. ● To analyse how to develop more resilient systems. ● To become familiar with the basic principles and methods. ● To identify the values of space and indicators of sustainable development: biological diversity, built heritage, important components of sustainable management. ● To acquire the basic principles of recording, analysing and evaluation of data. ● To do a critical evaluation of the results of their work. ● To develop a positive attitude towards the natural values, healthy food production, bio systemic studies as a foundation for sustainable development. ● To think at a system level.

Teaching and learning methods	Lecture, group and individual self-study, presentation, group work, excursions, case studies, observation, brainstorming, exchange to understand the link between the various stakeholders (interviews, field visits…).
Teaching materials and media	Whiteboard, notepad, pencil, video equipment
PROJECT WORKING DAY	1 Introduction to the concept of food self-sufficiency of the herd at different levels and the link to agroecology. One option is to work on 3 questions with the students: 3 key-words linked to the topic, what would help the development, what are the difficulties. Each student writes one idea regarding each question on different post-it. Then the teacher/trainer gathers the post-it, put it up on the board. At the end students and teacher trainer discuss to highlight the major ideas. It enables to learn the students' points of view regarding the topic and to work with this base. 2 Students break into groups. 3 Groups work to identify different practices that can be set in place to reach the food self-sufficiency of the herd. It is based on bibliography, case study, video… It is possible that each group work on a different type of practices: management of the grassland, management of the herd, production of proteins… 4 Field visits on a farm: the farmer presents his system, his practices. He explains why he made those choices and what the impacts on the resilience of the farm, on the environment, on the economy are. The students ask questions to understand how the system work and how it is adapted to the context. If it is possible, the farmer also presents the links with the other stakeholders of the territory. The students ask questions to understand how the collective dynamic work on the territory scale. It is important to prepare the field visit upstream with the students and to think to which information is needed. On the D-day, it can help to distribute the tasks: to question the farmer, to take notes, to listen. 5 Back in the classroom, the students analyse:

	● The practices and the system, they build a SWOT matrix, ● The relationships on the territory and the possibilities to set up the food self-sufficiency at this scale. They can prepare a presentation or a role play to illustrate the social links. 6 Students present their works and then the whole class discuss about the choice of the practices, the system and the relationship. Then they can propose other practices. The teacher can also help the student to go further in the proposition of change. They need to understand that they can propose deep changes in the system with various steps split in the time. They can also discuss how the food self-sufficiency can be developed on the territory. Another option is to let the students create a map with the different stakeholders which can be involved on the territory and explaining the various links between them. It allows highlighting how the system can work at the territory scale.

3.2 MODULE: COMMUNITY GARDENS (AUSTRIA)

3.2.1. THEORETICAL INTRODUCTION

As agroecology is the ecology of the entire **food system** a transition towards agroecology means to challenge and transform the main **social practices** within the current food system. This can be done by introducing **social innovations**.

Here we use community gardens (CG) to learn about agroecology. In emphasizing CGs, aspects of social innovations are highlighted, enabling teachers and students to learn and explore the three different dimensions of agroecology—science, practice and movement. In Austria, **organic farming** has been acknowledged, practiced and successfully established for decades at these dimensions. Therefore, from this perspective, examples of organic farming and most stand-alone biophysical agroecology examples, such as a hedgerow, or a strip of plants protecting a riparian zone are no longer innovative. This makes it important to detect innovation in agroecology, which goes beyond the best practices of organic farming. This might happen either as a combination of **all three categories of agroecology in one case study**, or as a **social innovation** at the **movement level.** The latter could be exemplified through food sovereignty—a key concept of agroecology. Food sovereignty may be viewed as innovative because of its inherent challenge and demand for transformation of the current mainly marked-driven food system. Practices leading towards social innovations are often neglected and/or of minor relevance in the societal debate in Austrian – also in respect to Organic Farming.

Food sovereignty, defined in the "Declaration of Nyéléni" (Nyéléni 2007)[1], states that people should have the right to define their own food and agricultural systems in which they partake. “Food sovereignty prioritises local and national economies and markets and empowers peasant and family farmer-driven agriculture, artisanal fishing, pastoralist-led grazing, and food production, distribution and consumption based on environmental, social and economic sustainability.”

In community gardens (CG) people come together with the aim to establish and claim their right to define their own food and agricultural systems, illustrating and seeking for small-scaled food sovereignty. They tackle issues from polyculture diversity at their plot-level to external political issues as in keeping the space available for themselves. CGs therefor exemplify an awareness of the ‘social’ – by the different social practices of (self-)organisation implemented within the group of gardeners and by its individual gardeners – and its potential impacts on CG’s guiding principles (e.g. establishing cooperation and mutual learning) as well as its wide societal implications. In each of these social practices, innovation—the possibility of a new idea having the potential to improve either the quality or the quantity of life—may occur.

Because of their typically small-scale, CGs are interesting as a case study as their system is generally transparent and their boundaries are navigable. Therefore we introduce a **systems approach** that will enable students to determine the elements of a particular community garden system. The aims are to analyze the different systemic aspects through the analyses of ‘spaces’ within a community garden—physical, social, individual, and societal-political space. These spaces cover the systems boundaries of any given community garden and should lend to a holistic picture and understanding of a CG and its accompanied agroecological practices.

Listening to the story of a particular CG and observing the garden and reflecting on the various spaces that occur at the garden will allow for the identification and understanding of human and social values tied to environmental and food systems sciences and ultimately the role of social innovations within agroecology.

3.2.1.1. More on social innovation

For a comprehensive definition of social innovation, specifically in dealing with agroecological principles, we turn to Pol & Ville: "An innovation is termed a social innovation if the implied new idea has the potential to improve either the quality or the quantity of life. Examples of innovations that fit nicely with this definition abound: innovations conducive to better education, better environmental quality and longer life expectancy are a few" (Pol and Ville 2009 p.15). Using this definition we focus not solely on an innovations economical usefulness, but invite what are commonly seen as externalities—or overlooked services or benefits—to be included in the definition. In including these 'social goods', social innovation fits well with the principles of agroecology as a movement and more specifically to the concept of food sovereignty.

3.2.1.1. A brief introduction on community gardens

Community gardens, in particular, are on the rise across North America and Europe, and are producing much more than just food. From the promotion of health and community to financial security and access to fresh food, CGs provide an effective means for community-based practitioners—such as local organizations or policy makers—to carry out their roles within the areas of organizing, development, and change (Draper and Freedman 2010).

Although each garden may have a different context, typically a community garden is different from a private garden because it is public in terms of ownership, access, and degree of democratic control. The term *community* in community gardening refers to the involvement of multiple individuals, joining together in diverse settings (e.g., schools, neighborhoods, city blocks, faith communities, prisons, nursing homes, and hospitals), to grow, among other things, food. They are used by, and beneficial for, individuals of any age, race, ethnicity, and socioeconomic status, as well as the disabled and nondisabled alike (Ferris et al. 2001). CGs particularly in cities, have been able to enable access to affordable food (sometimes produced at the fraction of store price) that is also healthy and fresh (Peña 2005). CGs, as implied by their name, are spaces where social interaction occurs. Educational events, workdays and garden parties are a few of many possible socializing opportunities (Flachs 2010).

In addition to any garden's ecological and agricultural components—e.g., interaction with soil, plants, water, climate, fertility, etc.—community gardens often experience tensions as they are often found in urban spaces that can be temporary or are pressured by expansion. This leads to challenges with land use, ownership and material sourcing. Actors involved in CG are not only their members, but their leaders, owners, volunteers, civil-society, organizations, and policy makers (Gregory 2015).

CGs play important roles in fostering food access and healthy eating, physical and mental health, environmental stewardship, and community organizing (Gregory 2015). As such they make an excellent case study as a sub-system of the current food system; enabling the observation of ‘the social’ or social interaction and innovation within the CG system and with an agroecological lens. Therefore, it is our wish to introduce students to the different and perhaps more complex forms of agroecology—that of the movement—via a community garden systems analysis.

Figure 7: Adding the social in agroecology. The urban garden as an outdoor classroom

Module title **Hours: 4-30** **Seminar: 2** **Excursion/Exercise: 6** **Self-study: 1-10** **Preparation for contact time: 5** **Literature review: 9** **Report preparation: 1-5**	**Community Gardens Systems Analysis**
Interdisciplinary connections	Learning activities connected to social innovation; systems thinking; theory and practice of organic gardening (incl. nutrient cycling, soil fertility, etc.), in (semi-)urban areas, food sovereignty (self-determination, -reliance and –sufficiency).
Requirements	A community garden must be chosen in the vicinity for the implementation of the module. Ideally it would be a self-organised (not a self-harvesting plot provided by farmers[2], municipalities or other private entities) community garden, in which many different people are active and where various aspects of food sovereignty are present at regional/local/farm-level/plot-level and social, technical, economic challenges are explored or at least communicated with the gardeners.
Results of the module	The students´ group is enabled to detect innovations in agroecology, which go beyond best practice organic farming either as 1.) a combination of all three categories of agroecology (science, practice and movement) in one case study, or/and 2.) at the movement level, specifically addressing social innovations by detecting elements of food sovereignty as an integral part of agroecology in the analyses of a community garden. The analysis has to be based on the introduction by the stakeholders (the gardeners) and their space (physical arrangement of the community garden, but also including all other dimensions of space).

Teaching approach and didactics	In the module we focus and reflect on the social innovations embedded within agroecology. To do so, we believe in a very open-ended teaching approach. In this module we envision the teacher giving very limited specific input. Instead the teachers are seen as facilitators to the students. Guiding them in their discussion groups and individually. Homework in the form of readings, group work and written work are possible for the extended version of this module.
Context	Social innovation within Community Gardens: In CGs three different social practices of (self-)organisation are implemented within the group of gardeners and by its individual gardeners. In each of these social practices, innovation—the possibility of a new idea having the potential to improve either the quality or the quantity of life—may occur. The different social practices and associated examples of social innovation are: 1. The *organisation within the group of community gardeners.* This means the internal organisation of a diverse and fluctuating group of gardeners from different societal backgrounds. Social innovation occurs in the process of decision-making, splitting the responsibilities and tasks among group members—such as tool storage, irrigation, community events, a group mission statement, etc.—and other larger group issues as it enables the individuals to acquire individual skills and knowledge as well as serving the purpose of establishing the CG as a site with the possibility of improving the life of the individuals actors on different levels depending on their individual motivation for participating (e.g. fresh and healthy produce, economic savings, connectedness to “nature” etc.) 2. The individual social practices with smaller groups or at the plot level (personal approach to gardening, , interaction with the immediate environment on their plot—resulting in individual gardening, soil building, pest and disease management, and harvesting logistics, etc.) 3. The *external organisational level*, dealing with formal procedures such as acquiring and maintaining access to the (urban) piece of land or other formal processes, such as building permissions etc. We encourage thinking about these different social

	practices (self-)organisation and the possible social innovations they entail in CGs, particularly within their predominant spaces mentioned below. This helps categorize and understand where the above mentioned social practices and their possible social innovations might take place. The overall objectives of a community garden are often organized around acquiring, creating, developing and maintaining a multidimensional space for individuals (the gardeners) to explore, learn, experiment and teach gardening (agroecological) principles and methods. In order for students to identify and analyse the social innovations within their community garden case with an agroecological perspective they need to be able to observe the interactions within and among these spaces: **Physical space:** This space is defined as the physical boundaries of the actual garden. How large it is, the layout, plants, animals, other physical arrangements, how the gardens are partitioned or used collectively. The physical space includes existing and wanted infrastructure, often tool sheds, fences, communal spaces, tools, irrigation, mulch, compost, etc. It is the space used on a regular basis by the participants. **Social space:** This space is not physically visible, but is the side where the learning and the application of different me methods are taking place to self-organise a group of different gardeners by setting objectives and by conducting social activities to reach the group and establish a mood for the community. The social space is also the side to enhance the gardeners´ skills to communicate, negotiate and discuss topics to come up with a common agreement for the whole group of gardeners. The side of the social enable the gardeners to create a community of gardeners, who work together and learn agroecological practices from each other. **Individual space:** The individual space enables the individual gardeners the experience of practically working with „nature“ and (bio-)diversity by taking over responsibility for a piece of land for at least one season and to cultivate it. It also enables the

	individual gardener to define one´s position and responsibility by taking over activities in a group (social dynamic). The individual space empowers critical reflection on personal challenges (self-organisation, timekeeping, etc.) and therefore the basis for personality development. The individual space ensures the opportunity to create an environment for mutual learning from each others´ talents and capacities **Societal-political space[3]** The societal-politcal space is not visible, but inherently connected to the physical existence of a community garden in the aquiration of the land. This space is designed: To enable political socialization[4] of individuals by "acquiring the space" and to then open up the movement's perspective of agroecology. To develop gardeners´ capacities to strategically work towards political goals within the community setting (over land ownership etc.), and to enable critical reflection of existing power relationships in the current political and food system.
Place or classroom and auxiliary accessories needed for the activities	Community garden and at least one person involved in the organisational process of the community garden. Ideally a motivated group of gardeners would be possible to speak to.
General lesson structure and activities	Note: This module is flexible. The following is organized for an afternoon of 3.5-4 hours focusing specifically on the case-study exercise (see below). The exercise can be drawn out over a semester to include multiple observation times, a deeper introduction into systems approaches and other theoretical knowledge, a written report, more group work, and more in-depth questioning. Alternatively this exercise could be focused on for one week and the other activity topics might each have a week along with an introduction, conclusion and assessment/presentation time. This of course, all depends on the structure of the class.
Evaluation	Students are evaluated three ways: 1. By their teacher on their class work and presentation 2. By their peers in a group assessment (see appendix) 3. Through a self-assessment (see appendix)

Exercises	**1) Crossing the borders** Agroecological teaching might only be fruitful if common agricultural knowledge is constantly challenged in a systematic manner by students and their teachers. “Thinking outside the box”, confronts daily life in CGs and its resulting materiality and turns it upside down. In reflecting a fictional or alternative CG scenario larger systemic questions addressing social innovation and food sovereignty is made possible. But it is intended to cross the self-established barriers of perception within ourselves: What I am is a culmination of the consequences of my consumption, my health status, my wealth, my network, the region’s economy, and the region's climate, etc. The point is to think big. Include the improbable but not the impossible. What alternative solutions are there to common challenges? Specifically when there are no boundaries? Work backwards, think about the solution and then figure out how it might be done. This exercise not only attempts to improve critical thinking, it also analyses the case study in terms of understanding the system but also its challenges and then attempts to solve them.

	2) Systems thinking Here students are introduced to thinking and framing agroecology within a system. Everything that exists is part of a process and all processes are part of a system with interdependencies making systemic thinking nonlinear. As agroecology strives to challenge the current food system we foster here the process of studying a community garden in order to identify its goals and purposes and understand its internal systems and procedures. We use this systems analysis as a problem-solving technique to break down a community garden into its sub-systems within the larger food system. We do this by looking at its different spaces (see below) to examine the pieces of the CG for the purpose of studying how well those components work individually and interact to accomplish their purpose. **3) The social in agroecology** Here students delve deeper into the understanding of the community aspects within the CG. How are decisions made? How are particular issues communicated? What kind of partnerships are made? What are the external and internal social influences within the particular CG. Here the students need to observe the social practices going on within the garden. They also need to interview different community garden actors. How is the particular case garden connected to the CG movement? To the food sovereignty movement? **3) Case study learning** A group of students learns by visiting a real case with stakeholder, where the agroecological analysis of a community garden takes place. They can state the questions and explore the spaces. **4) Multifunctionality** This is an important aspect to think about in productive agroecology systems, whether in a farm system or a social group in agroecology. The multifunctionality of an specific element of the community garden organisation could be determined, or the multifunctionality of an edible wind breaker along a field (habitat for beneficial (and other) organisms, spot of high diversity, source of income (timber, berries, honey, etc...); ideas for how to make elements more multifunctional within student's case studies could also be identified.

Intended learning outcomes	The overall learning outcomes are to facilitate critical thinking skills in analysing a community garden, with specific focus on connecting the importance of the social/community aspects within the system and its agroecological connections. The particular case-study exercise is elaborated here in this module in which its specific learning outcomes are as follows: 4. Understand agroecology as a science, practice and movement and the role of social factors within those domains (on-going) 5. Be able to identify the different interconnected parts of a community garden system including spaces and levels (achieved through group work plenary discussion) 6. Analyse agroecological principles within social systems and the importance of social innovation within agroecology (on-going) 7. Group learning and hands-on experiences—the community garden example offers interesting perspectives on knowledge exchange and innovation processes at the community level as well as challenges in working in groups (on-going).
Teaching and learning methods	Introductory lecture (methods and content), case study exploration (interview, transect walk, etc.) and learning (gardening with the gardeners), group-self-study, group presentations, group report, excursions
Teaching materials and media	White/black board, note pad, pencil, camera (pics or/and video equipment), outdoor clothing, sunscreen, hats, etc.

PROJECT WORKING DAY	1. Introduction to the concept of community gardens and then their connections to agroecology (in the classroom) (20 mins) 2. Students break into groups (5 mins) 3. Students receive a handout (with leading questions and concepts appropriate to the exercises (see above) they were assigned) about activities and concepts they need to complete and define the case-study garden (each group has a topic related to a specific space of the CG—i.e., physical, social, individual, and societal/political space). They should discuss their possible outcomes and goals within their group (25 mins) 4. The class goes to the community garden and gets an introduction to the entire context there—ideally from the CG leader and or participants (30 -60 mins) 5. Each student has an individual observation activity. Ten minutes of silence where they sit and observe or walk around and observe according to their topics (the different spaces). (10 - 15mins) 6. Then students come together as a group and discuss, develop a group plan, ask questions to the garden representatives or workers or teacher. (30 mins) 7. Class returns to the classroom and create a presentation to describe their findings on flipcharts (30 mins) 8. Students present (10 mins each, 40 mins total) Class plenary discussion and conclusion (20-30 mins)—this class plenary is led by the teacher prompting the students to draw the community garden system (in relation to its spaces and the presentations of the 4 groups) and the connection and importance of social aspects in agroecology.

[1] The Nyéléni Movement organizes for international food sovereignty and works closely with agroecology.
See: https://nyeleni.org/spip.php?page=NWarticle.en&id_article=372

[2] A self-harvesting plot is a plot, where a farmer (or other landlord) provides small plots on their own land for individual gardeners (mainly for one growing season attached to an annual fee). The logistics of the self-harvesting plot (legal framing, rules, access to the plot, etc.) is organized by the farmer. Sometimes the farmer also provides services, such as soil tillage and seeding of certain crops. Therefore the gardener rents the plot, which includes the logistical planning.

[3] Political socialization/action through appropriation and self-organisation: Community gardens often only exist because of individuals´ continuous struggle to gain access to these productive resources since the very beginning. The motivation to do so might differ from situation to situation, but this process of appropriation of “space”, mirrors common power relations and therefore enables participating gardeners to reflect on the current socio-political environment – the wider food system - where productive resources from the community garden is embedded in. This process also provides the opportunity to develop individuals´ capacities to elaborate strategies to pursue and reach political goals (also outside the community garden) as an individual and as a group. The relation to agroecology is in the reflection of land tenure and access to land as both is quite unevenly distributed in most countries on global scale. Access to this basic productive resource of agricultural production is mostly restricted. The movement dimension of agroecology was often driven by this question (e.g. Brazilian landless movement. See (Koohafkan et al. 2012). The consciousness about the political environment in general (the political system) and power relations in detail agriculture is embedded in enables individuals´ ability to recognise the political strategies of different stakeholders in the (political) debate about the agricultural policies, the food system, land tenure and land and permits active participation in debates.

[4] See: Powell, L., & Cowart, J. (2003; p 15).

Figure 8: Community gardens can also contribute to smaller-scale scientific experiments and the practice of agroecological methods.

Additional resources

- http://scholarworks.gvsu.edu/sss/55/
- https://www.researchgate.net/profile/Timothy_Leslie2/publication/286413569_Agroecological_and_social_characteristics_of_New_York_city_community_gardens_contributions_to_urban_food_security_ecosystem_services_and_environmental_education/links/572363f808ae586b21d8849d/Agroecological-and-social-characteristics-of-New-York-city-community-gardens-contributions-to-urban-food-security-ecosystem-services-and-environmental-education.pdf
- http://digitalcommons.lmu.edu/cgi/viewcontent.cgi?article=1037&context=cate
- http://digitalcommons.lmu.edu/cate/vol2/iss1/8/
- http://escholarship.org/content/qt6bh7j4z4/qt6bh7j4z4.pdf
- https://www.researchgate.net/publication/288063768_Community_garden_information_systems_Analyzing_and_strengthening_community-based_resource_sharing_networks
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3.3 MODULE: ECOVILLAGE (LITHUANIA)

3.3.1. THEORETICAL INTRODUCTION INTO THE MODULE

Ecovillage is a settlement, which combines sociocultural environment with a low–impact way of living. Choosing to live in ecovillage is choosing an alternative way to individualistic, materialistic and consumer-oriented lifestyle. This innovation deals with climate change, environmental pollution, resource shortages and social problems people face nowadays.

An ecovillage is a human-scale settlement consciously designed through participatory processes to secure long-term sustainability. All four dimensions (the economic, ecological, social and cultural) are seen as mutually reinforcing. Attention to each is essential for holistic and healthy community development. (GEN, www.gen-europe.org, 2011). Ecovillages are an outcome of citizens walking their talk in lowering ecological footprints while increasing their sense of belonging and purpose. It demonstrates that it is within human capacity and knowledge to consciously enhance and improve the environments in which we live. (GEN, www.gen-europe.org, 2011).

Ecovillages are one of the possibilities if we want to choose a different future for ourselves and our descendants. The nature shows us, sometimes maybe in a quite explicit way or even in a cruel way that our current “development” is not going in the right direction. Climatologists and other scientists are warning us that we do not have any more time to waste. Therefore, the experiences and solutions of various ecovillages from all around the world are even more valuable since they are tested and people live there according to the principle of sustainability. Thus, ecovillages can be seen as sustainable research communities that are committed to discovering new ways of coexistence of people and nature. Eco-village is a sustainable human settlement, which is in harmony with all aspects of human life, including cultural, ecological and spiritual dimension.

The creation of new settlements (may also be created in existing urban environments) that are built human-friendly, encourage people to interact with each other and to have real relationships, rational use of energy, if possible they produce their own energy and healthy food, less need for transportation and in particular allow a higher quality of living and thereby contribute to the development of people as material and spiritual beings.

3.3.1.1 Development of the ecovillage

Time is needed to progress from the first idea to the establishment of an ecovillage because there are many decisions to be made and there is a lot of work involved. At the beginning of this stage the ecovillage exists only in the minds of its initiators, as an idea to create a better place to live. In this stage, the ecovillage initiators need to formulate the ecovillage vision, prepare the settlement design and build the basic living arrangements. The experience of Baltic Sea region ecovillages showed that the usual duration of the establishment stage is 2-5 years. However, for some ecovillages the process from the first steps in designing an ecovillage to having the place ready for living is likely to take 10 or even 15 years.

Figure 9: Ecovillage life cycle stages. Source: "Living in harmony: inspiring stories from ecovillages".

A wide range of people become initiators of ecovillage establishment: they could be one person or one family, a group of initial residents, a business company, an NGO, a religious organization, or even a municipality. No matter who initiated the ecovillage establishment, the duration and success 12 of the establishment stage mostly depends on the ecovillage vision. So the first and main task for the ecovillage founders at the establishment stage is to formulate a realistic yet inspiring ecovillage vision. An ecovillage vision depends on the motivation and values of the ecovillage initiators. If we analyse the motivations and values of ecovillage founders, we find that they have three dimensions: spiritual, ecological and social. If the founders of an ecovillage want the establishment stage to be shorter and to avoid many problems in the future, it is best to have a vision encompassing all three dimensions of an ecovillage model.

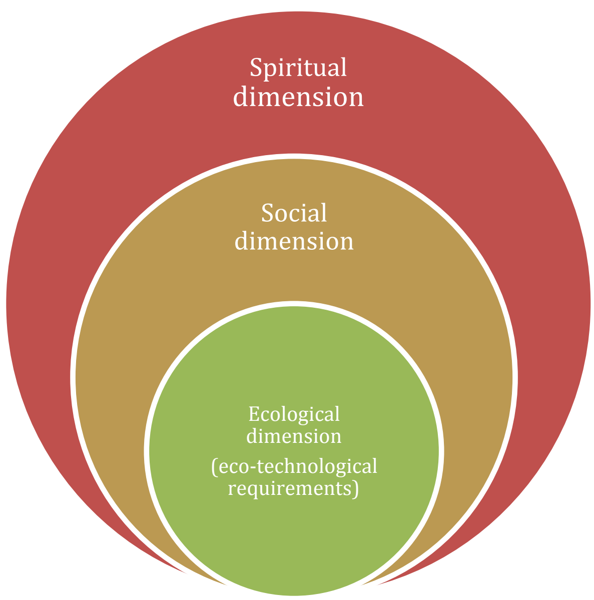

Figure 10: Three dimensions of an ecovillage vision. Source: "Living in harmony: inspiring stories from ecovillages".

The vision for the **ecological dimension** of an ecovillage should describe the main eco-techno values of the founders: regarding buildings, infrastructure and activities on the territory of the ecovillage. The ecovillages comprised of individual homesteads usually have ‘internal rules’ where they describe the main requirements dealing with eco-techno decisions.

Focus on eco-techno decisions ‘Ecovillage as healthy and pleasant place to live’. The ecological dimension is actually the underlying dimension of the three. The wish to live in a healthy place in harmony with nature is common to the founders of all ecovillages. Some of the ecovillages focus on eco-techno decisions only, with inhabitants not pursuing a high level of intercommunication: good neighbourhood relations are sufficient. The vision of such ecovillages does not include agreement between members of the community on special spiritual values, a common philosophy or a unity of approaches. A focus on eco-techno decisions is most typical for ecovillages that are initiated as business projects.

The values must be formulated as requirements for all residents dealing with the following issues:

- Buildings (architecture, building materials),
- Water supply and sewage management,
- Energy solutions (electricity, heating systems etc.),
- Waste management,
- Usage of transport on ecovillage territory,
- Agricultural processing on ecovillage land,
- Livestock rearing and animal slaughter.

The vision for the **social dimension** of an ecovillage should describe the desirable level of communality. Some ecovillages aim to live as one big family, the inhabitants share common resources, provide mutual aid and have a lot of common activities. Other ecovillages prefer a more individual lifestyle where residents communicate as good neighbours and organize some traditional social events or meetings to discuss development of the ecovillage but do not strive to spend a lot of time together. However, most ecovillages try to find a balance between individual and communal lifestyles, creating a supportive environment for the inhabitants who want to be a part of the group. Regardless of whether the founders’ vision is a maximum, minimum or average level of communality, these founders should also declare the principles for the ecovillage governance. The ownership rights to ecovillage land, buildings, roads, and other infrastructure must be very clear for each potential resident of the ecovillage. Special attention should be focused on sources of finance for ecovillage building and the responsibility to cover loans and additional payments necessary in the future for maintenance of communal property, e.g. heating and repair of meeting houses.

Focus on social relations – ‘Ecovillage as closely-knit communities’. Some ecovillage founders are primarily driven by a desire to live in a better organized community. Although they admit that environmentally unfriendly behaviour is one of the major disadvantages of modern society, their aims are more than just technical ecologically focused solutions for an ecovillage. Their main purpose is to gather a group of people who are likely to socialize frequently and in which communication would be more balanced and life more secure than in traditional environments. Most ecovillages oriented on the social dimension foster inter-personal relationships and continually experiment to develop a better communication style, trying to ensure that life in the community does not interfere with the creative freedom of each individual.

The vision for the **spiritual dimension** of an ecovillage should describe the main spiritual values of the founders. Most ecovillages formulate spiritual dimensions of their ecovillage vision as a general aim to live in harmony with the Earth and all living beings. Some ecovillages take as their base a specific view of the world, described in terms of the philosophical theories such as Rudolf Steiner or Sri Aurobindo theories. If the ecovillage is focused on the spiritual dimension, a large part of the daily activities will be devoted for the awakening and transformation of consciousness. Rituals promoting the development of our inner self and a culture of creativity become an important tool to strengthen the spiritual life of an ecovillage. Most founders of ecovillages initially focus on the development of one of these three dimensions and only later, when the ecovillage grows and come into contact with other members of the ecovillage movement, do they tend to gradually develop the other two dimensions. Although this is quite a natural way of evolving, it does take a while to implement. Moreover, trying to enact fundamental changes in the ecovillage vision at later stages of the ecovillage life cycle could be a source of conflicts. Therefore, when creating a vision it is desirable to agree in advance on all three dimensions regardless of the dominated motive to establish the ecovillage. We now present some examples of the motivations to establish an ecovillage grouped by their focus on one of these three dimensions.

Focus on spiritual values – ‘Ecovillage based on a philosophical concept’. The spiritual dimension is the most general dimension of the three – it could even be called the ‘umbrella dimension’. Residents of all ecovillages are people looking for an alternative lifestyle. For some of them, their vision of the spiritual dimension is simply a more nature-friendly lifestyle. Others also include closer community-seeking (in comparison with mainstream lifestyles) within this dimension. Some founders of ecovillages have more ambitious aims in this regard; for them the spiritual dimension includes seeking to perfect ourselves as human beings and our cultural life. Usually they strive to attract or include members from many religious orientations and find common spiritual values uniting all religions. Some of the ecovillages try to create their own concept of humanity, but for most of them, the beginnings of their design of ecovillage vision are to be found in particular philosophical concepts, such as Anthroposophy or ‘Kin’s Domains’.


Straw house in ecovillage

Straw house constructing

Ecovillage primary school main building

Ecovillage primary school summer class

Meeting with the founder of ecovillage

Ecovillage family

Figure 11: Kardokai Ecovillage in Lithuania.

Module Title Hours: 30 Lecture: 2 Excursion/Exercise: 8 Self-study: 4 Preparation for contact time: 10 Literature review: 3 Report preparation: 3	Ecovillage
Interdisciplinary connections	Geography, sociology, engineering, construction, agriculture
Results of the module	Topic is connected to getting to know eco-villages via online web pages and films. The students get to know how ecovillages function, how they are composed and the way of life in them and they understand the meaning of sustainability as a way of life.
Context	POSSIBLE EDUCATIONAL ACTIVITIES FOR ACHIEVING THE GUIDANCE FOR OBJECTIVES: ● General discussion of the reasons of people to settle in an ecovillage; ● Discussion in groups of pluses and minuses of the ecovillages, ● List of the key features of the ecovillage, ● Analysis of own interest to settle in the ecovillage, ● Analysis of the stages of ecovillage development, ● With the help of web pages the students draw up a plan of an ecovillage, ● Make a list of the main characteristics of an ecovillage, which distinguish it from the conventional typical settlement, ● Analyse the case studies based on the environmentally-friendly settlement activities and use of technologies in the ecovillages http://www.balticecovillages.eu/thematic-expertises-cases-studies ● Select 1-3 eco-technologies, which they can apply in the ordinary settlement, ● Analyse the case studies based on ecovillage establishment, government and community building http://www.balticecovillages.eu/thematic-expertises-cases-studies, ● The students make a draft of their work day in an ecovillage and in their day they search for elements of agroecology, ● Discussion on community role in the settlement.
Material and accessories to be brought by students	Notepad, paper, pencil, video equipment
Place or classroom and auxiliary accessories needed for the activities	Computer, projector, outside working space for demonstration and practical work, ecovillage.

Evaluation	**Evaluation of the work carried out** • The students compare different ecovillages among each other; they search for the differences and critically evaluate the current way of life at the expense of the use of natural resources. • If it is possible, they visit one of the ecovillages in Europe or the world or meet any founder or co-founder of an ecovillage.
Exercise	Choose your example of ecovillage on the web page and present it with exposing the elements of agroecology as a science, a movement and as a field of research. http://www.balticecovillages.eu http://gen.ecovillage.org/ http://www.ic.org/directory/ecovillages/ http://www.ecovillageroad.eu/
Intended learning outcomes	Students should know the relevant ecovillage theories and concepts; Be able to critically discuss their findings and methodology; Apply the relevant agroecological elements in ecovillage.
Teaching and learning methods	Seminar, lecture, field trip or excursion, video and/or photo reportage, self-study, practice of using straw-clay technology for making a building material, permaculture gardening
Teaching materials and media	Flipchart, visualisation tools for presentation and watching videos, straw and clay, permaculture garden
PROJECT WORKING DAY	Lecture: 1. Agroecology and ecovillages 2. Presentation of the main characteristics of ecovillage. Excursion/field trip or using the video: students make description of the ecovillage and include sustainable point of view. Workshop: • Students prepare PowerPoint presentation for oral presentation and use as materials excursion description or video. • After the presentation they develop suggestion how we can build up ecovillage around us. Students integrate ecovillage with agroecology and explain possibilities for using agroecology in ecovillage.

Other resources

Ecovillages for sustainable rural development project website www.balticecovillages.eu
Ecovillage road http://www.ecovillageroad.eu/
Ecovillage sustainability self-evaluation test http://www.balticecovillages.eu/ecovillage-sustainability-self-evaluation-test
Policy recommendations" Ecovillages for sustainable rural development
http://www.balticecovillages.eu/policy-recommendations-ecovillages-sustainable-rural-development
Case studies based on the environmentally-friendly settlement activities and use of technologies
http://www.balticecovillages.eu/case-studies-based-environmentally-friendly-settlement-activities-and-use-technologies
Case studies on ecovillage establishment, governance and community building
http://www.balticecovillages.eu/case-studies-ecovillage-establishment-governance-and-community-building
Global Ecovillages Network, GEN gen.ecovillage.org/
Global Ecovillage Educators for a Sustainable Earth www.gaiaeducation.org
Diana's Leafe Christian's private newsletter about Ecovillages www.ecovillagenews.org
Gaia Trust www.gaia.org
Living Routes - study abroad in sustainable communication www.livingroutes.org
Fellowship for intentional community http://fic.ic.org
Permaculture - inspiration for sustainable living http://www.permaculture.co.uk
Paul Wheaton private site for permaculture www.permies.com
Permaculture Institution www.permaculture.org
Rob Hopkins private site for transition culture www.transitionculture.org
Transition Network www.transitionnetwork.org
Ecovillage solution online library http://gen.ecovillage.org/index.php/searchresourcedirectory.html

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Hall R. (2013). The Enterprising Ecovillager Achieving Community Development through Innovative Green Entrepreneurship. Handbook. ISBN 978-609-8080-42-1

3.4 MODULE – BIODIVERSITY (ITALY)

Biodiversity has a key effect on food production and the quality of people's lives. Most of the ecosystem services in the agricultural landscape, from pollination to biocontrol and control over the spread of non-native species depend on a favourable state of biodiversity.

Agricultural biodiversity represents the variety and variability of animals, plants and micro-organisms that are used directly or indirectly for food and agriculture. The loss of agricultural biodiversity in our global food production systems is an issue of increasing concern, recognized by the Rio Convention on Biological Diversity and the Sustainable Development Goals of the United Nations. When we lose agricultural biodiversity, we also lose the options to make our diets healthier and our food systems more resilient and sustainable.

Modern agriculture practices imply the simplification of the structure of the environment, replacing nature's diversity with a small number of cultivated plants and domesticated animals. Scientifics researches proves that the world's agricultural landscapes are planted mostly with some 12 species of grain crops, 23 vegetable crop species, and about 35 fruit and nut crop species. This means that no more than 70 plant species are spread over approximately 1440 million ha of presently cultivated land in the world. (Migual A. Altieri, 1999) In this way impoverished and degraded systems are highly dependent on external inputs, unstable, sensitive to stress and negative factors.

Food production is one of the biggest threats to biodiversity. With increasing food demand, pressures will increase. The further development and prosperity of our society will depend on how effectively we can coordinate food production and preserve biodiversity.

In agroecosystems, biodiversity performs a variety of ecological services beyond the production of food, including recycling of nutrients, regulation of microclimate and local hydrological processes, suppression of undesirable organisms and detoxification of noxious chemicals (Migual A. Altieri, 1999). Therefore biodiversity is one of the most important components of agroecology. When ecosystems are diverse, the ecological processes are not at risk, since biological resources such as genetic resources, plants, soil organisms, bacteria provide key processes and through their interactions contribute to the nutrient cycling, biological and pest regulation and increased productivity and natural pollination. (TWN, 2005)

Therefore it is essential to aware young generations how to preserve and improve the biodiversity of food production systems, which could be realised at different levels and scales.

Mainly the small scale farmers have an important role in preserving and promoting biodiversity. With indigenous knowledge and preserved traditional practices, which have been pasted from the generation to generation, they are able to produce and manage agroecosystems in a way that improves the state of agroecosystems (TWN, 2005).

Through the module the students will learn about the concept and importance of biodiversity of agroecosystems. They will understand how the elements of traditional farmer knowledge, collaboration among different stakeholders and decision makers can improve the biodiversity at local, regional and national level. Within the module the students will learn about the agroecology mainly from the social, environmental and economic aspects

3.4.1. THEORETICAL INTRODUCTION INTO THE MODULE

Agro-ecology in many European countries, such as Italy, is inherently connected to the development of organic farming and the Bio-districts experience is today the most important example of agro-ecological approach, applicable to the sustainable management of a territory, particularly in protected areas. This systemic approach is a good mechanism to protect biodiversity not only at local, regional, but also at national and international level.

It is an overall approach to the farm management: the agro-food production, that combines best environmental practices, a high level of biodiversity, preservation of natural resources and the application of high level animal welfare standards, as well as production methods following the responsive preferences of a growing part of consumers for products obtained from natural substances and processes.

Bio-district is a territory of a sub-regional level with a non-profit association amongst agriculture enterprises and agro-food farmers, citizens/consumers, even associated together as with the fair-trade groups, local public administrations, national and regional parks, protected natural areas, commercial, touristic and cultural enterprises, social cultural and environmental associations. They act according to the principles and methods of the organic production and consumption and agroecology.

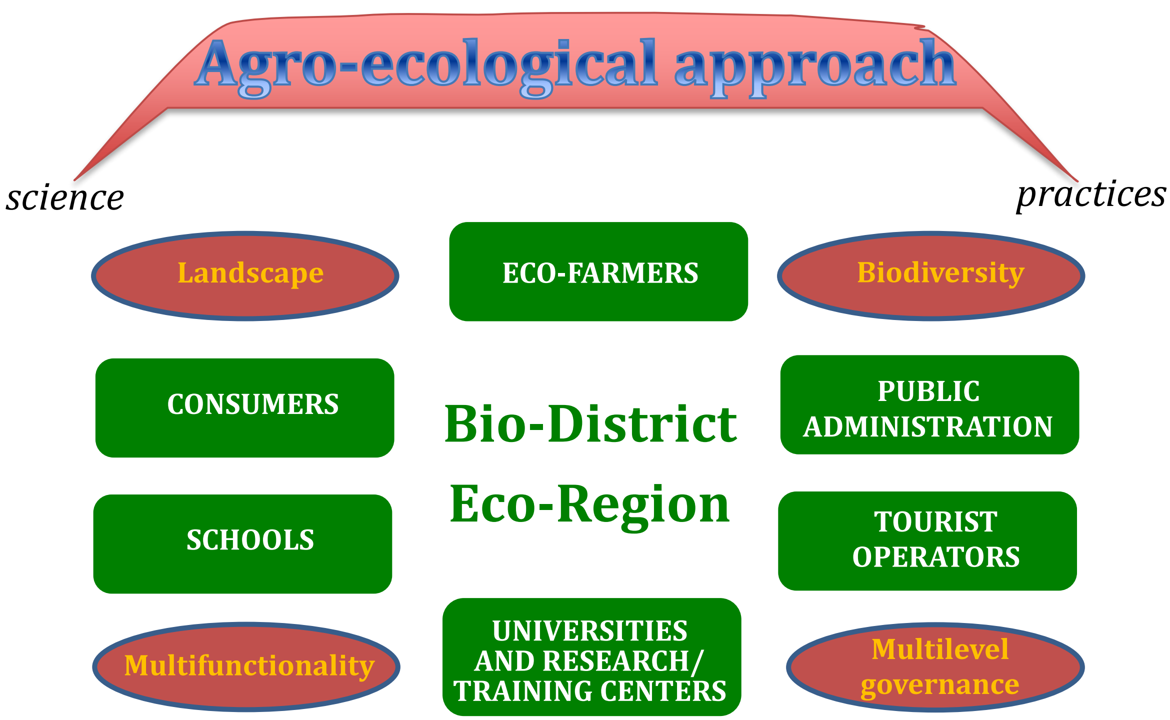


Figure 12: Agroecological approach

The productions resulting from the link between territorial vocations and production techniques are often enhanced by setting in production areas the stages of processing the agricultural product. Hence the food product in these areas also becomes cultural heritage and a local identity mark: local economic and social actors become more responsible in the management of natural and environmental resources, which are common to several sectors (agriculture, tourism, commerce, etc.).

The multifunctional agriculture demonstrates that agro-farmers, in addition to ensuring food production, which will be increasingly important in the future, also ensure patrol and protection of the territory, the biodiversity, the hydro geological balance, the landscape, natural resources, all waters and land, local culture and traditions. It is an overall approach to the farm management: the agro-food production, that combines best environmental practices, a high level of biodiversity, preservation of natural resources and the application of high level animal welfare standards, as well as production methods following the responsive preferences of a growing part of consumers for products obtained from natural substances and processes.

Mainly the small scale family farmers have important role as guardians of nature and biodiversity. The focus is on protection of agrobiodiversity of the territory, based on old seeds saving where many cooperatives for preserving the cultural heritage in the form of collective seed saving and seed Banks have been established.

In the module the students will get familiar with all aspects of agroecology, in term of science, practice and movement. The module involves various approaches and dimensions such as environmental, economic, ethical and social aspect. Great emphasis is on recognition how agroecology can change our common vision of both agriculture and society. It shows that multifunctional organization of small family farmers, by applying many innovative agroecology practices, improve environmental conditions, achieve greater agrobiodiversity and preserve the cultural heritage (cultural landscape, old seeds and animal breeds, traditional knowledge etc.) of rural areas, which consequently reduces costs of the environmental management.

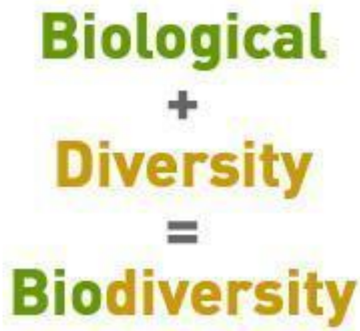
http://www.ecoregion.info/wp-content/uploads/2017/03/ReteINNER-presentazione_ENG.pdf

Figure 13: Biodiversity of Sala's gardens in Padula, Italy.

Figure 14: Seed banks for the preservation of old varieties contributes to the preservation of the biodiversity of the local environment

Module Title Hours: 30 Lecture: 2 Excursion/Exercise: 5 Self-study: 10 Preparation for contact time: 5 Literature review: 4 Report preparation : 3	BIODIVERSITY
Interdisciplinary connections	Learning activities connected to agronomy, ecology, biology, food production, organic farming and gardening, geography, plant production, collective approach.
Requirements	Learning module could be implemented in the local vicinity, protected area, city park, farm etc. The students visit a biodiversity rich area and observe the plants and their life conditions. With the help of information technology (educational boards, applications and web pages) they gain important information about the observation of plants (e.g., in the park, a botanical garden).
Results of the module	Through different learning activities in the classroom or on the field the students will learn and understand the concept of biodiversity as a core of the agroecological approaches. They will mainly collaborate with different local actors and understand it is important to consider and protect the biodiversity at different levels (local – bottom up approach, regional, national) and scales (plot, farm, community, city park, landscape). **The environment:** Students will identify different traditional approaches, skills, knowledges and practices that preserve and improve the biodiversity at different levels and scales. **The economy:** Preservation of biodiversity reduces the dependency on external inputs and improves the stability of food agroecosystems that reduce the financial and

	energetic inputs. **The social aspect:** To understand the importance of different actors´ collaboration in territory, mostly among the family farmers, local community and decision makers. The common goals and relationships based on the organic farming and agroecology principles will be much more effective in developing and implementing. The cooperation of farmers offering and sharing seeds, purchasing food products and political actions toward biodiversity and natural resources protection. But biodiversity protection is not the only that is important. Through cooperation, responsible and sustainable development, the cultural traditions of local ancestors, old plant varieties and cultural landscape are preserved and protected for future generations. **Technical aspect/practice:** To identify traditional and new techniques/tools adapted from the past as solutions to current challenges for preserving traditional plant breeds and their uses.
Teaching approach and didactics	In the module the environmental, social as well as technical aspect are highlighted. Students will explore and learn the importance of biodiversity in different ways: ● Discussion with the students through the video and the diverse literature on biodiversity and ecosystems services, ● Field visits to the local community gardens, organic farms etc. with description of the sustainable/agroecological techniques for preservation of the biodiversity ● Interview with local actors and experts on agroecology best practices to preserve the natural resources, plant and animals species
Context	1) **Understanding the concept of biodiversity of agroecosystems**: the students can explore the internet resources, watch the Euro-educATES movie or read the book of SALA's Gardens or similar topics. They can start the discussion and try to find the link between the practices they already know.

	2) **Understanding the meaning and importance of ecosystem services of agroecosystems**: students will understand that the health of plants, soil and animals leads to biodiversity and they will understand that ecosystems are essential to agroecology. 3) **Study different traditional and innovative techniques and practices** for preserving and improving the biodiversity of food production systems at different scales and level: on the basis of field visits and interviews with local actors (farmers, botanists, biologists, academics…) will identify simple sustainable management of local resources based on organic farming, permaculture and agroecology. 4) **Understanding the importance of preserving the traditional local autochthonous plant species and animal breeds**, which are adopted to local environmental and climate conditions. 5) **Understanding the positive impact on the environment and economy:** different species in agroecosystem reduce the dependence on external factors and ensure the stability of the system. Circular economy, co-sharing of lands and collective use of resources support the biodiversity.
Place or classroom and auxiliary accessories needed for the activities	It is recommended to organize the field visit to the local area, where the students have an opportunity to observe and explore the biodiversity of specific environment and to compare different levels of biodiversity of different environments (river side, meadow, forest, organic farm, city park, school garden, urban centre…). It is welcome to include an expert who will explain the functioning and discuss the concept of biodiversity. On-site: suitable footwear, pen, notebook, sound and video recorder.
Evaluation	• The students have to explain in their own words the importance of biodiversity for sustainable self-sufficiency and specify examples that they know from personal practical experiences. • To describe the functioning of the ecosystem services system • To explain the agroecological practices that support and preserve the biodiversity and ecosystem services of agroecosystems at

	different levels – plot, farm, community, landscape ● To explain the importance and benefits of local actors and small farmers collaboration to preserve the biodiversity ● Explain agroecology as science, as a practice and as a movement and find examples from the local environment, where different forms of agroecology are already emerging.
Exercise	Through on-line environmental atlases the students explore and identify local areas with a higher level of biodiversity. They select the field visit location (botanical garden, preserved area, organic farm, natural protected areas, meadow, city park, school yard etc.) to compare the level of biodiversity of different environments. The students visit different environments (a centre of biodiversity, nature park, regional park, etc.) and on the field work they get familiar with the activities that are carried out. They draw a mind map and explain how biodiversity affects the activities at the selected location. To understand the meaning and the importance of biodiversity for food production systems in connection to agroecology the students can carry out different learning activities: ● they can make herbariums and equip them; ● they can use different methods to measure properties of plants; ● they can identify different agroecological practices that preserve and promote biodiversity ● they can design artistic and decorative products using materials from plants; ● with the use of biological devices, they can independently observe plants and animals and make inventories; ● they can think about the possibility of seed banks of wild and cultivated plants; ● they can make homes for living, reproduction and feeding of the animals and prepare food for the animals for the winter part of the year; ● they can link their knowledge from the field to geographical knowledge, environmental protection and ethics; ● they can inform the public about the importance of the conservation of biodiversity; ● they can encourage critical thinking and the use of experiential methods;

Intended learning outcomes	● to get acquainted with the meaning and the concept of biodiversity, ecosystems services, bio-district, bioregion; ● to become familiar with the levels of biodiversity; ● to become familiar with the basic law, which relates to biodiversity conservation at national and EU level; ● to get acquainted with different agroecological approaches that preserve and improve the biodiversity of agroecosystems; ● to get acquainted with plant and animal representatives in the local environment; ● to get acquainted with the importance of the protection of plants and animals; ● to understand natural processes and the interaction between human and nature; ● to understand the various mechanisms and measures for the conservation of biodiversity in the context of different levels; ● on the concrete cases of the local environment the students are acquainted with different measures of protection of biodiversity and compare them with each other; ● to understand the importance of conservation of habitats with the aim of conservation of species;
Teaching and learning methods	Brain storming, introductory lecture by teachers, group and individual self-study, case study exploration, discussion and interview with local expert, farmer, on-site exercises, group work presentations, discussion etc.
Teaching materials and media	Notepad, pen, video, simple field equipment etc.
PROJECT WORKING DAY	Lecture: Agroecology and Biodiversity Short introductory presentation and discussion on biodiversity and ecosystem services in relation with agroecology food production systems. **Methods:** ● Excursion/field trip; ● Using the video: bioregion, ecological region, bio district; ● Meeting with eco-experts to discuss and observe sustainable practices for protecting and promoting biodiversity; ● An interview with the inhabitants/local actors of bio districts, preserved natural areas,

	botanical gardens; ● Making the map of farm/bio district/protected area etc. **Field visit:** Guided tour with an expert (farmer, botanist…) to the school garden, local organic farm or community garden with presentation of the agroecological techniques used for protection of the agrobiodiversity. **Individual work:** Students observe the case study to identify approaches and methods for conserving or promoting biodiversity. They can draw a plan of different systems, techniques, innovative solutions and infrastructures for promoting biodiversity at different levels (plot, farm, community, landscape) The students will analyse different cases using the On-line Data Base of the Agroecology best practices in the Bio-district – DBSs (http://www.ecoregion.info/db-bds/) to better understand how agroecology practices preserve the biodiversity. Preparation of PPT presentation and presentation from the other students group. **Results:** Oral and graphic presentation of the practical knowledge of biodiversity.

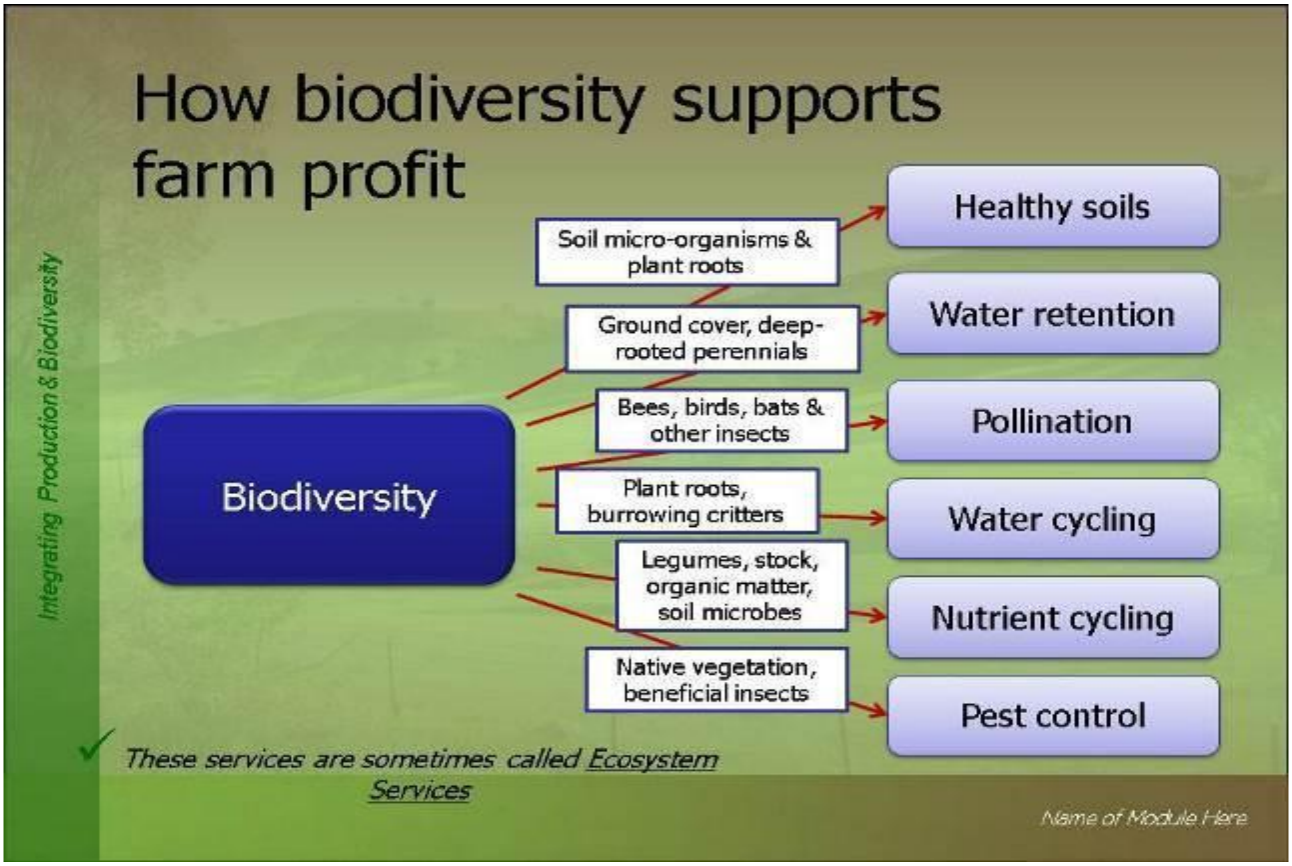


Figure 15: Biodiversity and farm profit. Source: https://www.google.si/search?q=biodiversity&source=lnms&tbm=isch&sa=X&ved=0ahUKEwiVj8q8yvLVAhWILcAKHQLFDCMQ_AUICigB&biw=2221&bih=1186#imgrc=QbQ4fa6MOSjvbM.

Resources

- Biodiversity and agroecology: http://www.organicresearchcentre.com/?go=research%20and%20development&page=Biodiversity%20and%20agro-ecology
- IN.N.E.R. Bio-districts Network English website (www.ecoregions.info)
- IN.N.E.R. Bio-districts Network Italian website (www.biodistretto.net)
- IN.N.E.R. Bio-districts Network in Facebook (www.facebook.com/biodistretti)
- IN.N.E.R. Bio-districts Network inTwitter (www.twitter.com/Biodistretti)
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3.5 MODULE: SECRET OF THE SOIL (SLOVENIA)

Knowing the soil is all the more important due to the fact that food grows in the soil and its quality depends on the health of the soil. There are many problems with fertile soil around the world as conventional methods of farming are destroying it. At the local level, soil knowledge is important for planning the use of land and for self-sufficiency. Therefore this module is intended for the use of procedures to analyse physical, chemical and biological properties of the soil, for used techniques and interpretation of results as well as developing thinking about how we can take care of our own soil to keep it healthy and adaptable to climate changes. This is especially important because the soil is the basis for plant growth, and the plants are the carrier of biodiversity in the ecosystem. By this we emphasize the responsibility towards the environment, which directly affects the social dimension, i.e. human health and their well-being. And this again affects the economic dimension of sustainability. If people are healthier and satisfied, they are more successful at work and biodiversity, healthy plants and soil directly help the development of bio-economy.

3.5.1 THEORETICAL INTRODUCTION INTO THE MODULE

The most widely recognized function of soil is its support for food production. It is the foundation for agriculture and the medium in which nearly all food-producing plants grow. Food availability relies on soils: nutritious and good quality food and animal fodder can only be produced if our soils are healthy. A healthy living soil is therefore a crucial ally to food security and nutrition.(http://www.fao.org/3/a-i4405e.pdf) and file:///C:/Users/Uporabnik%204/Downloads/Hortikultura_URN_NBN_SI_DOC-P4F78U8Y.pdf.

Healthy soils supply the essential nutrients, water, oxygen and root support that our food-producing plants need to grow and flourish. Soils also serve as a buffer to protect delicate plant roots from drastic fluctuations in temperature. Soil health, also referred to as soil quality, is defined as the continued capacity of soil to function as a vital living ecosystem that sustains plants, animals, and humans.

Therefore the soil health is at the core of agroecology. This approach recognizes the equal importance of the physical, chemical and biological soil health adapting specific practices to specific ecological conditions in order to increase soil organic matter recycle nutrients and maintain soil biodiversity.

The design of diverse agroecological systems can significantly improve soil health and reverse soil degradation while increasing the production of nutritious food. These systems build on ecological principles and are based on system diversity and ecological synergies.

Within the module, the students will learn agroecology from all aspects, that is, in terms of science, practice and movement. The module expresses above all the **educational innovation**, since the methodological approach enables deep and direct transfer of knowledge through own experiences in real circumstances into practice, which enables the individual to upgrade the new theoretical knowledge through practical experience into a permanent, useful and lifelong knowledge.

Environmental innovation is also highlighted with the emphasis on natural food production approaches that reduce negative environmental pressures while encouraging biodiversity and the rational use of renewable resources. Furthermore, the emphasis is on **technological innovation**, which presents various innovative agroecological practices for the protection and improvement of soil health, with an emphasis on adapting to climate changes without the use of heavy machinery and chemicals.

Students will learn through the module that by using natural approaches such as the use of mulch, the installation of irrigation system in garden beds, the addition of organic biomass / compost, we can improve the properties and quality of the soil, which also reduces the susceptibility of the soil to drought. The **social innovation** can be identified through the module primarily as the individual awareness of responsible behaviour and protection of the soil, spreading the awareness of self-sufficiency on the level of individuals and of the community in everyday life and the opportunity for creating own green jobs in the field of self- sufficiency.

3.5.1.1. A brief introduction on soil health in food production

Soils are habitats for human, animal and plant life. They are a vital foundation for biodiversity. Soils perform buffer and storage functions and have the capacity to transform organic material into nutrients, thereby helping to regulate the cycle of matter and to conserve and regenerate groundwater. They do not only act as carbon sinks but also release carbon into the atmosphere and thus, have a significant impact on the climate. After the oceans, soils are the world’s greatest reservoirs of the carbon. Soils are highly significant for humans. They are essential for growing food crops as well as non-food renewable resources. They are the foundation of global food security, at the same time they are an important source of income, especially in the agrarian economies of many developing countries.

Challenges and need for action: soils are a non-renewable and non-multipliable resource – it can take centuries or even millennia for new soil to form. Soil resources get under ever-increasing pressure from global population growth and the ensuring demand for additional food and raw materials.

Climate changes will have an increasing impact on soil fertility and erosion in the future. The increasing occurrence of drought and heavy rainfall will further exacerbate soil degradation and erosion. Changes in temperature and water balance will intensify the pressure on soils. But even the soil itself can contribute to climate change. Land-use changes and improper fertiliser use result in the release of greenhouse gases. The human beings are thus faced with the challenge of increasing soil productivity despite the deteriorating climatic conditions. The long-term aim must be to increase soil productivity and to conserve the area of land usable for agriculture by adopting sustainable land-use methods.

Recent developments: there is international consensus that we must respond to the anticipated changes by intensifying agriculture and land use in a sustainable manner. At the same time, we must protect the soil from degradation. However, opinions differ as to how soil productivity can be increased in the best way.

Approaches and best practices: soil conservation is a basic requirement for the maintenance of soil fertility. It is a priority that needs to be addressed before rather than after serious damage has been done. Protecting the soil demands good agricultural practices which improve the soil structure, balance nutrients and improve its water and nutrient-use efficiencies.

Land degradation and soil health: land degradation is defined as any form of deterioration of the natural potential of land that affects ecosystem integrity either in terms of reducing its sustainable ecological productivity or in terms of its native biological richness and maintenance of resilience (UN GEF). This is mainly caused by human activities. Main drivers are unsustainable agricultural practices, deforestation and ceiling of landscapes. Land degradation and desertification threaten fertile land and the benefits human society derives from throughout the world.

In order to maintain soil functions, its health is of key importance. Soil health has been defined as the capacity of soil to function as a living system. Healthy soil maintains a diverse community of soil organisms that help to control plant disease, insect and weed pests, form beneficial symbiotic associations with plant roots, recycle essential plant nutrients, improve soil structure with positive repercussions for soil water and nutrient holding capacity, and ultimately improve crop production (FAO). Hence, nutrients and microorganisms available in the soil need to be well managed to maintain its fertility in a sustainable manner.

Another general thread to agricultural land and food security is caused by non-reversible land consumption. Cities and transport infrastructure are expanding all over the world, particularly in developing countries and emerging economies. If arable land has been built on, it can no longer be used to grow food. Therefore, the dedication of land for various purposes should be planned and implemented in a wise, sensitive and sustainable manner while minimizing the consumption of arable land. On the other hand, the forests should not be considered as reserve for gaining new arable land since the forests are ecosystems in their own right and importance.

Figure 16: Soil management in practice at the Learning polygon for self-sufficiency Dole, Slovenia.

Module Title Hours: 30 Lecture: 2 Excursion/Exercise: 5 Self-work: 5 Preparation for contact time: 8 Literature review: 5 Report preparation: 5	SECRET OF THE SOIL
Interdisciplinary connections	Learning activities connected to agronomy, ecology, biology, geography, food production, organic farming and gardening, experimentation and innovative practice, organic approaches in plant production, systemic approach, group work and learning, environmental protection, self-sufficiency.
Requirements	Learning module could be implemented in the local vicinity (at school or student's home garden) or organised as a study visit to the local organic farm. It is recommended that students see samples of innovative sustainable agricultural practices to improve soil properties and its health on the basis of an interview with the head of the farm before carrying out quick soil tests on the selected farm. When interpreting the obtained results, the students will be able to identify and suggest the use of innovative agroecological practices to improve soil quality and adapt to climate change.
Results of the module	Students will learn the importance of the concept healthy soil in the food production at various levels (garden, plot, farm, landscape). They will understand it is important to consider this at different levels. They will also be able to understand that soil is the basic natural resource for food production and that health of plants and animals depends on different aspects of healthy soil: ● **The environment:** to talk about traditional and innovative practices and their impacts on soil quality improvement at different levels: plot, farm, landscape. Thus reducing environmental pressures - adapting to climate change, not using chemical agents.... ● **The economy:** to understand the reduction of the inputs to improve the soil conditions (simple arrangements in the garden, in the field and in the

	landscape) ● **The social aspect:** to detect the impact of collective work between different stakeholders to improve the practice at local level. Students understand that the land owner is obliged to monitor the conditions of the soil and that he must prevent soil degradation and handle the soil with respect. ● **The science:** by measuring the selected properties of the soil they will understand that the soil is a very complex system and that any human intervention, which is not considered before, directly affects the soil's conditions and it is therefore necessary to learn and know the soil formation laws. ● **the practice:** students identify different innovative agricultural practices based on traditional knowledge and innovations to improve the soil conditions at different levels: plot (adding mulch, quartz gravel, installation of moist retaining layers in beds, raised beds, compost), farm (biodiversity, planting of individual trees and shrubs, compost,...),landscape (windbreaks and shelterbelts, water retainers, wetlands).
Teaching approach and didactics	In this module, we focus on technical aspects but also on the environmental and social approach. Students can learn in different ways: they start from observations, field visits and exchanges with farmers/soil experts, experiences of the students. Then, guided by the teachers through open questions, the students can discuss all the information in group work. They place themselves in the role of the landowner, who wishes to obtain information about the soil conditions. They decide which soil will be analysed, why it is important to analyse the soil right there and how the results of the analysis will help to understand the sustainable use of soil. Their own research activity, that is, the soil analysis in the field, often encourages young people to want to know what their soil characteristics at home are (if they were actively involved in soil sampling and analyses at school). In this way they transfer the knowledge gained from their practical experiences to their own practice at home and reflect on the results, what they should do to improve their soil at home and achieve the desired standards.

	In agroecology, there is not only one solution to solve a problem. Various practices and changes can be set up regarding different contexts/depending on the context.
Context	The students carry out field analysis of the soil: ● Soil sampling ● Soil depth ● Soil colour ● Water in soil ● Soil structure ● Soil texture ● Reactions of the soil ● Carbonates in the soil **When analysing the soil, students get acquainted with key concepts that enable their understanding of soil formation. These are:** **Pedogenetic factors:** students through environmental observations understand the importance of individual factors, i.e. water, rock, relief, slope and land use. **Pedogenetic processes:** When observing the soil, students learn that soil properties are the result of processes that rule in the soil, such as humification, braunisation, decay and erosion. **The structure of the soil:** when observing soil particles (grudges) students understand the importance of soil structure and their role in retaining soil moisture, soil breathing and plant growth potential. The selected properties of the soil are measured either by means of an observation sheet and instructions, or by using field work cases. Then they interpret the obtained results and evaluate the condition of the soil. **Sustainable farming practices for healthy soil** Due to the loss of land fertility, we are more and more concerned about the soil care at all levels, from local to global. A new Soil Strategy is being developed for this purpose. In Slovenia, the 5th December 2017 Partnership for Soil was established, with the sole purpose of devoting greater responsibility to the soil, from education, promotion to production and decision-making on sustainable approaches. https://esdac.jrc.ec.europa.eu/projects/SOCO/FactSheets/SI%20Fact%20Sheet.pdf -

	Owners of the land themselves already decide to introduce sustainable approaches of their land use (garden, field, estate), as they find they have a positive effect on the soil conditions. Students can collect information in their own local environment about how garden owners care for their soil (either they use e.g. silicate sand, egg shells, charcoal, mulch, domestic compost). The same can be asked about how organic farmers care for the soil on cultivated areas, how they plough, what kind of manure they use, and what protective agents. In the province, they can also observe how nature has adapted itself to the flow of water, to retain water, how the man has shaped a cultural landscape (terraces, borders) and why and whether today's rules of sustainable agricultural practices derive from tradition only or are innovations (ecoremediation). Sustainable approaches in a simple way, with minimal financial resources, with minimal energy used to improve the quality and fertility of the soil, as we adapt to climate changes effectively, reduce soil susceptibility to drought and increase biodiversity.
Place or classroom and auxiliary accessories needed for the activities	Classroom; computer, projector, working space for practical work **On-site:** garden tools for excavation, suitable footwear, pen, notebook, camera, sound recorder, case for soil and water analysis. Activities can be performed at a school or home garden, community garden, in the field, organic farm or agricultural landscape. For a better implementation of the module, seeing a good practice can be organized at a local farm, which is already implementing sustainable agricultural practices to improve soil properties and adapt to climate changes. In the frame of an interview, the head of the farm will present good practices, problems and the advantages of implementing measures to improve soil quality to the students.
Evaluation	The students have to explain: ● The students explain the soil as natural source; ● They understand the healthy soil as the basis for food production; ● They explain the importance of agroecology for the preservation of soil fertility and responsible management of the natural resource; ● They explain the key physical, chemical and biological characteristics that affect the fertility of the soil; ● They can perform simple, quick soil analysis; ● They can interpret the results of the analysis; ● They can identify sustainable approaches for improving

	soil properties in the field in various criteria (garden, field, farm, landscape); ● They recognize the strengths and weaknesses of the measures and can propose improvements. Students are evaluated three ways: ● By the teacher on their class work and presentation; ● By their peers in a group assessment; ● Through a self-assessment.
Exercise	Observation of pedogenetic factors that directly influence the formation of soil (students draw a sketch of interaction of natural and social as well as historical factors) and draw attention to the regulations which often dictate soil management. In the field survey, students assess where (on the site), it would be appropriate to take soil samples, why there, and what data should be measured; why, what these data will tell them and how they can be included into sustainable soil management. When taking soil samples, the students observe the upper layer, the roots, the humus, the life in the soil, the moisture, the texture, and determine the state/conditions of the soil. The analytical part is performed according to the possibilities they have, either on the field with a quick observational test or in a school laboratory. The choice of methods and methods themselves depend on the school equipment, needs, the interest of students and time capabilities. The results of analyses are interpreted by the students in terms of natural conditions, how rocks affect texture, how weather affects moisture, and how plants affect the organic matter. The results are also evaluated from the social point of view, how the man as an anthropogenic factor changes the soil, how this increases the compaction, how this affects the proportion of humus in the soil through fertilization. They also evaluate the results of the measurements from the economic point of view, what can be cultivated in particular soil and how soil should be improved.
Intended learning outcomes	

	● Understanding all aspects of agroecology through soil, that is, environmental, social and economic aspect in connection with science, as well as understanding the formation of soil with its properties and the possibility of changing them; ● Understanding the concept of soil fertility and soil property factors; ● Students are familiar with soil properties and their representation in the environment; ● Learning the methods of simple soil analyses; ● Learning about necessary tools for their job, determine the structure, texture, moisture, colour and acidity of the soil; with the help of the results and soil characteristics they identify the type of soil and make a conclusion about a possible agrarian land use, soil intervention with the purpose to improve the quality of the soil; ● Connecting the results of the analysis with the use of soil and its cultivation; ● Value and appreciate the soil as heritage given to us, which as a natural resource allows us the cultivation of food, feed, industrial feed stocks and energy materials; ● Through the learning process, students develop the skills of critical thinking, collaborative learning, they upgrade theoretical knowledge through their own practical experiences.
Teaching and learning methods	Introductory lecture implemented by the teacher (methods and content), case study exploration (interview, observation etc.), group or individual self-study, presentation, group work, excursions, exercises
Teaching materials and media	Notepad, pen, video, soil research equipment
Project working day	Lecture: **Soil and agroecology** ● Short introductory presentation of the concept of agroecology and the presentation of a learning topic related to AE - Soil protection by food production for the health of ecosystems; ● A short film about the importance of the soil - the option http://soilsolution.org/watch-the-film/ and a presentation of the Euro-Educates film to understand the importance of AE diversity; ● Before going to the field, students gain insight into the soil research area and learn about geological, climatic, water and plant characteristics through expert literature, thematic maps and other sources - they are acquainted with pedogenetic factors, processes and soil properties. The use of online atlases is recommended to learn basic

	pedogenetic factors; ● A garden tour in the school surroundings, a field or a local farm visit is proposed. A teacher or an expert (head of the farm) presents the importance of the soil as an integral part of the landscape, a carrier of biodiversity and a medium for food production in connection with agroecology. The head of the farm presents sustainable practices carried out on the farm to improve fertility and adapting to climate changes (60 min); ● Students receive instructions for carrying out field work and are divided into smaller groups (5 min); ● On the basis of the interview with the head of the farm or an expert and the field visit, they describe agroecological practices for improving soil quality and adapting to climate changes (15 min). **Open guided questions for the interview with the farmer:** ● How do you assess soil health in the field? ● What are the agroecological practices contributing to the improvement of soil health? ● What are the benefits experienced by farmers in applying these kind of practices? ● Where are the constraints of these practices? ● What are the challenges farmers face in the field regarding the soil? ● By means of worksheets students independently carry out quick soil tests. The teacher guides them through key questions in interpreting the obtained results (30min); ● Independently, using online sources or an interview with a farmer, the students get acquainted with policy measures to promote soil-friendly practices, identify the strengths and weaknesses of individual measures; ● Developing an improvement plan / a proposal for improvement of soil health on a selected system (school or home garden, field, farm) based on taking up and sharing the roles (head of your garden or school, farm manager, farmers' community, decision makers on agricultural policies, etc.); students propose solutions from various aspects of AE (technical, educational, political) to learn and understand the concept of AE and the systemic approach to solving the problem, with emphasis on the bottom-up approach and knowledge transfer, farmer-to-farmer approach; ● Preparation of the PPT presentation or poster and presenting it to other students in the group, an open discussion to exchange the experiences and opinions; ● New knowledge evaluation.

Practical suggestions for additional learning activities	Proposals for the implementation of different learning activities to understand the importance of soil: ● How much soil is in earth – experiment with an apple, demonstration: ● Use of ICT tools; ● Field characteristics of soil for understanding the physical, chemical and biological properties of soil; ● Re-using organic matter for humus in the use of rainwater for self-sufficiency: rainwater accumulation in pond and basic physical and chemical characteristics.
Field characteristics of soil for understanding the physical, chemical and biological properties of soil	● Recognizing the soil in the field using a quick test; ● Observation and comparison of soil properties; ● Using simple tools for monitoring soil carbonates and soil reactions; ● An integrated view of the soil: what is our soil like/ what are its characteristics?
Re-using organic matter for humus in the soil	● An experiment which demonstrates the re-use of organic matter for the formation of humus; ● In agriculture the humus is often lacking in the soil, therefore, the humus content can be increased with the re-use of organic matter; ● The importance of humus in the soil for adapting to climate changes.
Using rainwater for self-sufficiency: rainwater accumulation in pond and basic physical and chemical characteristics	● Rainwater retention is an old approach where people used rainwater for watering and irrigation and as an ecosystem for animals; ● We know simple approaches how to make a puddle or pond (grassy basin, or using tires and foil), where we can collect rainwater to use in a school garden or at home; ● With simple tools - indicators, we can check the content of nitrites, nitrates, phosphates, reaction and colour and the content of floating particles; ● Collecting rainwater and re-using it reduces the possibility of flooding, drought and supports the ecosystem balance.

Resources

- https://esdac.jrc.ec.europa.eu/projects/SoilTrec/Documents/SoilTrEC_SoilSchoolBook_FINAL.pdf
- http://www.soil-net.com/dev/page.cfm?pageid=secondary_intro&loginas=anon_secondary
- http://www.iperca.org/our-e-learning-tool/
- http://e-learning.rua.edu.kh/courses/soil-organic-matter/

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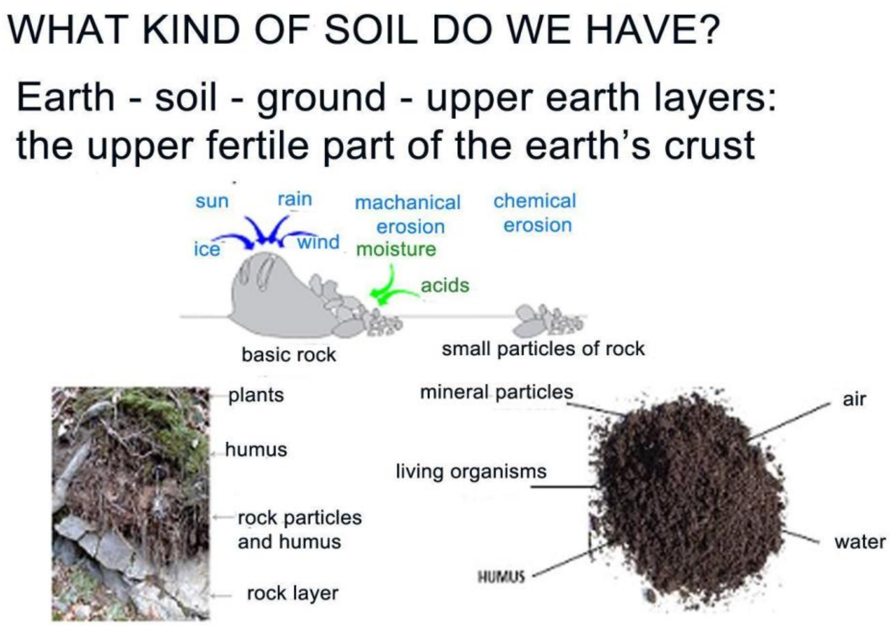
Ana VOVK KORŽE in Franc LOVRENČAK, Maribor, Ljubljana, 2004, Oddelek za geografijo Filozofske fakultete Univerze v Ljubljani, 49 strani (ISBN 961-237-105-9). PRIROČNIK ZA SPOZNAVANJE PRSTI NA TERENU= Ana Vovk Korže and Franc Lovrenčak. Maribor, Ljubljana.2004. Department for Geography, Faculty of Arts, University in Ljubljana. 49 pages. (ISBN 961-237-105-9). MANUAL FOR FIELDWORK WITH SOILS

3.5.2 WORKSHEETS FOR SIMPLE SOIL ANALYSES

For better understanding of basic physical, chemical and biological properties of soil the students should carried out simple soil analyses based on finger tests. Activities can be performed at a school or home garden, community garden, in the field, organic farm or agricultural landscape.

TEST 1: What kind of soil do we have?



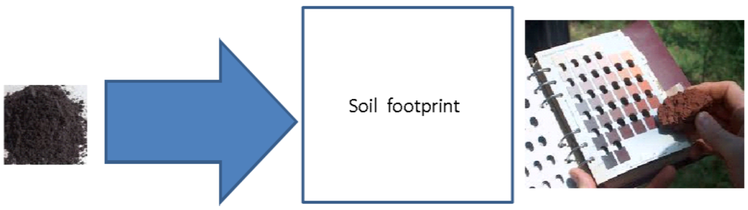
TEST 2: Colour of the soil

COLOUR OF THE SOIL

COLOUR – indicates the amount of organic matter and humus in the soil.

Result: dark colour – a lot of humus.

Light colour – little humus

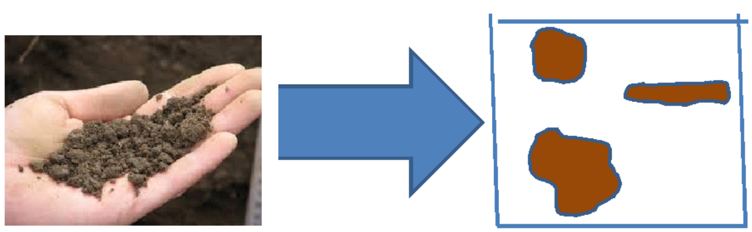


TEST 3: Form of soil particles

FORM OF SOIL PARTICLES

The form of soil particles is called structure and it tells us much about water holding capacity of the soil.

Result: round shape – water is retained.
Rectangular, thin shape – water drains.



TEST 4: Soil granularity or soil Texture

Soil granularity or soil texture

Soil granularity tells us how much sand and clay the soil contains.

If it can be rolled, it is clay in texture.
If it cannot be rolled into a worm - it is sandy.

It can form a roll

or

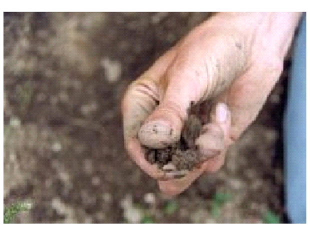
it cannot form a roll.

TEST 5: Soil cohesion or soil adhesiveness

Soil cohesion/soil adhesiveness

The data about soil cohesion give us information about water holding capacity of soil, how long the soil can hold moisture.

The soils which immediately become dry are not sticky and cannot hold moist.
The soils with a higher moisture content retain water longer and are therefore sticky.



The soil is sticky

or

not sticky.

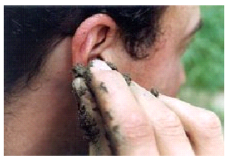
We rub the soil with our fingers as if we were “counting” and thus we feel its stickiness.
If a roll is formed, it is sticky, otherwise it is not.

TEST 6: The presence of rock fragments in the soil - skeleton

The presence of rock fragments in the soil - skeleton

The presence of rock fragments is called a skeleton.
It causes dryness of the soil – the more it is present in the soil, the more is soil subject to draught.

We rub the soil with our fingers and try to hear the creaking.



The soil creaks

or

the soil does not creak.

If there is no sound, the soil has no skeleton.
If there is creaking, the soil has skeleton.

TEST 7: The content of nutrients in the soil

The content of nutrients in the soil

Nutrients allow plant growth and life in the soil. If the soil is immersed in vinegar and it foams, this means that it contains nutrients. And vice versa, if nothing foams, it does have calcium, potassium, magnesium.

Foams

or

dos not foam.

Foams ? - Contains nutrients.

Does not foam? – Does not contain nutrients.

TEST 8: reaction – soil acidity

Reaction – soil acidity

The reaction of the soil significantly affects the availability of nutrients, so it is important to know the pH value. If the soil is acidic, the nutrients are not accessible, if it is too basic, the salts that kill the soil are secreted, so in most cases the ideal is poorly acidic to poorly basic reaction.

pH 4 6 is an acidic soil

pH 6 to 7 is slightly acidic to neutral

pH 7 to 8 is neutral to slightly alkaline

pH above 8 is a basic soil

IF the pH is not appropriate, change it with quartz sand, limestone sand or natural substances.

TEST 9: What is our soil like?

What is our soil like?

1 Humus content

2 Water outflow

3 Sandy or clay

4 Water retention

5 Dryness

6 Nutrient content

7 Availability of nutrients

How do the measured properties affect the fertility of the soil?

Examples of Slovenian and EU online atlases

Slovenian Atlas of the environment http://gis.arso.gov.si/atlasokolja/profile.aspx?id=Atlas_Okolja_AXL@Arso
PISO portal https://www.geoprostor.net/piso/ewmap.asp?obcina=BENEDIKT
Slovenian Soil Data Information System http://www.kis.si/eTLA
Slovenian Infrastructure Center for Pedology and Environmental Protection http://soil.bf.uni-lj.si/index.php
Public soil information for Slovenia: http://rkg.gov.si/GERK/
European soil data centre https://esdac.jrc.ec.europa.eu/

Resources

https://extension.psu.edu/soil-quality
http://www.sustainabletable.org/207/soil-quality
http://www.fao.org/3/a-i4405e.pdf
https://esdac.jrc.ec.europa.eu/projects/SOCO/FactSheets/SI%20Fact%20Sheet.pdf
https://www.thespruce.com/easy-diy-soil-tests-2539856
http://teca.fao.org/discussion/agroecology-and-soil-health
http://www.fao.org/3/a-i4803e.pdf
https://www.researchgate.net/publication/24181662_Concept_Components_and_Strategies_of_Soil_Health_in_Agroecosystems
https://remineralize.org/
https://www.sare.org/Learning-Center/Books/Building-Soils-for-Better-Crops-3rd-Edition/Text-Version/Introduction/Soil-Health-Integral-to-Sustainable-Agriculture
https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/soils/health/
https://link.springer.com/article/10.1007/s13593-015-0285-2
http://newmedit.iamb.it/share/img_new_medit_articoli/469_11gangatharan.pdf

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4 ADDITIONAL INFORMATION TO THE MODULES

4.1. Module: Territory Farms Autonomy for Food Self-Sufficiency in Breeding System

Source: https://www.animalsciencepublications.org/publications/af/articles/1/2/anfront_1_2_005

4.1.1 World Trade Organization and Common Agricultural Policy

In the long run, the European beef sector is potentially sensitive to the decisions that will be taken in the next agreement of the World Trade Organization (**WTO**) and in the Common Agricultural Policy (**CAP**). The Doha Round, which started in 2001, has not been finalized yet due to disagreements among countries concerning European agriculture including the beef sector through three topics:

- How direct payments are granted to beef producers. To be considered compatible with the criteria defined in the WTO (Article 6 of Annex 2 of the Uruguay Round Agreement on Agriculture), subsidies paid to farmers should be decoupled (Swinbank, 2008), meaning that they should not be awarded on the basis of agricultural production from farms or on the basis of evolution of prices (domestic or international). To accommodate this requirement, the EU authorities decided to reform the CAP in 2003 and 2008. They made mandatory the application in all member states of a decoupling of direct payments to avoid the risk that a future WTO agreement would require a reduction of the EU agricultural funds (including funds for the beef sector for which the average amount of direct aid is often greater than incomes). In the European Commission proposals for the post-2013 CAP, an exemption to this general rule was allowed for the specific case of suckler cows. Thus, for member states who express a desire, coupled support may be maintained. Considered unnecessary by some member states (such as Ireland and Germany), this option was judged to be necessary by the French authorities. In France, the government feared that the decoupling of aid would lead to a drastic decline in the herd of suckler cows and thus in the production of beef, especially in mountain areas where alternatives are often scarce. With decoupling, some farmers could adopt a strategy not to produce beef while continuing to receive direct payments historically allocated to this production. The European offer of beef (and its territorial distribution) could be sensitive to changing rules for awarding direct aids to farmers in the future.

- Aid granted by public authorities to promote exports of agricultural products on international markets. The level of export refunds has decreased substantially in the EU over time: from 10 billion euros in 1990 to less than 1 billion in 2010. In the next World Trade Organization (WTO) agreement, these aids will probably be prohibited. The European beef sector need not fear a prohibition because exports of beef have become marginal (primarily with the bordering countries) and should remain so in the coming decades. Export of beef will mainly concern some special beef (in terms of quality) and some live animals (export of know-how in genetics).

- Border protection through tariffs (which is different than border protection through EU bans on growth promotions or on other types of products for safety reasons). At this stage of the multilateral negotiations in the (delayed) Doha Round, it has been agreed that the future reduction in customs duties on agricultural and food products will be applied according to what is called a tiered formula. This means that a 50% reduction in customs duties is foreseen (compared with a past reference period) for products whose final consolidated tariff (or the *ad valorem* equivalent, AVE) is less than 20%; a 57% reduction for the 20 to 50% AVE bracket 64% for the 50 to 75% bracket and 70% for the AVE bracket exceeding 70% (as the beef sector). The sensitivity of different European agricultural products to this possible future reduction in customs duties is not standard because the difference between the EU price and the international price varies from one product to another. In the beef sector, the EU price is generally significantly greater than that of the large exporting countries (Institut de l'Elevage, 2011). Customs duties applied at the EU borders are still substantial: 12.8% of the value and 3 euros per kilogram for boned, chilled, and frozen meat. With the exception of the possible (justified) classification of the beef tariff headings as sensitive products (products benefiting, by way of exception, from a lower reduction in customs duties), a large reduction in tariff protection prompts the fear of downward pressure on the price of EU beef. As discussed below, a low price of beef and consequently a low income for beef producers will not help to sustain rural communities in some specific parts of Europe.

In addition to multilateral trade agreements, the future dynamics of the European beef sector will also depend on internal choices concerning the next CAP reforms (European Commission, 2010b). European production of beef in the coming decades will be particularly sensitive to changes in the dairy sector (i.e., the pace of development of milk production to meet growing international demand for dairy products). The abolition of milk quotas in 2015 and the introduction of decoupling of direct payments could encourage the development of milk production in the most competitive geographical areas at the expense of other less profitable agricultural production. For example, in a country like Ireland, milk production is likely to grow at the expense of suckler cows. In France, an increased concentration of the herd of suckler cows in disadvantaged areas is possible. In geographical areas where cereal production is possible, the risk of abandoning beef production for the benefit of cereal crops is a serious threat, especially if cereal prices remain durably high (Chatellier, 2011). Should it become necessary to increase the herd of suckler cows to maintain a certain level of beef production in the EU, France is surely the country with the greatest potential for doing so (due to a low population density in rural areas and to its large fodder areas).

The specialized beef farms will also be very sensitive to changes in the amount of direct aid. Given the level of production costs and the selling prices of animals, the income of these farms is, on European average, well below the amount of direct aid. In the context of the future CAP reform and EU financial perspectives for the 2014-2020 period, the issue of targeting direct aid will be crucial for the beef sector. To support this sector in the long term, direct aid should be better allocated, in the sense of payment for environmental and territorial services to preserve rural employment.

The level of beef production will also depend heavily on price relationships between crop and animal production. The beef sector needs more stable prices, given the length of the beef production cycle (long) and the low return on capital. In this sense, it seems important that the future CAP maintains some instruments to regulate the market (public intervention when the price drops to a low level) and encourages young farmers to start up. It also seems necessary to build some new tools to help European producers to deal with price volatility. The fight against price volatility requires modifying tax policies, adopting new risk management instruments and implementing a better coordination of agricultural policies at the international level (Pisani and Chatellier, 2011).

Social Considerations

One major social consideration is strongly associated with competitiveness of the beef supply chain. Ensuring a minimum income for beef producers is vital to sustaining vibrant rural communities, which is important for local governments. Indeed, the more producers in rural areas, the more other activities will be developed, and this is highly important for the economic development of mountain grassland areas in which no other agricultural activity is possible except ruminant breeding for the production of typical meat and dairy products. This concerns not only bovine but also ovine breeding. We can observe here a convergence of objectives between social expectations, competitiveness of the beef supply chain, and the assurance of beef quality linked to geographical origin.

Many other social considerations have to be taken into account mainly in developed countries because consumers of beef are citizens who are expressing their thoughts and emotions in the modern media. The industrialization of animal production systems during the last 50 years and the progressive distance of cities from farms have raised questions concerning livestock production systems, including animal welfare. In the context of safety crises and media events (boycotts of veal meat, illicit trading, use of hormones, and the "mad cow" crisis), citizens believe that herbivores should eat grass, which is a natural and cheap product available in pastures. This natural way of production is supposed to preserve animal welfare as well as to protect the environment, two points expected by citizens at least in France (Tavoularis, 2008) and which we will discuss in more detail.

In the Amsterdam treaty (1997), the European Union acknowledges that animals are sentient beings and stipulates that animal welfare shall be taken into account in farming. Consumers in the EU support the improvement of animal welfare in Europe and are prepared to pay more for animal welfare-friendly products. The objective of research and development activity is thus to improve the general level of animal welfare by introducing standard welfare indicators (Botreau et al., 2009). Some basic studies are still needed to better characterize the welfare state of an animal and to better understand the mechanisms of plasticity allowing animals to adapt, in a suitable and timely manner, to a variety of farming conditions. Novel and cheap biosensors or other technological innovations are new tools for online monitoring of animal health or reproductive status to better assess overall animal welfare. Non-invasive practices such as simple manipulation of farming environmental parameters (light, odour, temperature, noise, food delivery, and social partner effects) also have to be taken into account to improve animal welfare. Research should take advantage of modern techniques such as imaging, "omics," and modelling. Because animal welfare is multifactorial, quantitative modelling is a key tool to be developed to better assess animal welfare, taking into account all the factors that influence animal welfare. Putting animal welfare assessment into practice will be the last, but not the least, challenge in this area.

Environmental Considerations

For millennia, human beings have lived in harmony with animals, but this is less the case because of an increased distance between the majority of the population living in cities and those living on farms in rural areas, with fewer connections between them. In addition, our natural resources are being exploited in an unsustainable manner to maintain growth of livestock production systems to satisfy the increasing demand for animal products including beef. Furthermore, the emergence of new challenges concerning global climate change is a further major problem for agriculture, especially for beef production, which has been calculated to be among the worst in terms of carbon footprint. Therefore, the consequences of global change on livestock systems should be taken into account in agricultural research and practices. More precisely, livestock sector governance should be strengthened to ensure that its development is environmentally sustainable (Figure 1; FAO, 2009). In addition, farmers are now looking for robust animals; that is, animals that can adapt more easily to environmental challenge (Friggens et al., 2010).

Livestock have been implicated in many negative processes: land use change especially in developing countries, nutrient excretion, fossil energy use (e.g., feed production and transportation across oceans), competition for food, and emission of greenhouse gases. Only a few examples of these injurious situations and the potential ways to reduce them will be detailed here; these topics were detailed and discussed in the first issue of *Animal Frontiers*.

First, the increasing general awareness of the environmental problems tied to cattle farming should prompt a series of research and practical initiatives designed to assess the environmental impacts of farming systems parallel to their economic performance (Veysset et al., 2010). Better and harmonized methods with increased precision to assess the ecological footprint of animal products should be developed and applied to all production types (Hermansen and Kristensen, 2011).

Second, research is still needed to reduce greenhouse gas emissions, especially methane, from livestock production, and especially from beef. This can be achieved by different means, for instance, by the improvement of existing farming systems and the development of innovative new systems that minimize waste and also by basic research on ruminant microbiota to reduce methane production during the digestion process (Martin et al., 2010), although it is difficult to see how to convert scientific results in this area into practice (Hermansen and Kristensen, 2011). It is noteworthy to indicate here that methane emissions from cattle are correlated with the quantity and quality of ingested cell walls.

Third, intensification of animal farming systems induced an increase in nitrogen spillage in the soil-crop-animal interaction. In the next future, the strategy should be closure of the nutrient cycle at the farm level, which can only be obtained when an integrated whole system approach is used. This implies a greater feed autonomy, and especially (closely linked) forage autonomy of farms. In addition, more basic research and modelling approaches (Martineau et al., 2011) are needed to reduce nitrogen excretion into the environment through the optimization of digestive and metabolic functions, an improved understanding and prediction of dietary nitrogen utilization for production, and a reduced excretion in urine and faeces.

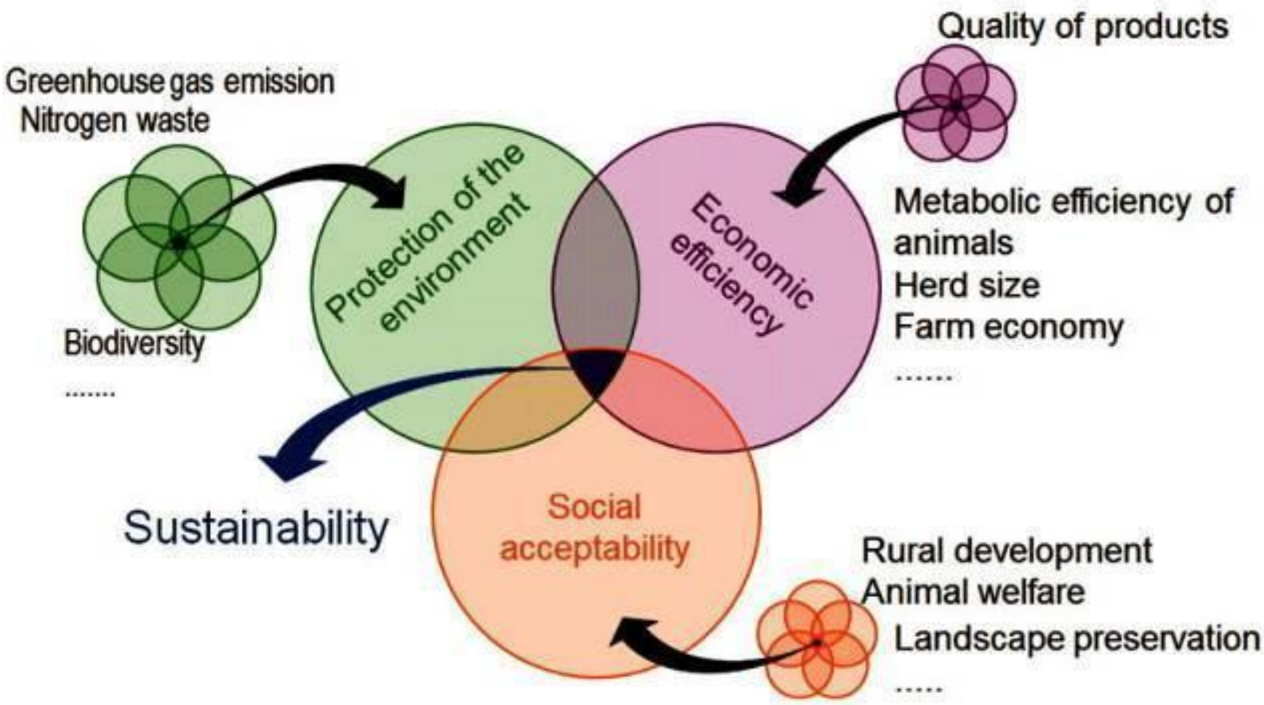

Figure 17: Sustainability of livestock farming is a multidimensional approach with 3 major dimensions, which result in turn from the aggregation of different criteria.

At the same time, livestock farming systems offer numerous benefits: producing food from human-inedible sources, preserving ecosystem services, recycling plant nutrients, and providing social benefits that have been previously discussed. But livestock farming systems can offer even more such as helping with the sequestration of carbon in the soil, preserving plant and insect biodiversity, and conserving landscape for tourism purposes, depending on the farming practices. Sequestration of carbon in the soil can reach 50% of the emissions and is greater when the stocking rate is low and with grassland systems (Soussana et al., 2010). We need to improve tools to assess carbon sequestration at the farm scale, and more importantly, practice livestock farming methods to increase this sequestration (Hermansen and Kristensen, 2011). Second, some research has already been done on the evolution of plant species abundance within a stocking rate gradient and to assess the nutritive value of permanent pasture as well as plant and insect biodiversity. A model has been developed to explore the response to management practices favourable to biodiversity: this is possible by using more late-cut grasslands (Jouven and Baumont, 2008).

To summarize this section, animal production systems must preserve and enhance our environment rather than degrade it. It is clear from the above examples that livestock, and especially livestock used for beef production, can achieve this goal thanks to significant changes such as more extensive systems in grassland areas or more intensive sustainable and environmentally acceptable farming systems. Indeed, intensive and self-sufficient systems for low negative environmental impact are in a good position to achieve satisfactory economic results and have low sensitivity to price volatility in the current economic context (Mosnier et al., 2010).

More Efficient and Robust Animals and Better Genetics

Of utmost importance is the urgency to keep (or even increase) competitiveness of animal production systems to maintain farms and farmers with a sufficient degree of income, autonomy, and responsibility. The opening of a worldwide market of animal products has considerably changed the objectives of future European livestock systems. Producers should adapt themselves and their livestock systems to this new situation that has placed them in direct competition with faraway producers they do not know. A French study has shown that beef farmers have increased their competitiveness by more than 45% in the last 20 years (less than 10% due to genetics, nutrition, and breeding and about 40% due to an increase in herd size per farmer). Indeed, consequences of farm restructuring were much more important than the benefits of the progress in genetics and nutrition. Unfortunately, the average income for beef producers did not increase. In fact, it remained almost constant over 20 years despite a huge increase in financial aid from the Europe Community (Veysset et al., 2005 and personal communication). This asks the question whether it is still possible to increase the economic efficiency of production.

It is clear that the cost of feed has always represented a main part of the production cost of animal products, especially in the case of beef because the efficiency of metabolizable energy utilization for body gain above maintenance is low in ruminants (30 to 70%) compared with body gain in monogastrics (75 to 85%; Reid et al., 1980). At an animal level, meat production by ruminants is less efficient than by pigs or poultry, in part due to lower digestibility of forages compared with grains. Unfortunately, the cost of grain (which is used for fattening of cattle) has markedly increased lately, placing more emphasis on forage to maintain competitiveness (e.g., in the United States; Winslow, 2011). There is also a strong demand for natural feeding of ruminants (pastures) for improved animal health and welfare, limiting the use of antibiotics and other medication. This means animals will be more robust to be able to adapt to environmental challenges across seasons and across years (Friggens et al., 2010). At the same time, there is an increased competition for land use between the production of food for humans, the production of feed for farm animals, and other agricultural or non-agricultural use of land. The efficiency of energy utilization in cattle is thus a determinant of the profitability of beef production (Reynolds et al., 2011). This again emphasizes the key role of good efficiency management in production. Improving our knowledge of the regulation of ingestive and digestive processes will be a major scientific challenge that will allow adapting animal nutrition to constantly changing climatic and economic situations, while preserving metabolic efficiency. Variation between animals in feed conversion efficiency may have genetic components, allowing the selection of animals with greater efficiency. Although at least 90% of production is due to the environment (management, feed, animal health, and housing) and only a maximum of 10% due to the genetic ability of the animal, the recent sequencing of the cattle genome and the development of "omic" approaches have opened a new scientific era to better understand metabolism and hence improve nutrition and biological efficiency of cattle (Cassar-Malek et al., 2007) and humans (Hocquette et al., 2010). The analysis of the interaction between nutrition and genotype to produce animals with greater metabolic capacities to deal with new climatic constraints is another promising area of research. Knowledge of molecular aspects of digestion (which have received relatively little attention up to now) will be very important to understand how genetics and development of the animal affect the digestive process and to understand how animals use nutrients for different physiological functions (e.g., digestive function, growth, or reproduction).

In this context, the example of the beef chain in Australia may be useful to study. In Australia, farmers measure the cost of everything, especially the cost of animal feeds, and only use the best feed and the best genetics, with the best management system, and consequently, they never stop learning and are hence better educated than 30 years ago. In Australia, farmers have no government support, so they live or die by what they do (Kirton, 2011). We call that precision livestock farming, which should be developed as well in Europe. Some European countries have the advantage of feeding ruminants with grass at pasture and have been doing so for decades, whereas many Anglo-Saxon countries seem to be rediscovering this "natural beef." From an economic point of view, a profitable beef production sector will continue to exist in Western Europe in marginal grass land areas with low costs for land and natural resources such as grass and with efficient short-term fattening procedures (Mihina et al., 2007). More generally, sources of feed for beef production should be primarily human-inedible materials such as forage from land unsuitable for growing crops, crop residues, or food- and fibre-processing by-products. This is already the case in developing countries such as China.

The Management of Beef Quality

One major but classic issue is the need to control animal products for human satisfaction and nutrition from a quantitative point of view. Consumers are also asking for eating enjoyment and convenience. In addition, animal products (e.g., fresh meat or meat in ready meals) must provide essential elements for life and should be included in the human diet to meet but not exceed human needs, thus avoiding health problems that are well-developed in modern society (e.g., obesity, cardiovascular risk, and cancer; Scollan et al., 2011). The second objective is predominant in developed countries, whereas the first one is more important in developing countries in which a large part of human populations still do not have enough to eat. It is noteworthy that the hierarchy by consumers between safety, efficiency, technological value, sensory and nutritional values of products, convenience, and other considerations (such as the carbon footprint) depends on the geographical location, with more emphasis on environmental and social concerns in Europe. Of course, these considerations (especially the quality criteria) have to be adapted with the development of ready-to-use products. Nowadays, some emphasis is placed on controlling variability in palatability in most developed countries. The controversial association between meat consumption and incidence of certain cancers needs clarification, but recent studies suggest this is of more importance for processed red meat products compared with intact meat (Scollan et al., 2011).

Regarding these challenges, the priority in our opinion should be a much greater integration of the beef supply chain with many more connections between actors (farmers, producers, abattoirs, wholesalers, and retailers). It should be noted that all disagreements within the beef supply chain (for instance between farmers and abattoirs, or between abattoirs and wholesalers) not only impair the overall efficiency of the process of quality guarantee for consumers, but also favour an unequal distribution of added values between actors. The consequence of consumer dissatisfaction is a progressive decrease in beef consumption per capita as observed in most developed countries. The consequence of disputes between actors of the beef supply chain is their incapacity to guarantee quality for consumers and to tell them the truth. We observe much contradictory or complex information given to consumers, or even a lack of or imprecise information, making it very difficult for consumers to find out what they need to know about beef.

The European beef product market is highly differentiated and very segmented because of the presence of many official quality signs under national or European labelling systems indicating high quality, environmental quality (organic farming), or quality linked to origin or provenance that coexist with many other distinctions, certified products, and brands. This wealth of schemes and labels creates a highly complex situation with a probable risk of information overload for consumers. Generally, consumers have a favourable *a priori* perception of products that carry some specific official quality signs (e.g., the organic farming label and the French quality sign Label Rouge), but they express a degree of misunderstanding on the real guarantees offered by them. Clearly, a high price for products with an official quality sign is a negative factor for purchases. In addition, increasing price sensitivity hampers products that carry an official quality sign, and younger consumers are less sensitive to the presence of an official quality sign (Tavoularis, 2008). These two observations are unfavourable for the further development of high-quality beef despite a demand by consumers and stakeholders in the food chain for quality guarantee systems. Safety and competitive prices have always been the main reasons driving food purchases in Europe and will continue to be so and to be of more importance than origin, brand, quality, or a combination of these.

All these observations do not raise specific scientific questions but mainly challenge the beef supply chain organization. One main challenge is how to apply our scientific know-how because it is presently not fully exploited (Scollan et al., 2011). Another challenge is to combine farming, genetics, biology, new genomic approaches (Hocquette et al., 2007, 2009), and traditional meat science to improve beef quality. Surely, these new challenges reinforce the need to conduct research in an industrial context. Indeed, scientific research should have an economic impact. In the case of red meat, we also have to work on its competitive advantages for human health (important source of proteins, omega-3 fatty acids, and minerals such as iron and zinc). One objective would be to get nutritional value signals into the supply chain by marketing the key positive attributes of red meat. Unlike beef from Asia and America, beef from Europe is mostly lean especially when it is produced from late-maturing European beef breeds such as Charolais, Limousin, Belgian Blue, or Blonde d'Aquitaine (Hocquette et al., 2010), and we must promote this European specificity. Consumer purchase of animal products is essential in supporting the beef market, and therefore, the meat must be of high and consistent eating quality (Scollan et al., 2011). One very good example of such pragmatic and industry-oriented research in the beef quality area is the development of the Meat Standards Australia grading scheme to predict beef quality for consumers. This system is comprehensive, accurate, and scientifically supported, and most importantly, consumer-oriented. The Meat Standards Australia has identified the critical control points of beef palatability for individual muscles and for specific cooking methods and aging times. The scheme is the result of a high degree of cooperation between scientists and professionals from farm to plate and would introduce the much needed changes to support the preservation and the development of the beef sector. It could be very useful both scientifically and politically in Europe where the beef industry is much too conservative (Hocquette et al., 2011).

Conclusions

Various scientific, strategic, and organizational aspects were evoked throughout the paper for different purposes and should be summarized here to define our views for the future of the beef supply chain.

Generally, recent developments in the fields of animal genetics, genomics (including genome sequencing and nutrigenomics), up to metabolomics provide important research approaches to investigate how genetic and nutritional variations regulate phenotypic variation in livestock, including the variation in sustainability traits (nutrient use efficiency, emissions, health, robustness). However, genomics alone is not a powerful enough tool and should be combined with phenomics, a modern word meaning high-throughput phenotyping, which became recently the bottleneck of modern biology. To address these issues with state-of-the-art concepts and technologies, a network of advanced and standardized phenotyping infrastructures, such as facilities for measuring greenhouse gas emissions or nutrient use efficiency, is required.

Despite these developments of basic research, the scientific questions should be targeted at practical issues; for example, the development of predictive approaches based on the systematic exploration of living organisms at different organizational levels and in different living conditions. This approach would provide more insight into whole animal response as a function of farming practices. Consequently, the introduction of modelling in biology is needed. Better knowledge of animal biology would help the development of precision livestock farming.

Focusing on efficiency of nutrition is also an essential challenge to limit the cost of using high-quality nutrient resources as animal feed and to reduce potentially harmful emissions (e.g. carbon, methane, and nitrogen). The new context will impose novel diet formulations for which digestive responses should be evaluated. The use of these concepts in animal feed requires knowledge of feed nutritional characteristics and an understanding of the response of the animal to specific nutrients (in terms of animal performance and product quality). The potential to maximize forage utilization by ruminants calls for an improvement of our knowledge on forage intake and digestion, and also on carbon sequestration in soils. The publication of tables of feed value and feed evaluation systems have been major accomplishments, but the development of a European system of farm animal nutrition would be a key step toward a more efficient use of scientific resources adapted to European concerns (and may differ from those from other parts of the world). Furthermore, there is an increasing demand to evaluate feeds based on multiple criteria including nutrition, product quality, animal health and welfare, traceability, and general sustainability.

Whereas research priorities to mitigate climate change and optimize beef quality were perceived by most actors to be in direct conflict and mutually exclusive, it is more and more acknowledged that in farming, economic, social, and environmental performances are inseparable and are positively linked. Livestock do offer many benefits to ecosystems; notably they provide a means for managing grasslands while providing human beings with meat and dairy products. Society is also calling for a manifold re-greening of agricultural systems. Livestock farmers are therefore forced to adapt their farming systems if they hope to preserve their income and offer products geared to the market need and to societal demand for sound, environmentally friendly farming practices. Although raising livestock is justifiable ecologically, it does not necessarily mean that all ways of raising them are, or that ruminants are needed everywhere. Researchers, in concern with farmers, are asked to look some decades ahead and envision new ways of raising animals to amplify their benefits (Janzen, 2011). The challenge is to develop new concepts for efficient and sustainable animal farming and nutrition, especially in beef production for which the metabolic efficiency is low compared with milk production or meat production from monogastric animals. Beef should be produced using fewer natural resources in more sustainable livestock systems. This concept of sustainability should include environmental, economic, and social issues (Capper, 2011) and consider the interaction between land use, carbon footprints of foods, and expectations of consumers, instead of focusing only on productivity (Hermansen and Kristensen, 2011).

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Jean-François Hocquette graduated as an engineer in agronomy and received a PhD in endocrinology. Since 1991, he has been a research scientist at INRA (France). He was appointed in 1999, head of the Muscle Growth and Metabolism group, and, in 2006 until 2011, director of the Herbivore Research Unit (172 staff, [View Article]). J. F. Hocquette's research interest concerns muscle biology as relevant to beef quality. He has co-authored a book about milk and beef quality and patented a genomic marker for meat tenderness. He has been an invited speaker at 26 conferences. Hocquette is a member of the French Meat Academy and is involved in the activity of the EAAP Cattle Commission.

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Scollan, N. D., P. L. Greenwood, C. J. Newbold, D. R. Yáñez Ruiz, K. J. Shingfield, R. J. Wallace, and J. F. Hocquette. 2011. . Future research priorities for animal production in a changing world. Anim. Prod. Sci. 51:1–5. **[View Article] [Web of Science]**

Soussana, J. F., T. Tallec, and V. Blanfort. 2010. . Mitigating the greenhouse gas balance of ruminant production systems through carbon sequestration in grasslands. Animal 4:334–350. **[View Article] [Web of Science]**

A. Swinbank 2008. . Potential WTO challenges to the CAP. Can. J. Agric. Econ. 56:445–456. **[View Article]**

G. Tavoularis 2008. . Les signes officiels de qualité en perte de reconnaissance. Crédoc.Consommation et mode de vie. ISSN 0295-9976. No. 212, June 10, 2008.

Veysset, P., M. Lherm, and D. Bébin. 2005. . Evolutions, scatters and determinants of the farm income in suckler cattle Charolais farms.A study over 15 years (1989-2003) from a 69 farm constant sample. Prod. Anim. 18:265–275. **[Web of Science]**

Veysset, P., M. Lherm, and D. Bébin. 2010. . Energy consumption, greenhouse gas emissions and economic performance assessments in French Charolais suckler cattle farms: Model-based analysis and forecasts. Agric. Syst. 103:41–50. **[View Article] [Web of Science]**

F. A. Winslow 2011. . The current situation and future direction of beef cattle production in the USA. International Workshop on Beef Cattle Production Technology. April 29, 2011.Beijing, China.

4.2. Module: Community gardens

4.2.1. Helpful Community Gardening links

France

http://www.jardinons-ensemble.org/

http://balises.bpi.fr/arts/le-jardin-partage--le-jardin-auguste-renoir-a-paris

http://rade-de-brest.infini.fr/projet-de-jardin-partage-a-st.html

https://www.paris.fr/services-et-infos-pratiques/environnement-et-espaces-verts/nature-et-espaces-verts/les-jardins-partages-203

https://france3-regions.francetvinfo.fr/auvergne-rhone-alpes/rhone/lyon/43e-jardin-partage-lyon-s-est-installe-rives-saone-1023005.html

http://almamater-psud.blogspot.co.at/

Austria

https://gartenpolylog.org/gardens

https://gartenpolylog.org/de/gartenpolylog-gemeinschaftsgarten/was-sind-gemeinschaftsgarten

http://garteln-in-wien.at/gemeinschaftsgaerten-und-nachbarschaftsgaerten/

Lithuania

https://citiesintransition.eu/cityreport/a-pioneer-in-vilnius-the-first-lithuanian-urban-farm

http://pu-pa.eu/collective-gardens-revival/

https://www.delfi.lt/grynas/gyvenimas/vilniuje-suzaliuos-tarptautinis-bendruomenes-darzas.d?id=71376544

Slovenia

http://prostorisodelovanja.si/skupnostni-vrt-v-borovi-vasi/

http://www.smartcitymaribor.si/si/Projekti/Pametno_bivanje_in_urbano_nacrtovanje/Skupnostni_urbani_EKO_vrt/

Italy

http://urbanitaly.com/milan-community-garden/

https://prezi.com/zx9nkkm76dao/community-gardening-in-northern-italy/

https://giardiniintransito.wordpress.com

http://www.giardininviaggio.it/tag/giardini-comunitari

Community garden lesson plans and curricula*

https://www.growing-gardens.org/wp-content/uploads/2013/03/Growing-Gardens-Youth-Grow-Lesson-Plan-Manual-Jan-2016.pdf

http://growing-minds.org/garden-lesson-plans/

https://www.arocha.ca/wordpress/wp-content/uploads/2016/02/Community-Gardening-Resouce-Links-for-School-Teachers1.pdf

http://gardening.cals.cornell.edu/lessons/

*The age groups that these lesson plans target varies so be aware that you might have to simplify or make more complex various lessons for your students

Community gardens and the food system lesson plans and curricula:

This blog suggests many activities at the end of this blog page concerning soil, beneficial animals, parts of plants, etc these can be easily linked to the entire garden system or used to show the sub-systems involved within the overall community garden. Here a description of a sensory garden is given:

https://gardenatschool.wordpress.com/2014/09/28/sensory-garden-ideas/

Here is a book that focuses on food systems curricula that you can integrate into your lesson plans:

https://thefoodproject.squarespace.com/book-sales

This is a link to a dissertation focusing on food systems and learning gardens packed with pedagogical techniques and theories, cases studies and best practices:

https://pdxscholar.library.pdx.edu/cgi/viewcontent.cgi?article=1608&context=open_access_etds

4.3. Module: Ecovillage

https://ecovillage.org/about/vision-mission-goals/

4.3.1. WHO IS THE GLOBAL ECOVILLAGE NETWORK?

The Global Ecovillage Network (GEN) is a growing network of regenerative communities and initiatives that bridge cultures, countries, and continents.

GEN builds bridges between policy-makers, governments, NGOs, academics, entrepreneurs, activists, community networks and ecologically-minded individuals across the globe in order to develop strategies for a global transition to resilient communities and cultures.

4.3.2. WHAT IS AN ECOVILLAGE?

An ecovillage is an intentional, traditional or urban community that is consciously designed through locally owned, participatory processes in all four dimensions of sustainability (social, culture, ecology and economy) to regenerate their social and natural environments.

Ecovillages are living laboratories pioneering beautiful alternatives and innovative solutions. They are rural or urban settlements with vibrant social structures, vastly diverse, yet united in their actions towards low-impact, high-quality lifestyles.

4.3.3. WHO IS IN THE GEN NETWORK?

GEN is composed of 5 regional networks, spanning the globe. The network is made up of approximately 10,000 communities and related projects where people are living together in greater ecological harmony.

Some network members include large networks like Sarvodaya (2,000 active sustainable villages in Sri Lanka); the Federation of Damanhur in Italy and Nimbin in Australia; as well as small rural ecovillages like Gaia Asociación in Argentina and Huehuecoyotl in Mexico.

It also includes urban rejuvenation projects like Los Angeles Eco-Village and Christiania in Copenhagen; permaculture design sites such as Crystal Waters, Australia, Cochabamba, Bolivia and Barus, Brazil; and educational centres such as Findhorn in Scotland, Centre for Alternative Technology in Wales, Earthlands in Massachusetts, and many more.

4.3.4. GEN'S STRATEGY TO CHANGE THE WORLD

VISION

The Global Ecovillage Network envisions a world of empowered citizens and communities, designing and implementing their own pathways to a sustainable future, and building bridges of hope and international solidarity.

MISSION

As a solution-based, multi-stakeholder alliance, GEN provides information, tools, examples and global representation to the expanding network of those dedicated to developing and demonstrating sustainability principles and practices in their lifestyles and communities around the world.

GOALS

- To advance the education of individuals from all walks of life by sharing the experience and best practices gained from the networks of eco-villages and sustainable communities worldwide.
- To advance human rights, conflict resolution, and reconciliation by empowering local communities to interact globally, while promoting a culture of mutual acceptance and respect, effective communications, and cross-cultural outreach.
- To advance environmental protection globally by serving as a think tank, incubator, international partner organization, and catalyst for projects that expedite the shift to sustainable and resilient lifestyles.
- To advance citizen and community participation in local decision-making, influencing policy-makers, and educating the public, to accelerate the transition to sustainable living.

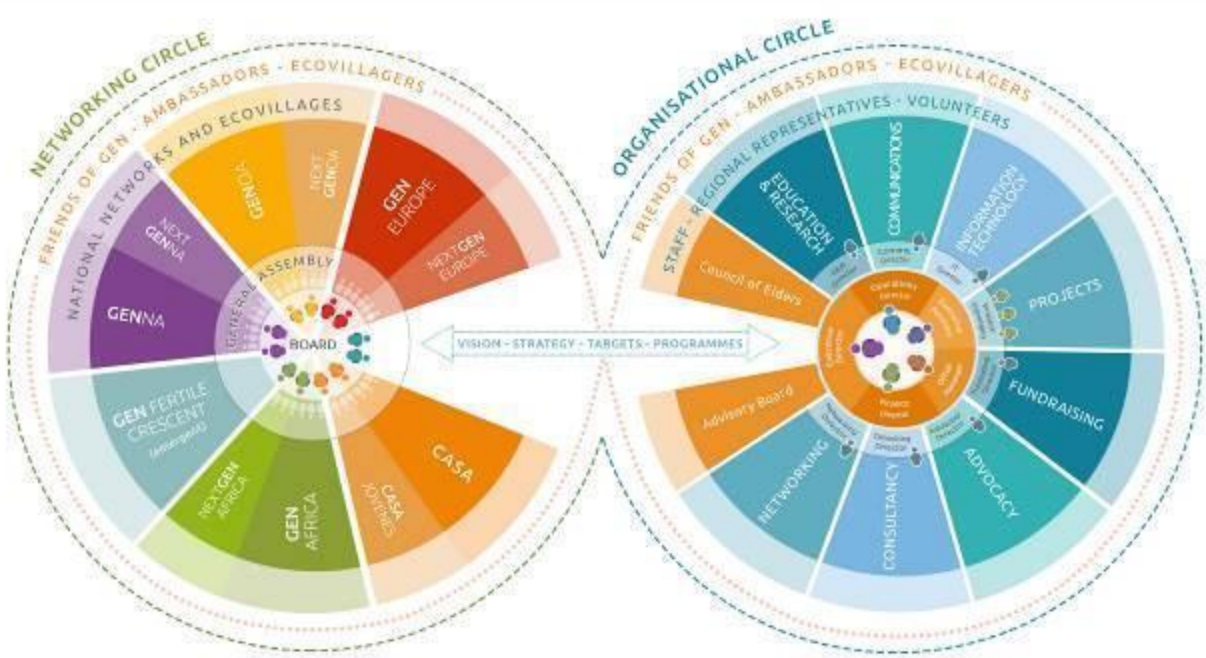

Figure 18: Organisational structure diagram. Sourse: https://ecovillage.org/global-ecovillage-network/gen-structure/

4.3.5 ORGANISATIONAL STRUCTURE DIAGRAM

On the Networking side, GEN is stewarded by a Board of Trustees (with 2 representatives each from the Regions, from NExtGEN and from GEN), plus an active General Assembly (with 9 representatives from each region), connected to the further national networks and ecovillages.

4.3.5.1. GEN STAFF

On the Organisational side, GEN is operated by its staff with the support of volunteers, interns, ambassadors, and advisors from all regions. GEN has several Focus Areas (Networking, Consultancy, Information Technology, Fundraising, Communications, Education & Research, Advocacy), with employed staff who maintain the core organisational infrastructure and also manage GEN's funded projects.

4.3.5.2. GEN BOARD

Responsible for carrying the larger picture for GEN's overall Vision and Mission, the GEN Board is composed of two Charity Trustees representing each of the Regional Networks of GEN (GEN Africa, GEN Europe, GENOA, CASA, and GENNA), as well as two representatives from NextGEN and GEN (the Board President, and a representative from the country where GEN is incorporated).

All Trustees are officially instated and blessed by the General Assembly at least once per year. Charity Trustees have the responsibility to serve the interests of GEN and serve as double-links, sharing information about their Regional Network in the Board of GEN; and vice versa. The Board aims for gender balance, and makes decisions in accordance to Sociocratic principles.

4.3.5.3. ADVISORY BOARD

The GEN Advisory Board provides additional perspectives, support and resources to the Global Ecovillage Network. Its members are regularly consulted regarding strategy, fundraising, global networking, and the ongoing development and evaluation of the organization's work.

4.3.5.4. COUNCIL OF ELDERS

The Council of Elders is a group that represents the founders of the GEN movement. These are people who have been accompanying GEN for many years, and who share their experience from a long term perspective on GEN's work and mission in the world. This Council meets regularly in online calls (at least 6 times per year) and inform GEN staff on strategy, vision, and any current questions.

4.3.5.5. GENERAL ASSEMBLY

The General Assembly is formed by the 45 official Members of GEN (also named Regional Representatives), with 9 representatives from each of the geographic regions, including among these representatives of NextGEN.

General Assembly representatives are chosen from the regional network's council, staff and membership, and they meet in an online General Assembly, (at least every 15 months, but ideally 3 times per year) to approve budgets and any constitutional changes by majority vote (at least 30% must be present to endorse changes).

4.4 Module: Biodiversity

https://www.nwf.org/Wildlife/Wildlife-Conservation/Biodiversity.aspx

Biodiversity is the variety of life. It can be studied on many levels. At the highest level, you can look at all the different species on the entire Earth. On a much smaller scale, you can study biodiversity within a pond ecosystem or a neighbourhood park. Identifying and understanding the relationships between all lives on Earth are some of the greatest challenges in science.

Most people recognize biodiversity by species. A species is a group of living organisms that can interbreed. Examples of species include blue whales, white - tailed deer, white pine trees, sunflowers and microscopic bacteria that you cannot even see with your eye. Biodiversity includes the full range of species that live in an area.

4.4.1. Biodiversity at a Glance

Let’s look at the species biodiversity within a local pond. At first glance, we can identify different plants, including cattails and water lilies. If we wait a while, we might be able to spot a garter snake, a bullfrog or maybe a red-winged blackbird. With a closer look, you can see invertebrates and worms under leaves, on grasses and in the pond water.

Think you’re done? - You have not even scratched the surface of the biodiversity within the pond! Using a microscope, you would be able to see hundreds or even thousands of different bacteria that inhabit the pond water. They are all part of the species biodiversity of this small ecosystem!

4.4.2 BIODIVERSITY IS MORE THAN JUST SPECIES

Species diversity is only one part of biodiversity. To properly catalogue all the life on Earth, we also have to recognize the genetic diversity that exists within species as well as the diversity of entire habitats and ecosystems.

Genetic Biodiversity is the variation in genes that exists within a species. A helpful way to understand genetic diversity is to think about dogs. All dogs are part of the same species, but their genes can dictate whether they are Chihuahua or a Great Dane. There can be a lot of variation in genes – just think about all the colours, sizes, and shapes that make up the genetic diversity of dogs.

Ecological Biodiversity is the diversity of ecosystems, natural communities and habitats. In essence, it’s the variety of ways that species interact with each other and their environment. The forests of Maine differ from the forests of Colorado by the types of species found in ecosystems as well as the temperature and rainfall. These two seemingly similar ecosystems have a lot of differences that make them both special.

4.4.3 SOME BIODIVERSITY FACTS

Researchers have estimated that there are between 3 - 30 million species on Earth, with a few studies predicting that there may be over 100 million species on Earth! Currently, **we have identified only 1.7 million species**, so we have a long way to go before we can come close to figuring out how many species are on Earth!

- There is more biodiversity within tropical ecosystems than temperate or boreal ecosystems. Tropical rainforests have the most diversity.
- The most diverse group of animals are invertebrates. Invertebrates are animals without backbones, including insects, crustaceans, sponges, scorpions and many other kinds of organisms. Over half of all the animals already identified are invertebrates. Beetles are some of the most numerous species.
- Science has so much more to learn about the biodiversity of microscopic organisms like bacteria and protozoa.

4.4.4. THE IMPORTANCE OF BIODIVERSITY

Biodiversity is extremely important to people and the health of ecosystems. A few of the reasons are:

- Biodiversity allows us to live healthy and happy lives. It provides us with an array of foods and materials and it contributes to the economy. Without a diversity of pollinators, plants, and soils, our supermarkets would have a lot less produce.
- Most medical discoveries to cure diseases and lengthen life spans were made because of research into plant and animal biology and genetics. Every time a species goes extinct or genetic diversity is lost, we will never know whether research would have given us a new vaccine or drug.
- Biodiversity is an important part of ecological services that make life liveable on Earth. They include everything from cleaning water and absorbing chemicals, which wetlands do, to providing oxygen for us to breathe—one of the many things that plants do for people.
- Biodiversity allows for ecosystems to adjust to disturbances like extreme fires and floods. If a reptile species goes extinct, a forest with 20 other reptiles is likely to adapt better than another forest with only one reptile.
- Genetic diversity prevents diseases and helps species adjust to changes in their environment.
- Simply for the wonder of it all. There are few things as beautiful and inspiring as the diversity of life that exists on Earth.

4.4.5 THREATS TO BIODIVERSITY

Extinction is a natural part of life on Earth. Over the history of the planet most of the species that ever existed, evolved and then gradually went extinct. Species go extinct because of natural shifts in the environment that take place over long periods of time, such as ice ages.

Today, **species are going extinct at an accelerated and dangerous rate**, because of non-natural environmental changes caused by human activities. Some of the activities have direct effects on species and ecosystems, such as:

- Habitat loss/ degradation
- Over exploitation (such as overfishing)
- Spread of Non-native Species/ Diseases

Some human activities have indirect but wide-reaching effects on biodiversity, including:

- Climate change
- Pollution

All of these threats have put a serious strain on the diversity of species on Earth. According to the International Union for Conservation of Nature (IUCN), globally about one third of all known species are threatened with extinction. That includes 29% of all amphibians, 21% of all mammals and 12% of all birds. If we do not stop the threats to biodiversity, we could be facing another mass extinction with direct consequences to the environment, human health and livelihood.

4.4.6 HELPING BIODIVERSITY IN YOUR OWN BACKYARD

You can play a part in protecting the biodiversity of your local community by creating a Certified Wildlife Habitat®. One of the greatest threats to biodiversity is habitat loss. A Certified Wildlife Habitat® provides food, shelter, water and a place to raise young for native wildlife—the essential elements of habitat that wildlife need to survive. A Certified Wildlife Habitat® can provide food and homes for a range of local species that need your help.

4.4.7 LINKING BIOLOGICAL AND CULTURAL DIVERSITY

The Joint Programme between UNESCO and the CBD Secretariat (SCBD) was developed at the International Conference on Biological and Cultural Diversity, held in Montreal, Canada in 2010. It was endorsed by UNESCO's constituencies and welcomed by the 10th meeting of the Parties to the CBD (CBD COP 10) held in October 2010 in Nagoya, Japan (Decision X/20).

CBD COP 10 recognized the Joint Programme as a 'useful co-ordination mechanism to advance the implementation of the Convention and to deepen the global awareness of the interlinkages between cultural and biological diversity'. State Parties and other relevant stakeholders were invited to 'contribute to and support the implementation of this joint programme'.

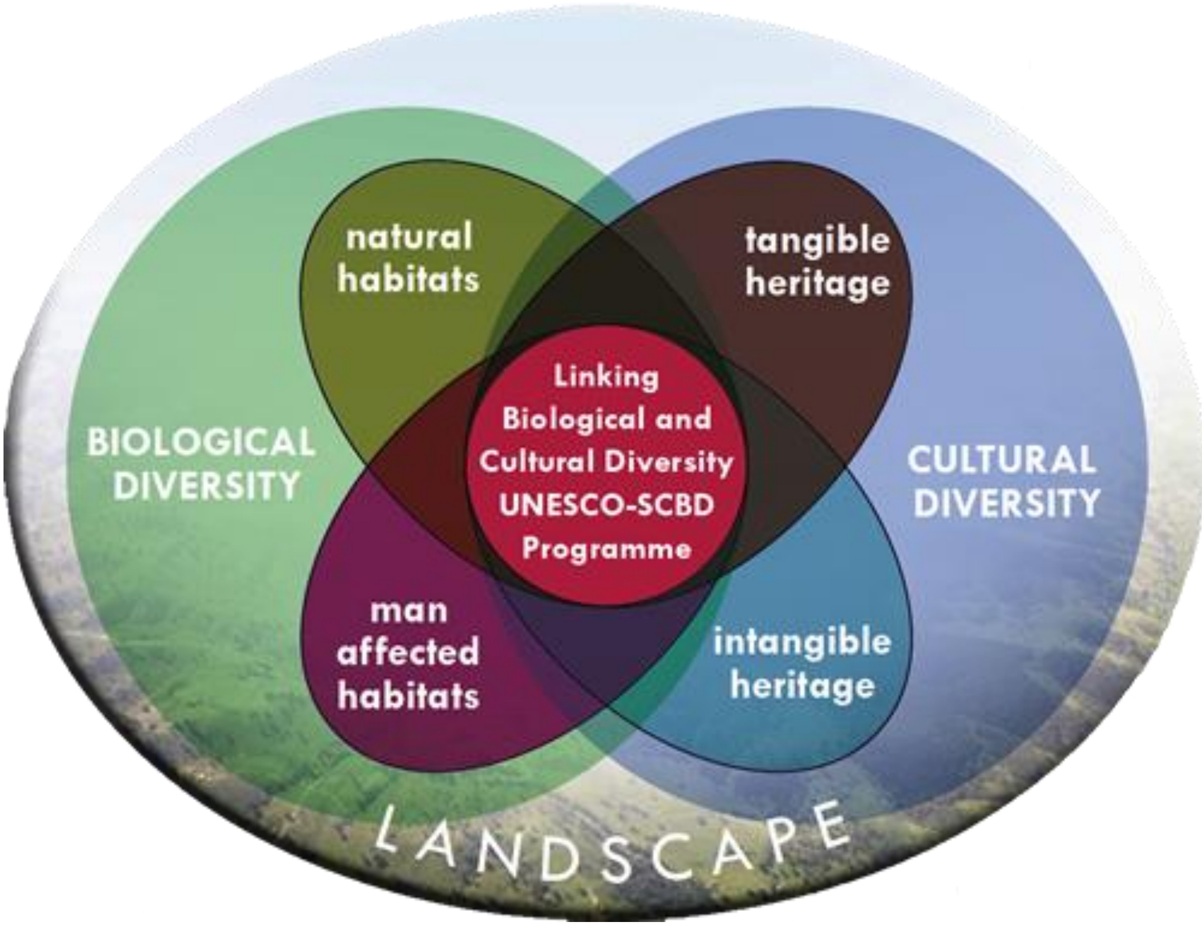

Figure 19: The Joint Programme between UNESCO and the CBD Secretariat (SCBD). Source: https://www.cbd.int/lbcd/about.

A focus on preserving traditional Mediterranean agricultural systems provides unique opportunities to link UNESCO-SCBD's Joint Programme on Biological and Cultural Diversity (http://www.cbd.int/lbcd/) and FAO's Globally Important Agricultural Heritage Systems initiative (GIAHS, http://www.fao.org/giahs/). A holistic approach is an important step to ensure ecologically sustainable development, conserve cultural identities, improve farming community livelihood, preserve agro-biodiversity and ensure the continued provision of vital ecosystem services for humanity. The Mediterranean diet, with foundations in the Cilento homeland of the Bio-districts, is described by the UNESCO Cultural Heritage of Humanity website (http://www.unesco.org/culture/ich/en/RL/00884) as encompassing more than just food of the various cultures. These lifestyles are embedded in bio-cultural landscapes that are at risk from global markets, industrial agriculture, invasive species and climate change.

Today, the Mediterranean is characterized by landscape patterns whose compositions result from countless, long and complex cultural and historical processes. However, the pressure on these landscapes and their rapid transformation into more modern forms it is strong. In this context, an identification and clarification of the role of such mixed and complex forms of agro-forestry systems and landscapes, named "Giardino Mediterraneo" ("Mediterranean garden") is necessary. This term is often applied to and associated with numerous different agricultural and agro-forestry systems as well as to numerous different kinds of rural landscapes, due to the complex and intricate historical process that has led to their identification and cultural evolution over time. However, a comparison with the typological systems currently used for the cataloguing and mapping of traditional Mediterranean landscapes at different scales shows the transversal importance of polycultural Mediterranean garden landscapes.

The alliance between the natural and social sciences has proven to be a successful analytical approach to understand and conserve ecosystems worldwide, while seeing people as key agents within these (1971 Man and the Biosphere Programme, 1972 Stockholm Declaration, 1992 Rio Conference). In this context, authors from various areas of expertise have stressed the importance of recognizing the inextricable link between biological and cultural diversity and the need to raise awareness of these interactions for global sustainability.

Resources:

2010 was the International Year of Biodiversity
https://www.cbd.int/2010/welcome/

The Joint UNESCO- SCBD Programme on Links between Biological and Cultural Diversity (https://www.cbd.int/lbcd/)

Sources:

International Union for Conservation of Nature
Comparing and Graphing Nine Environmental Threats, Researchers Find Unexpected Evils
Encyclopaedia of Earth: Biodiversity

World of Biology. McGrath, Kimberley A., ed. The Gale Group, Farmington Hills, MI: 1999.

Precious Heritage: The Status of Biodiversity in the United States. Stein, Bruce A., Lynn S. Kutner and Jonathan S. Adams. Oxford University Press, New York: 2000.

4.5. Module: Secret of the soil

http://extension.psu.edu/business/start-farming/soils-and-soil-management/soil-quality

Healthy soils yield healthy crops, but what is healthy soil and how do we achieve it?

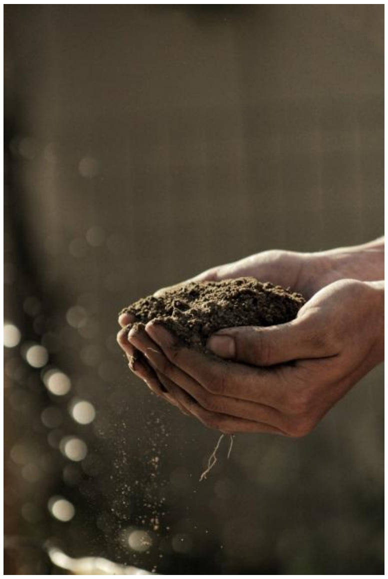

Figure 20: Soil health is the foundation of productive farming practices.

Soil health is the foundation of productive farming practices. Fertile soil provides essential nutrients to plants. Important physical characteristics of soil-like structures and aggregation allow water and air to infiltrate, roots to explore, and biota to thrive. Diverse and active biological communities help soil resist physical degradation and cycle nutrients at rates to meet plant needs. Soil health and soil quality are terms used interchangeably to describe soils that are not only fertile but also possess adequate physical and biological properties to "sustain productivity, maintain environmental quality and promote plant and animal health" (Doron 1994).

According to the (USDA) Natural Resource Conservation Service, "Soil quality is how well soil does what we want it to do." In order to grow our crops, we want the soil to hold water and nutrients like a sponge where they are readily available for plant roots to take them up, suppress pests and weeds that may attack our plants, sequester carbon from the atmosphere, and clean the water that flows through it into rivers, lakes, and aquifers.

4.5.1. HEALTHY, HIGH-QUALITY SOIL HAS:

- Good soil tilth
- Sufficient depth
- Sufficient, but not excessive, nutrient supply
- Small population of plant pathogens and insect pests
- Good soil drainage
- Large population of beneficial organisms
- Low weed pressure

- No chemicals or toxins that may harm the crop
- Resilience to degradation and unfavourable conditions

(Source: Soil Health Training Manual)

Remember, soil fertility is only one component of soil quality. Fertile soils are able to provide the nutrients required for plant growth. These are the chemical components of soil. Some plants need certain nutrients in large amounts, like nitrogen, phosphorus, and potassium, which are called macronutrients. Other nutrients, like boron and manganese, plants only need in very small amounts. In high-quality soil, nutrients are available at rates high enough to supply plant needs, but low enough that excess nutrients are not leached into groundwater or present at high levels toxic to plants and microbes. For more information on soil fertility, see Start Farming—Introduction to Soils: Managing Soils.

All these characteristics sound great. But when you look at your field, how do you tell whether you have high-quality soil and how do you improve it? The first step is to learn about the properties of your soil. The following describes soil properties and indicators of soil quality that are important for healthy, productive crops. Indicators are easily measurable things that allow us to see what is happening in soil.

4.5.1.1 SOIL TEXTURE

We cannot change certain aspects of a given soil. Soil texture is one such aspect. Soil texture is a good place to start when you look at your soil. When you understand your soil's texture, you know more about the possible restrictions on your particular piece of land as well as any advantages. (Find where your farm is on the soil texture triangle.)

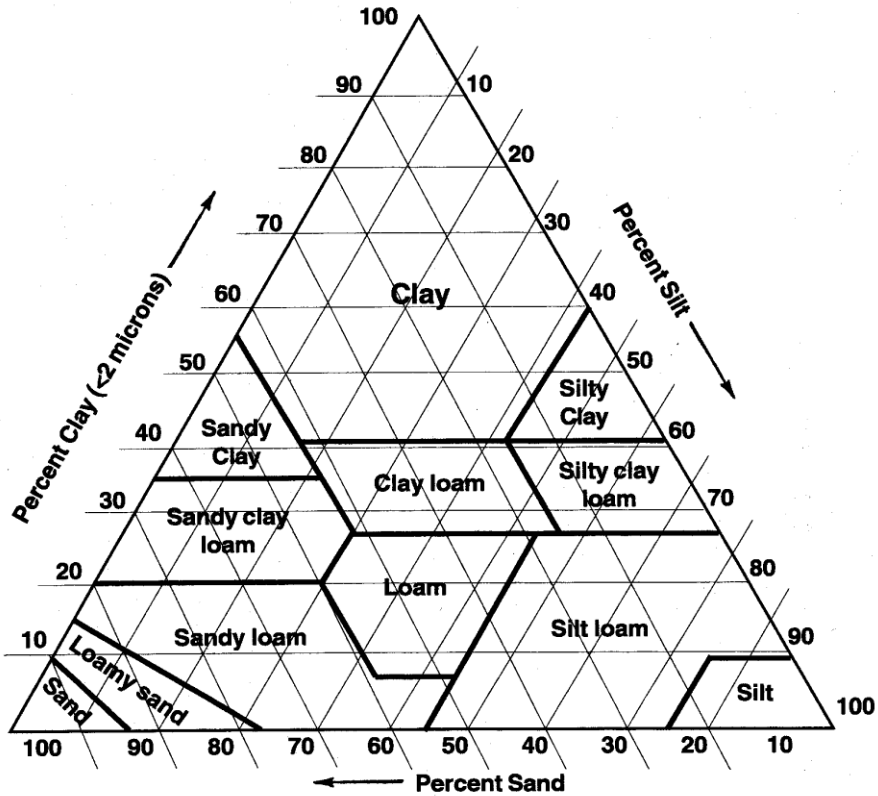

Figure 21: Soil Texture Triangle. The soils texture triangle shows different amounts of water and air in soil with different sized and shaped particles. Source: http://passel.unl.edu/UserFiles/File/Crp.%20Prod.%20Nat.%20Res.%20Mngmt/Soils%20lesson%202/Fig-2.3.gif

The terms sand, silt, and clay refer to particle size; sand is the largest and clay is the smallest. Gravel particles are larger than 2 millimetres (mm), sand particles are 0.05–2 mm, silt particles are 0.002–0.05 mm, and clay is smaller than 0.002 mm. To put this in perspective, if a particle of clay were the size of a BB, then a particle of silt would be the size of a golf ball and a grain of sand would be the size of a chair (FAO 2007). (See Illustration 2)

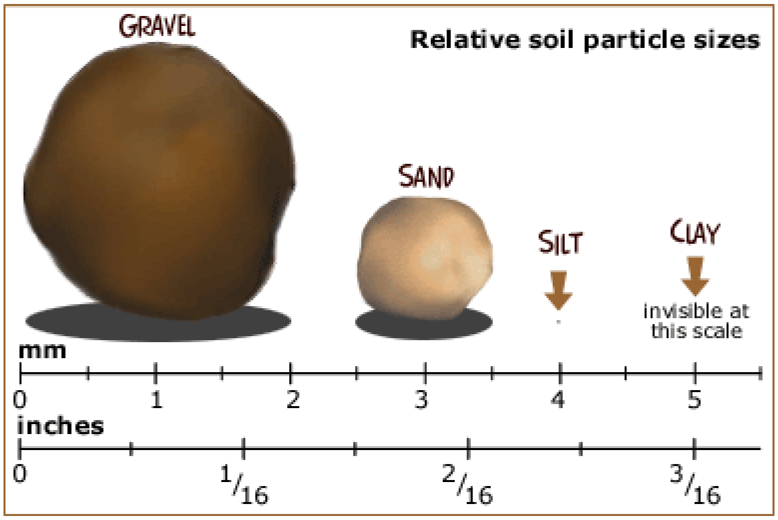

Figure 22: Particle Size. To put particle size in perspective, if a particle of clay were the size of a BB, then a particle of silt would be the size of a golf ball and a grain of sand would be the size of a chair. Source: C:\Users\janja\AppData\Local\Microsoft

Even though the definition is based on particle size, the shape of the particles is important for thinking about how soil texture relates to soil quality. Sand particles are generally round, while silt and clay particles are usually thinner and flatter. In a soil with larger, round particles, more space is available for the water and air that our plants need. Also, the air space between the particles is larger, providing good aeration. However, in a sandy soil, many of the air spaces are too large to hold water against the force of gravity, creating a soil with low water-holding capacity that is prone to drought.

4.5.2.1.1 HOW DO I TELL WHAT TEXTURE MY SOIL IS?

You can determine a soil's texture by how the soil feels. Does it feel gritty, greasy, or floury? Gritty soils are sandy. Silty soils feel floury when they are dry and greasy when they are wet. Clay will always feel greasy. Take a small handful of soil and drop enough water on it that you can form a ball. When you rub it in the palm of your hand, it will fall apart and you will feel the grit rub into your palm if it is sand. Silt will form a ball, but when you try to roll it out into a ribbon it will crack. A clay soil will roll out into a long ribbon.

4.5.4.2.2. DIFFERENCES BETWEEN SAND, SILT, AND CLAY

You are probably familiar with the characteristics of a clay soil. We call them heavy soils for a reason. They can be difficult to work. They dry out slowly and can leave a hard crust that does not allow the rain to penetrate. Clays are made up of very small particles. Some kinds of clay are layered together in sheets. Think of a piece of baklava or a deck of cards with many thin layers stacked on top of one another. Clay can hold water and nutrients between those fine layers. Another important aspect of clays is that each of these individual layers has many "parking spaces" for plant nutrients. In reality, these "parking spaces" are negatively charged sites on the surface of the layer, as well as within the structure of the clay layer. Many of the nutrients are positively charged (called "cations") and, therefore, are attracted to the negatively charged "parking space," just like the opposite ends of a magnet are attracted to each other. Tiny clay particles have more surface area than larger particles of sand or silt (FAO, 2007). That means more area is available for positively charged plant nutrients to stick to. (See Illustration 3.)

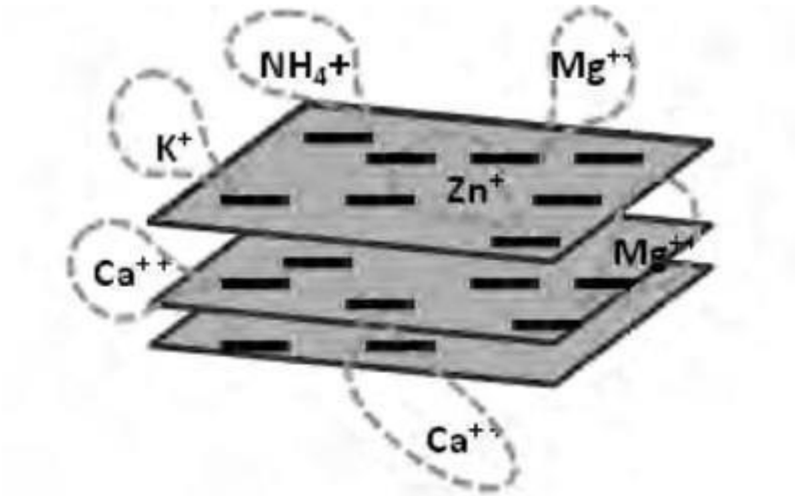

Figure 23: Clay Particles Holding Nutrients. Some clay holds water and nutrients between fine layers. Negative charges act like “parking spaces” holding positively charged plant nutrients in place. Illustration adapted from FAO, Farmer Field Schools.

Sand is loose and single grained. The individual grains can be easily seen and felt. If you squeeze a handful of dry sand, it will fall apart. If you squeeze wet sand, it will form a cast and then crumble when you touch it. Loam is a mix of sand, silt, and clay. It is mellow with a somewhat gritty feel, yet fairly sticky and slightly plastic (Russell 2005).

4.5.2.2 SOIL STRUCTURE

In pursuit of high-quality soil we generally try to build highly “structured” soils. While the texture of the soil is inherent and difficult, if not impossible, to change, we can influence the structure of the soil with our management practices. When we plough, cultivate, lime, add organic matter, and stimulate biological activity, we change soil structure.

Whereas texture is the composition or relative proportion of three soil particle types (sand, silt, clay), soil structure is the arrangement or geometry of these soil particles. Soil with good structure has a wide range of pore spaces or empty space between the soil particles. For example, in a good loam soil, 40–60 percent of the soil volume is pore space filled with air and water (Brady 1996).

To understand this concept, compare your soil to a building. If a building is made out of bricks, the “texture” of the building would be the proportion of cement, sand, and brick (clay, silt, and sand) that makes up the building. The “structure” would be the arrangement of these bricks to form large rooms, small rooms, hallways, etc. If an earthquake should cause the building to collapse into a pile of bricks, the texture would remain the same, but the structure would have been radically altered. To follow on our analogy, just as before the earthquake, the structure of the building provided much better living conditions than after (big and small rooms in which to move and live); similarly, a soil that has a good structure provides better living conditions for soil organisms and roots. It has many large and small pore spaces through which air, water, roots, and living organisms can move freely (FAO 2007). Soil scientists call soils with good structure “granular” or “crumb” type soils. These soils are loose and fluffy. Generally they are high in organic matter and have large soil aggregates. Think about what the soil looks like when you dig under a thick layer of sod. It has many crumbly pieces, large pores, clumps, roots, and decaying pieces of organic material.

In contrast, platy soils have thin layers of horizontal plates or leaflets. These plates are often inherited by the way the soil was formed, but we can also create them by overuse of heavy machinery on clayey soils. Deeper soil layers may be prism-like, columnar, or block-like. (See illustrations 4 and 5.)

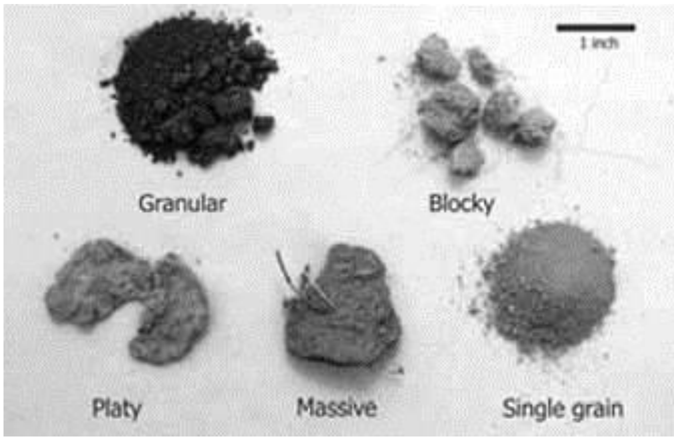

Figure 24: Soil Structure. Soil particles are arranged in different ways to constitute the soil's structure.

We don't generally change the structure of deeper soil layers with our management practices, but it is good to check the soil survey to find out what lies beneath your soil layer because it may affect drainage and root penetration.

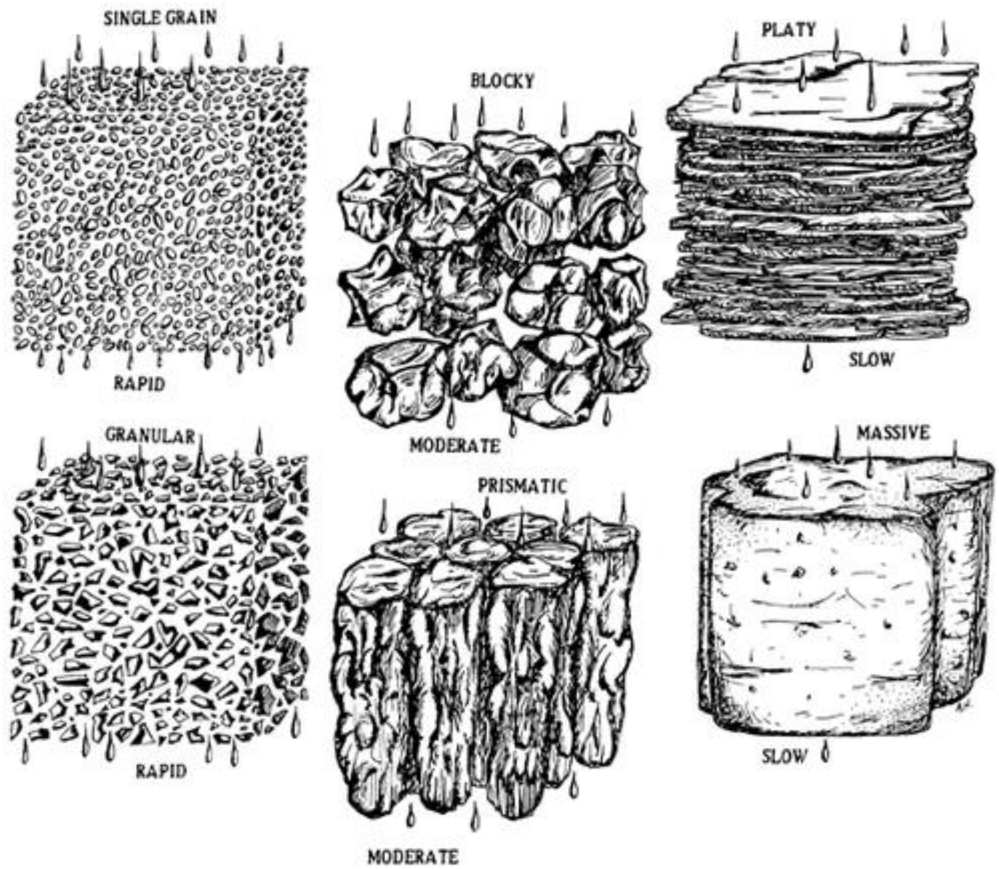

Figure 25: Soil Structure Affects Water Movement. Soil structure affects how quickly water moves through soil. Water moves quickly through soils with many small grains. Soils with larger aggregates in the form of blocks or prisms have moderate drainage.

4.5.2.2.1 SOIL AGGREGATES

The aspect of soil structure that often interests us most as soil managers and that we can most easily change is soil aggregation. Bacteria and roots produce sticky substances that glue soil particles together. Fungi and root hairs wrap soil particles into balls. These groups of soil particles are called aggregates. (See Illustration 6.) One important type of soil aggregate is water-stable aggregates. Water-stable aggregates are measured by the extent to which soil aggregates resist falling apart when wetted and hit by rain drops. (Gugino 2007)

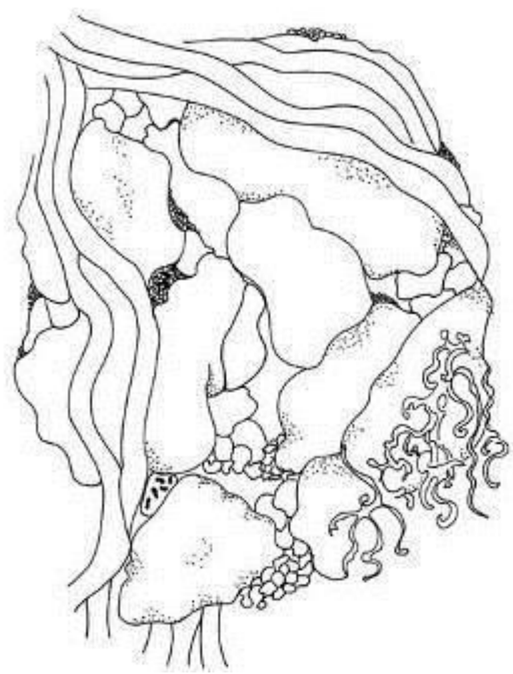

Figure 26: Soil Aggregate. Bacteria and roots produce sticky substances that glue soil particles together. Fungi and root hairs wrap soil particles into balls called aggregates.

4.5.2.2.2 WHY DOES IT MATTER?

The number of water-stable aggregates in your soil show its capacity to sustain its structure during the most extreme conditions (e.g., a heavy rainstorm after weather had dried the surface). Soils with low aggregate stability can constrict crops because they form surface crusts—which can reduce both water infiltration and air exchange, make the soil more difficult to manage, and reduce its ability to dry off quickly—and often have low biological activity. Aggregates are formed in part by exudates from bacteria, entanglement of soil particles in fungal hyphae, and digestion by earthworms. (See Illustration 6.) Low biological activity means reduced mineral cycling and competition with pest organisms. (Gugino 2007)

4.5.2.2.3 HOW CAN I IMPROVE IT?

As soil managers we can help build soil aggregates by growing green manure cover crops or adding animal manure. Also think about your tillage regime. Over the long term, repeated soil tillage can reduce soil tilth and break down stable soil aggregates. Such soils can be so degraded that they become addicted to tillage and crop establishment requires a soil-loosening operation. If you can reduce your tillage operations, you may reduce the disturbance to the soil biota that is essential for building aggregation. Feeding the soil food web with cover crops or other organic materials also increases the numbers of these organisms. Then bacteria and fungi work to help make aggregation happen.

4.5.2.3 COMPACTION

When soil has poor structure or we mistreat it, we compact the soil. A good loam soil is about 50 percent soil particles and 50 percent pore space filled with air and water (Brady 1996). When we run over the soil when it is too wet or with equipment that is too heavy, we are pushing the soil particles closer together.

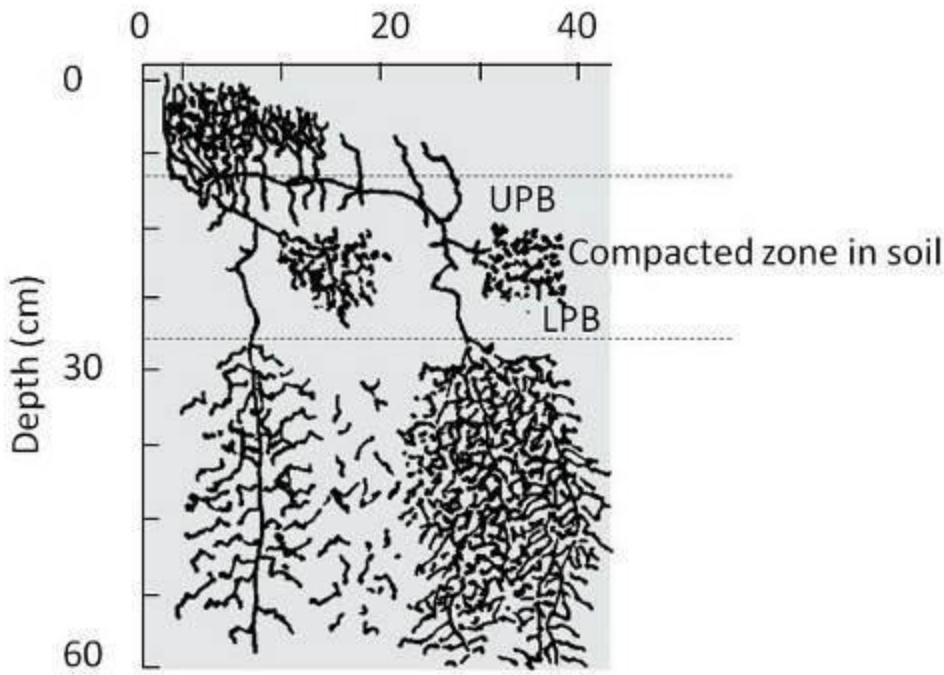

Figure 27: Compaction Reduces Root Growth. Roots occupy a larger soil volume in non-compacted soil layer (30–60 cm) than in compacted soil (15–30 cm). ***Source: Adapted by Sjoerd Duiker from Keisling, Batchelor, and Porter, "Soybean root morphology in soils with and without tillage pans in the lower Mississippi River Valley," Journal of Plant Nutrition 18 (1995): 373–84.***

As a result, the pores are small and can hold less air and water for plants. When soils become extremely compacted, roots can no longer penetrate the soil. Compacted soils have fewer and smaller roots. In a normal soil, crop roots are only in contact with less than 1 percent of the total soil volume. The roots have to be able to continually grow and explore to find new nutrient reserves, and water needs to be able to move easily through the soil where it can reach roots and wash nutrients to where roots are. Compaction not only directly affects root growth; it also reduces the amount of air-filled pores and thus oxygen in the soil. The increase in carbon dioxide (CO2) in relation to oxygen can be toxic to plant roots. For more information see Duiker publications listed in References.

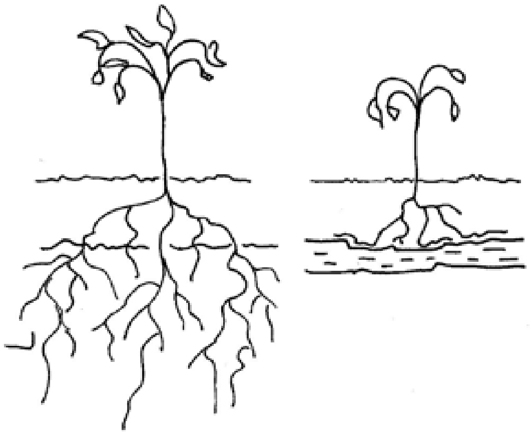

Figure 28: Plant growth is limited in compacted soils.

Managing soil compaction can be achieved through appropriate application of some or all of the following techniques: (a) adding organic matter; (b) controlling traffic; (c) mechanically loosening (e.g., deep ripping); and (d) selecting a rotation that includes crops with strong taproots able to penetrate and break down compacted soils. Deep ripping can reduce compaction initially. Unfortunately, unless it is combined with additions of organic matter or reduction in traffic, the benefits of ripping may only be seen for one to two years before the soil settles and re-compacts.

4.5.2.4. WATER-HOLDING CAPACITY

High-quality soils have a high available water-holding capacity.

Figure 29: Soil compaction causes reduced infiltration. Source: Duiker, Effects of Soil Compaction (University Park: Penn State Extension, 2004).

Plants are like people, right? They need food, water, and oxygen to grow. Soils with a high available water-holding capacity have a larger reservoir and can supply water over time when plants need it. Technically, a soil's available water-holding capacity is the amount of water the soil can hold between field capacity (after gravity has drained the soil) and the permanent wilting point. So what is field capacity? Imagine you just had a heavy rain that fully saturated the soil. Then you wait two days just until the point that the soil has stopped draining. That is field capacity. The permanent wilting point is defined as the soil moisture level at which a wilted plant cannot recover even after 12 hours in a remoistened soil. So, available water-holding capacity is the amount of water a soil can hold between the time it is fully saturated but drained and when it is so dry that plants die.

Clay and sandy soils will have different water-holding capacities. The available water-holding capacity is an indicator of how much water the soil can store. Sandy soils often cannot store as much water for crops between rains.

4.5.2.4.1. HOW CAN I IMPROVE ITS WATER-HOLDING CAPACITY?

The addition of organic matter to soils either from manure, compost, or cover crops can improve the soil's capacity to hold water. In the short term, you may want to consider adding stable organic materials like compost or crop residue high in lignin or cover crops high in carbon. In the long term, rotation to sod and reduced tillage are known to help.

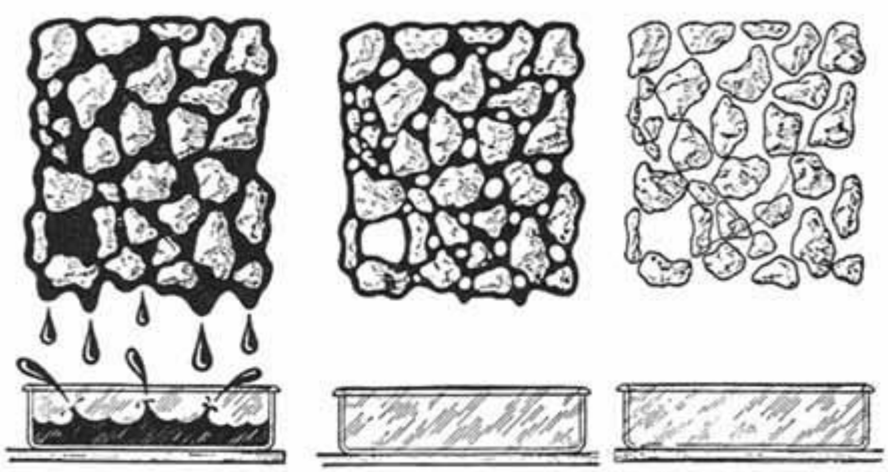

Figure 30: Water-Holding Capacity. (a) Saturated soil; (b) Field capacity; (c) Permanent wilting point. The water-holding capacity is the amount of water in soil field capacity (b) minus wilting point (c).

3.5.2.5 ORGANIC MATTER

Soil organic matter (SOM) is a complex of diverse components, including plant and animal residues, living and dead soil microorganisms, and substances produced by these organisms and their decomposition. SOM influences the chemical, biological, and physical properties of the soil in ways that are almost universally beneficial to crop production. The most common sources of SOM in farming are crop residues, cover crop residues, manures, and composts.

3.5.2.5.1 WHY IS SOIL ORGANIC MATTER SO IMPORTANT?

This tiny fraction of the soil volume (agricultural soils average 1–6 percent) has an overwhelming influence on most other soil properties. Often classified as “the living, the dead, and the very dead,” it is composed of three components: living organisms, fresh residue, and well-decomposed residue. Each of these components contributes to the vital functions of soil.

Bacteria, fungi, protozoa, earthworms, tiny insects, and other organisms form the living fraction of soil organic matter. Much to the surprise of anyone who considers soil to be dead dirt, living organisms compose about 15 percent of total soil organic matter, weighing between 2,000 and 30,000 pounds per acre (Gugino 2007; Brady 1996). This live fraction of the soil does a host of functions described below.

The second fraction of soil organic matter is the “dead”—fresh residues that have been recently added to soil. This is active, easily decomposed material that provides the fuel for soil organisms. When fresh SOM is added to the soil, most of it decays to CO2, water, and minerals within a few months to years. This process provides energy (e.g., via respiration) for soil microbes and mineral nutrients for both microbes and plants (e.g., crops). Just like cornflakes provide sugar and carbohydrates for humans, decaying leaves, manure, and plant roots provide sugars and carbohydrates for bacteria, fungi, and the soil food web.

Some soil organic matter is very resistant to (further) decay and can last (often bound tightly to clay particles) for hundreds of years. This very stable form of SOM is commonly referred to as humus. In fact, the average humus particle is one thousand years old. Humus is typically about 70 percent of the total SOM in agricultural soils. Humus, in particular, and SOM, in general, are important in enhancing soil nutrient-holding (especially cation) and water-holding capacities, soil structure and tilth, and general fertility (see Illustration 10). Organic matter management is an important part of farming, but our understanding of it is quite elementary. We know that soil fertility tends to increase with increasing SOM and that continual depletion of SOM eventually leads to very poor soils.

4.5.2.6. SOIL BIOTA

The soil is alive. In just one teaspoon of agricultural soil there can be one hundred million to one billion bacteria, six to nine feet of fungal strands put end to end, several thousand flagellates and amoeba, one to several hundred ciliates, hundreds of nematodes, up to one hundred tiny soil insects, and five or more earthworms. These organisms are essential for healthy growth of your plants.

For example, tiny insects in the soil rip and shred leaves and other organic material, breaking it down into smaller pieces that are then consumed by bacteria and fungi. These bacteria and fungi excrete sticky substances that hold the soil together into aggregates and provide food for an entire web of organisms in the soil. When these bacteria and fungi are consumed by other soil organisms, like the microscopic worms called nematodes, the nematodes excrete ammonia, an important source of nitrogen for plants.

Adding organic matter to soil is essential for all these soil organisms. Cover crops, leaves, compost, and other organic materials that we add to soil are food for these organisms. Which type of organic material we add to the soil changes which type of organisms will have the largest numbers. For example, adding material very high in carbon will encourage fungi that excrete enzymes such as chitinases, which can break down tough-to-digest material.

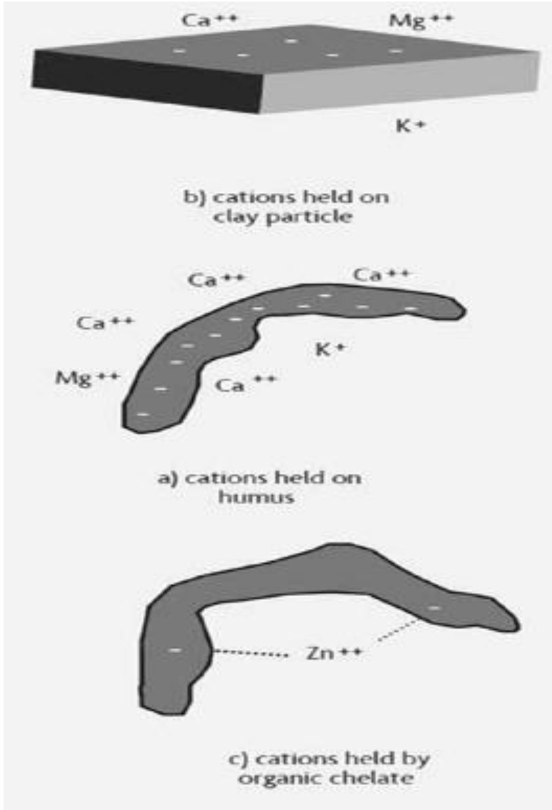

Figure 31: Organic Matter Holds Nutrients. Cations held on negatively charged organic matter and clay. Source: Magdoff and van Es, Building Soils for Better Crops (Beltsville, Md.: Sustainable Agriculture Research and Education Program, 2009), 15.

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5 Appendix

5.1 Suggestions for self and group evaluation

Sample Group Process Evaluation Form						
Individually, reflect on your group's dynamics and – anonymously – rate them according to each of the following variables (using a scale from 1 to 5). As a group, discuss the results and brainstorm concrete ways to improve your group processes.						
Goals						
Goals are unclear or poorly understood, resulting in little commitment to them.						Goals are clear, understood, and have the full commitment of team members.
Openness						
Members are guarded or cautious in discussions.						Members express thoughts, feelings, and ideas freely.
Mutual Trust						

Members are suspicious of one another's motives.						Members trust one another and do not fear ridicule or reprisal.
Attitudes Toward Difference						
Members smooth over differences and suppress or avoid conflict.						Members feel free to voice differences and work through them.
Support						
Members are reluctant to ask for or give help.						Members are comfortable giving and receiving help.
Participation						
Discussion is generally dominated by a few members.						All members are involved in discussion.
Decision-making						
Decisions are made by only a few members.						All members are involved in decision-making.

Flexibility						
The group is locked into established rules and procedures that members find difficult to change.						Members readily change procedures in response to new situations.
Use of Member Resources						
Individuals' abilities, knowledge and experience are not well utilized.						Each member's abilities, knowledge, and experience are fully utilized.

Peer Evaluation Form for Group Work

Your name ______________________________

Write the name of each of your group members in a separate column. For each person, indicate the extent to which you agree with the statement on the left, using a scale of 1-4 (1=strongly disagree; 2=disagree; 3=agree; 4=strongly agree). Total the numbers in each column.

Evaluation Criteria	Group member:	Group member:	Group member:	Group member:
Attends group meetings regularly and arrives on time.				

Contributes meaningfully to group discussions.				
Completes group assignments on time.				
Prepares work in a quality manner.				
Demonstrates a cooperative and supportive attitude.				
Contributes significantly to the success of the project.				
TOTALS				

Feedback on team dynamics:

1. How effectively did your group work?
2. Was the behaviour of any of your team members particularly valuable or detrimental to the team? Explain.
3. What did you learn about working in a group from this project that you will carry into your next group experience?

5.2 Proposals for implementing teaching activities

Suggestions for carrying out learning activities for individual learning modules. Different ideas of learning activities could be used and combined in different learning modules.

Scenarios and role playing

- Role-play of different landscape management actors
- To explore the ideas of imagery and perceptions of people to certain agricultural images, a photo booth can be arranged specific for this purpose to help discuss imagery and how it can help or harm agroecology.
- Scenario workshops

Skits and videos

- Animation
- Interactive movie
- Show food journalist videos addressing issues of race, migratory labour and gender from YouTube to foster social justice component of AE
- Illustrate that awareness raising is key in order to further Agroecogoly, and digital technology is one very successful way of reaching the masses. See various YouTube videos explaining marketing reasons of involvement with social media, etc.
- A student made video or a skit. The skit could be performed by the students if pre-defined roles are given, depicting the benefits of a community vs. an individual.

Teaching and Training

- Training materials
- Curriculum modules
- Module monitoring by students activated by teachers
- Demonstrations
- Practical and educational workshops

Systems

- Systems designing and drawing of a farm and its processes including its ecological environment. Highlighting multi-functionality.

Political

- Invite a board of panellists from UNESCO or cultural heritage sites to draw connections between preservation of traditional and cultural landscapes and tourism
- Describe or invite a key local player in a successful political case and it's the changes it incurred either locally or internationally. E.g., the governmental support of buffer strips, or supplements given to farmers illustrating environmental improvements on their farms. opportunities
- Internships

Methods

- Comparison of different agroecological methodologies
- Teaching teams
- Method descriptions
- Demonstrations
- Practical and educational workshops
- Participatory soil health analyses
- Participatory Bioblitz to quantify biodiversity
- Invite a board of panellists from UNESCO or cultural heritage sites to draw connections between preservation of traditional and cultural landscapes and tourism
- Examine traditional technologies in modern challenges or on farms today (e.g. the scythe)
- Show food journalist videos addressing issues of race, migratory labour and gender from YouTube to foster social justice component of AE

- To explore the ideas of imagery and perceptions of people to certain agricultural images, a photo booth can be arranged specific for this purpose to help discuss imagery and how it can help or harm agroecology.

Social media and digital work

- Webpage or web shop tutor
- Show food journalist videos addressing issues of race, migratory labour and gender from YouTube to foster social justice component of AE
- Illustrate that awareness raising is key in order to further Agroecology, and digital technology is one very successful way of reaching the masses. See various YouTube videos explaining marketing reasons of involvement with social media, etc.

Presentations and panels

- Presentation in combination with group work
- Inviting a panel of small farmers to compare and contrast marketing
- Invite a board of panellists from UNESCO or cultural heritage sites to draw connections between preservation of traditional and cultural landscapes and tourism
- Describe or invite a key local player in a successful political case and it's the changes it incurred either locally or internationally. E.g., the governmental support of buffer strips, or supplements given to farmers illustrating environmental improvements on their farms. Opportunities
- Highlight the culturally appropriate food production; often culturally appropriate produce is linked to the geological and climactic conditions. Individual project reports on a specific vegetable or grain could be done. Linking the food to appropriate uses, recipes, regions, and growing conditions. See: https://en.wikipedia.org/wiki/The_Botany_of_Desire

Group work

- Student group work
- Students group work to create records for each service by identifying the roles of functional biodiversity
- Analyses of cases with teachers and students
- Demonstrations
- Design and implement 'wilderness area' learn through observation, comparison and implementation of the area(s)
- Participatory soil health analyses
- Participatory Bioblitz to quantify biodiversity
- Examine traditional technologies in modern challenges or on farms today (e.g. the scythe)

Games

- Deck of cards with information
- Interactive computer game
- Game to explain community of producers and consumers
- Monopoly-style game in which land tenure is the focus. Large corporate farms vs, smaller farms and the possibility to cooperate together
- Systems game to show the importance of innovation are interconnected
- A matching game of pictures depicting 'black and white' scenarios of Industrial and sustainable agricultural visions. For more advanced groups, introducing more 'grey' area pictures
- A seed bank game that simultaneously teaches about biodiversity in plants but also sends messages of cooperation and the importance of understanding the market and policy. Made in the fashion of the new cooperative games (such as Pandemic) where you work as a team to beat the game

Reflection and Observation

- Constant reflection with other field cases and student progress
- Design and implement 'wilderness area' learn through observation, comparison and implementation of the area(s)
- Participatory Bioblitz to quantify biodiversity
- Observation exercises

On-Farm work

- Farm visits
- Professionally guided tours of best practices
- Demonstrations
- Open houses
- Participatory Bioblitz to quantify biodiversity
- Participatory soil health analyses
- Examine traditional technologies in modern challenges or on farms today (e.g. the scythe)
- Internships

Assessments

- Quizzes