Food and Agriculture Organization of the United Nations

THE 10 ELEMENTS OF AGROECOLOGY

GUIDING THE TRANSITION TO SUSTAINABLE FOOD AND AGRICULTURAL SYSTEMS

INTRODUCTION

Today's food and agricultural systems have succeeded in supplying large volumes of food to global markets. However, high-external input, resource-intensive agricultural systems have caused massive deforestation, water scarcities, biodiversity loss, soil depletion and high levels of greenhouse gas emissions. Despite significant progress in recent times, hunger and extreme poverty persist as critical global challenges. Even where poverty has been reduced, pervasive inequalities remain, hindering poverty eradication.

Integral to FAO's Common Vision for Sustainable Food and Agriculture[1], agroecology is a key part of the global response to this climate of instability, offering a unique approach to meeting significant increases in our food needs of the future while ensuring no one is left behind.

Agroecology is an integrated approach that simultaneously applies ecological and social concepts and principles to the design and management of food and agricultural systems. It seeks to optimize the interactions between plants, animals, humans and the environment while taking into consideration the social aspects that need to be addressed for a sustainable and fair food system.

Agroecology is not a new invention. It can be identified in scientific literature since the 1920s, and has found expression in family farmers' practices, in grassroots social movements for sustainability and the public policies of various countries around the world. More recently, agroecology has entered the discourse of international and UN institutions.[2]

WHAT MAKES AGROECOLOGY DISTINCT?

Agroecology is fundamentally different from other approaches to sustainable development. It is based on bottom-up and territorial processes, helping to deliver contextualised solutions to local problems. Agroecological innovations are based on the co-creation of knowledge, combining science with the traditional, practical and local knowledge of producers. By enhancing their autonomy and adaptive capacity, agroecology empowers producers and communities as key agents of change.

Rather than tweaking the practices of unsustainable agricultural systems, agroecology seeks to transform food and agricultural systems, addressing the root causes of problems in an integrated way and providing holistic and long-term solutions. This includes an explicit focus on social and economic dimensions of food systems. Agroecology places a strong focus on the rights of women, youth and indigenous peoples.

WHAT ARE THE 10 ELEMENTS OF AGROECOLOGY?

In guiding countries to transform their food and agricultural systems, to mainstream sustainable agriculture on a large scale[3], and to achieve Zero Hunger and multiple other SDGs, the following 10 Elements emanated from the FAO regional seminars on agroecology[4]:

Diversity; synergies; efficiency; resilience; recycling; co-creation and sharing of knowledge (describing common characteristics of agroecological systems, foundational practices and innovation approaches)

Human and social values; culture and food traditions (context features)

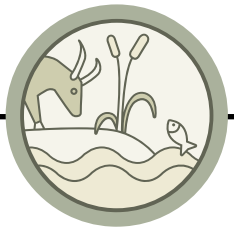
Responsible governance; circular and solidarity economy (enabling environment)

The 10 Elements of Agroecology are interlinked and interdependent.

WHY ARE THE 10 ELEMENTS USEFUL AND HOW WILL THEY BE USED?

As an analytical tool, the 10 Elements can help countries to operationalise agroecology. By identifying important properties of agroecological systems and approaches, as well as key considerations in developing an enabling environment for agroecology, the 10 Elements are a guide for policymakers, practitioners and stakeholders in planning, managing and evaluating agroecological transitions.

DIVERSITY



Diversification is key to agroecological transitions to ensure food security and nutrition while conserving, protecting and enhancing natural resources.

Agroecological systems are highly diverse. From a biological perspective, agroecological systems optimize the diversity of species and genetic resources in different ways. For example, agroforestry systems organize crops, shrubs, and trees of different heights and shapes at different levels or strata, increasing vertical diversity.

Intercropping combines complementary species to increase spatial diversity.[5] Crop rotations, often including legumes, increase temporal diversity.[6] Crop–livestock systems rely on the diversity of local breeds adapted to specific environments.[7] In the aquatic world, traditional fish polyculture farming, Integrated Multi-Trophic Aquaculture (IMTA) or rotational crop-fish systems follow the same principles to maximising diversity.[8]

Increasing biodiversity contributes to a range of production, socio-economic, nutrition and environmental benefits. By planning and managing diversity, agroecological approaches enhance the provisioning of ecosystem services, including pollination and soil health, upon which agricultural production depends. Diversification can increase productivity and resource-use efficiency by optimizing biomass and water harvesting.

Agroecological diversification also strengthens ecological and socio-economic resilience, including by creating new market opportunities. For example, crop and animal diversity reduces the risk of failure in the face of climate change.

Mixed grazing by different species of ruminants reduces health risks from parasitism, while diverse local species or breeds have greater abilities to survive, produce and maintain reproduction levels in harsh environments. In turn, having a variety of income sources from differentiated and new markets, including diverse products, local food processing and agritourism, helps to stabilize household incomes.

Consuming a diverse range of cereals, pulses, fruits, vegetables, and animal-source products contributes to improved nutritional outcomes. Moreover, the genetic diversity of different varieties, breeds and species is important in contributing macronutrients, micronutrients and other bioactive compounds to human diets. For example, in Micronesia, reintroducing an underutilized traditional variety of orange-fleshed banana with 50 times more beta-carotene than the widely available commercial white-fleshed banana proved instrumental in improving health and nutrition.[9]

At the global level, three cereal crops provide close to 50 percent of all calories consumed,[10] while the genetic diversity of crops, livestock, aquatic animals and trees continues to be rapidly lost.

Agroecology can help reverse these trends by managing and conserving agro-biodiversity, and responding to the increasing demand for a diversity of products that are eco-friendly. One such example is 'fish-friendly' rice produced from irrigated, rainfed and deepwater rice ecosystems, which values the diversity of aquatic species and their importance for rural livelihoods.[11]

CO-CREATION AND SHARING OF KNOWLEDGE

Agricultural innovations respond better to local challenges when they are co-created through participatory processes.

Agroecology depends on context-specific knowledge. It does not offer fixed prescriptions – rather, agroecological practices are tailored to fit the environmental, social, economic, cultural and political context. The co-creation and sharing of knowledge plays a central role in the process of developing and implementing agroecological innovations to address challenges across food systems including adaptation to climate change.

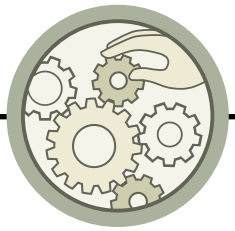
Through the co-creation process, agroecology blends traditional and indigenous knowledge, producers' and traders' practical knowledge, and global scientific knowledge.

Producer's knowledge of agricultural biodiversity and management experience for specific contexts as well as their knowledge related to markets and institutions are absolutely central in this process.

Education – both formal and non-formal – plays a fundamental role in sharing agroecological innovations resulting from co-creation processes. For example, for more than 30 years, the horizontal *campesino a campesino* movement has played a pivotal role in sharing agroecological knowledge, connecting hundreds of thousands of producers in Latin America.[12] In contrast, top-down models of technology transfer have had limited success.

Promoting participatory processes and institutional innovations that build mutual trust enables the co-creation and sharing of knowledge, contributing to relevant and inclusive agroecology transition processes.

SYNERGIES



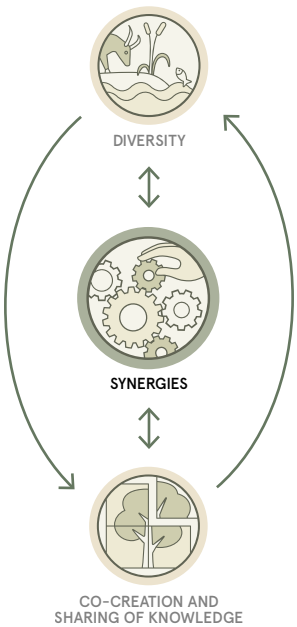
Building synergies enhances key functions across food systems, supporting production and multiple ecosystem services.

Agroecology pays careful attention to the design of diversified systems that selectively combine annual and perennial crops, livestock and aquatic animals, trees, soils, water and other components on farms and agricultural landscapes to enhance synergies in the context of an increasingly changing climate.

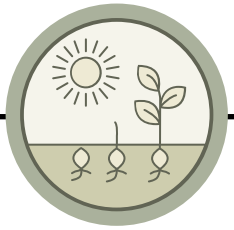
Building synergies in food systems delivers multiple benefits. By optimizing biological synergies, agroecological practices enhance ecological functions, leading to greater resource-use efficiency and resilience. For example, globally, biological nitrogen fixation by pulses in intercropping systems or rotations generates close to USD 10 million savings in nitrogen fertilizers every year,[13] while contributing to soil health, climate change mitigation and adaptation. Furthermore, about 15 percent of the nitrogen applied to crops comes from livestock manure, highlighting synergies resulting from crop–livestock integration.[14] In Asia, integrated rice systems combine rice cultivation with the generation of other products such as fish, ducks and trees. By maximising synergies, integrated rice systems significantly improve yields, dietary diversity, weed control, soil structure and fertility, as well as providing biodiversity habitat and pest control.[15]

At the landscape level, synchronization of productive activities in time and space is necessary to enhance synergies. Soil erosion control using *Calliandra* hedgerows is common in integrated agroecological systems in the East African Highlands.[16] In this example, the management practice of periodic pruning reduces tree competition with crops grown between hedgerows and at the same time provides feed for animals, creating synergies between the different components. Pastoralism and extensive livestock grazing systems manage complex interactions between people, multi-species herds and variable environmental conditions, building resilience and contributing to ecosystem services such as seed dispersal, habitat preservation and soil fertility.[17,18]

While agroecological approaches strive to maximise synergies, trade-offs also occur in natural and human systems. For example, the allocation of resource use or access rights often involve trade-offs. To promote synergies within the wider food system, and best manage trade-offs, agroecology emphasizes the importance of partnerships, cooperation and responsible governance, involving different actors at multiple scales.



EFFICIENCY



Innovative agroecological practices produce more using less external resources.

Increased resource-use efficiency is an emergent property of agroecological systems that carefully plan and manage diversity to create synergies between different system components. For example, a key efficiency challenge is that less than 50 percent of nitrogen fertilizer added globally to cropland is converted into harvested products and the rest is lost to the environment causing major environmental problems.[19]

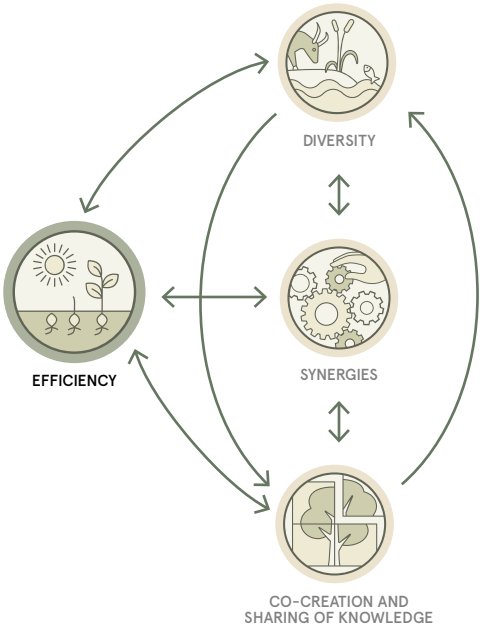
Agroecological systems improve the use of natural resources, especially those that are abundant and free, such as solar radiation, atmospheric carbon and nitrogen.

By enhancing biological processes and recycling biomass, nutrients and water, producers are able to use fewer external resources, reducing costs and the negative environmental impacts of their use.

Ultimately, reducing dependency on external resources empowers producers by increasing their autonomy and resilience to natural or economic shocks.

One way to measure the efficiency of integrated systems is by using Land Equivalent Ratios (LER).[20] LER compares the yields from growing two or more components (e.g. crops, trees, animals) together with yields from growing the same components individually. Integrated agroecological systems frequently demonstrate higher LERs.

Agroecology thus promotes agricultural systems with the necessary biological, socio-economic and institutional diversity and alignment in time and space to support greater efficiency.



RECYCLING

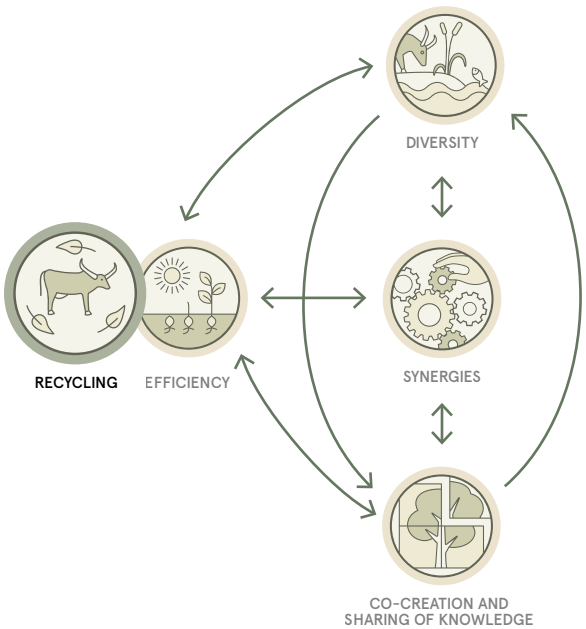
More recycling means agricultural production with lower economic and environmental costs.

Waste is a human concept – it does not exist in natural ecosystems. By imitating natural ecosystems, agroecological practices support biological processes that drive the recycling of nutrients, biomass and water within production systems, thereby increasing resource-use efficiency and minimizing waste and pollution.

Recycling can take place at both farm-scale and within landscapes, through diversification and building of synergies between different components and activities. For example, agroforestry systems that include deep rooting trees can capture nutrients lost beyond the roots of annual crops.[21] Crop–livestock systems promote recycling of organic materials by using manure for composting or directly as fertilizer, and crop residues and by-products as livestock feed.

Nutrient cycling accounts for 51 percent of the economic value of all non-provisioning ecosystem services, and integrating livestock plays a large role in this.[22] Similarly, in rice–fish systems, aquatic animals help to fertilize the rice crop and reduce pests, reducing the need for external fertilizer or pesticide inputs.

Recycling delivers multiple benefits by closing nutrient cycles and reducing waste that translates into lower dependency on external resources, increasing the autonomy of producers and reducing their vulnerability to market and climate shocks. Recycling organic materials and by-products offers great potential for agroecological innovations.



RESILIENCE

Enhanced resilience of people, communities and ecosystems is key to sustainable food and agricultural systems.

Diversified agroecological systems are more resilient – they have a greater capacity to recover from disturbances including extreme weather events such as drought, floods or hurricanes, and to resist pest and disease attack.

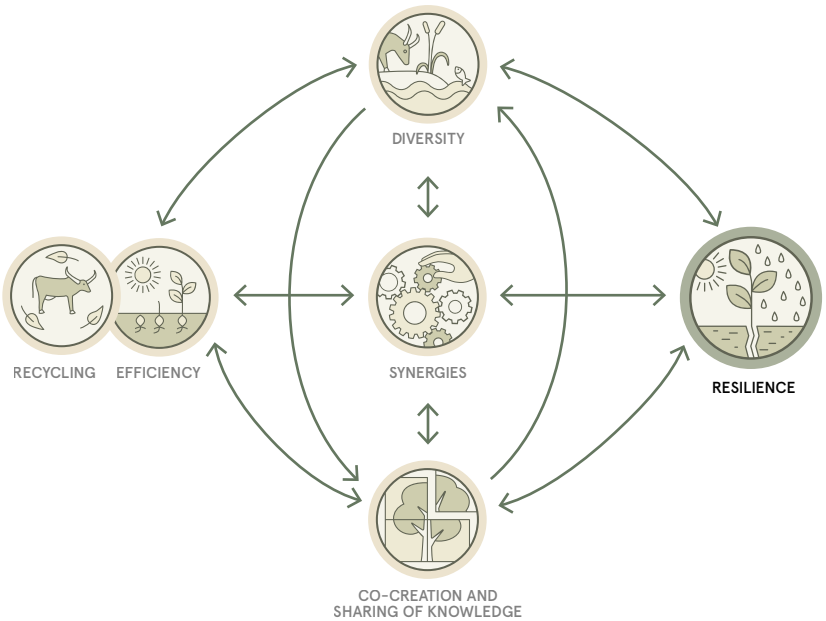
Following Hurricane Mitch in Central America in 1998, biodiverse farms including agroforestry, contour farming and cover cropping retained 20–40 percent more topsoil, suffered less erosion and experienced lower economic losses than neighbouring farms practicing conventional monocultures.[23]

By maintaining a functional balance, agroecological systems are better able to resist pest and disease attack. Agroecological practices recover the biological complexity of agricultural systems and promote the necessary community of interacting organisms to self-regulate pest outbreaks.

On a landscape scale, diversified agricultural landscapes have a greater potential to contribute to pest and disease control functions.[24]

Agroecological approaches can equally enhance socio-economic resilience. Through diversification and integration, producers reduce their vulnerability should a single crop, livestock species or other commodity fail.

By reducing dependence on external inputs, agroecology can reduce producers' vulnerability to economic risk. Enhancing ecological and socio-economic resilience go hand-in-hand – after all, humans are an integral part of ecosystems.



HUMAN AND SOCIAL VALUES

Protecting and improving rural livelihoods, equity and social well-being is essential for sustainable food and agricultural systems.

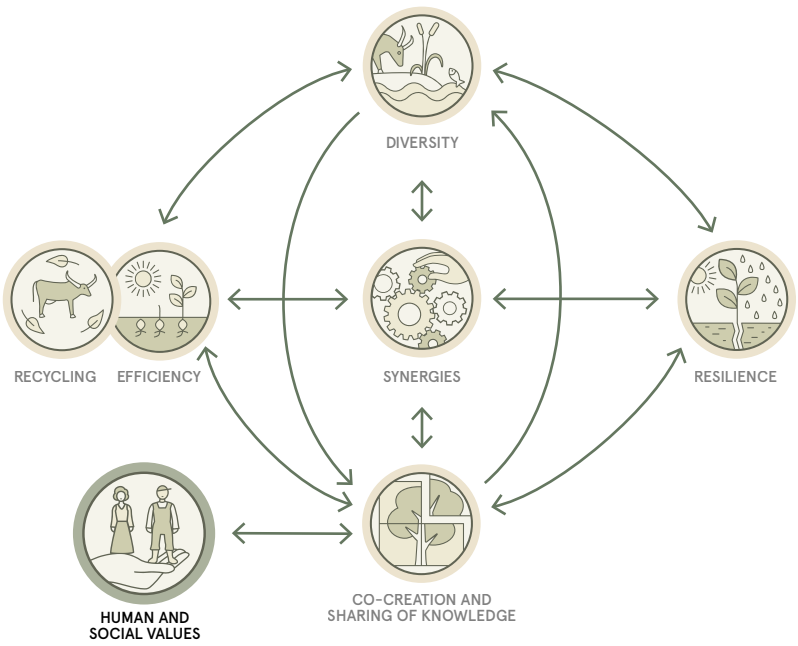
Agroecology places a strong emphasis on human and social values, such as dignity, equity, inclusion and justice all contributing to the improved livelihoods dimension of the SDGs. It puts the aspirations and needs of those who produce, distribute and consume food at the heart of food systems. By building autonomy and adaptive capacities to manage their agro-ecosystems, agroecological approaches empower people and communities to overcome poverty, hunger and malnutrition, while promoting human rights, such as the right to food, and stewardship of the environment so that future generations can also live in prosperity.

Agroecology seeks to address gender inequalities by creating opportunities for women. Globally, women make up almost half of the agricultural workforce. They also play a vital role in household food security, dietary diversity and health, as well as in the conservation and sustainable use of biological diversity. In spite of this, women remain economically marginalised and vulnerable to violations of their rights, while their contributions often remain unrecognized.[25]

Agroecology can help rural women in family farming agriculture to develop higher levels of autonomy by building knowledge, through collective action and creating opportunities for commercialization. Agroecology can open spaces for women to become more autonomous and empower them at household, community levels and beyond – for instance, through participation in producer groups. Women's participation is essential for agroecology and women are frequently the leaders of agroecology projects.

In many places around the world, rural youth face a crisis of employment. Agroecology provides a promising solution as a source of decent jobs. Agroecology is based on a different way of agricultural production that is knowledge intensive, environmentally friendly, socially responsible, innovative, and which depends on skilled labour. Meanwhile, rural youth around the world possess energy, creativity and a desire to positively change their world. What they need is support and opportunities.

As a bottom-up, grassroots paradigm for sustainable rural development, agroecology empowers people to become their own agents of change.



CULTURE AND FOOD TRADITIONS

By supporting healthy, diversified and culturally appropriate diets, agroecology contributes to food security and nutrition while maintaining the health of ecosystems.

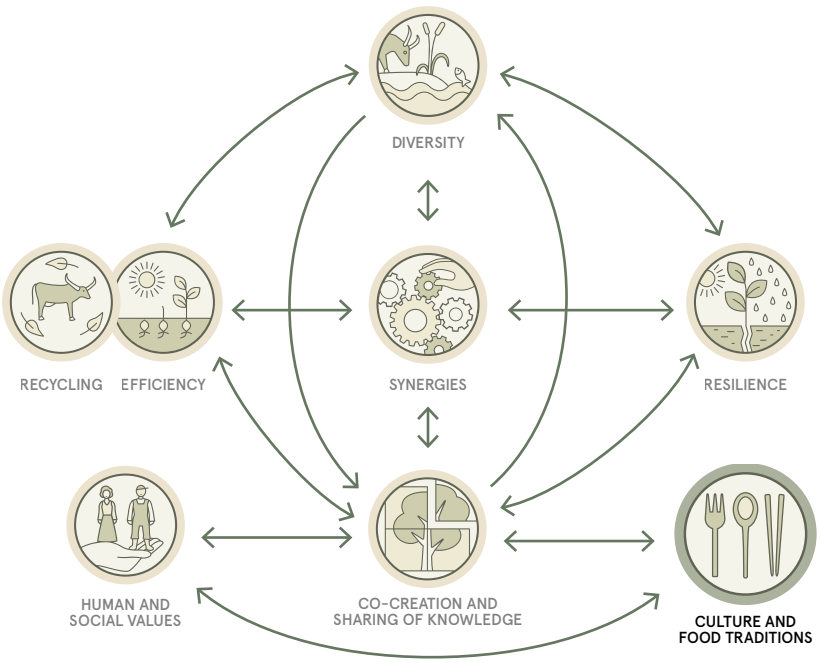
Agriculture and food are core components of human heritage. Hence, culture and food traditions play a central role in society and in shaping human behaviour. However, in many instances, our current food systems have created a disconnection between food habits and culture. This disconnection has contributed to a situation where hunger and obesity exist side by side, in a world that produces enough food to feed its entire population.

Almost 800 million people worldwide are chronically hungry and 2 billion suffer micronutrient deficiencies.[26] Meanwhile, there has been a rampant rise in obesity and diet-related diseases; 1.9 billion people are overweight or obese and non-communicable diseases (cancer, cardiovascular disease, diabetes) are the number one cause of global mortality.[27]

To address the imbalances in our food systems and move towards a zero hunger world, increasing production alone is not sufficient.

Agroecology plays an important role in re-balancing tradition and modern food habits, bringing them together in a harmonious way that promotes healthy food production and consumption, supporting the right to adequate food. In this way, agroecology seeks to cultivate a healthy relationship between people and food.

Cultural identity and sense of place are often closely tied to landscapes and food systems. As people and ecosystems have evolved together, cultural practices and indigenous and traditional knowledge offer a wealth of experience that can inspire agroecological solutions. For example, India is home to an estimated 50 000 indigenous varieties of rice[28] – bred over centuries for their specific taste, nutrition and pest-resistance properties, and their adaptability to a range of conditions. Culinary traditions are built around these different varieties, making use of their different properties. Taking this accumulated body of traditional knowledge as a guide, agroecology can help realise the potential of territories to sustain their peoples.



RESPONSIBLE GOVERNANCE

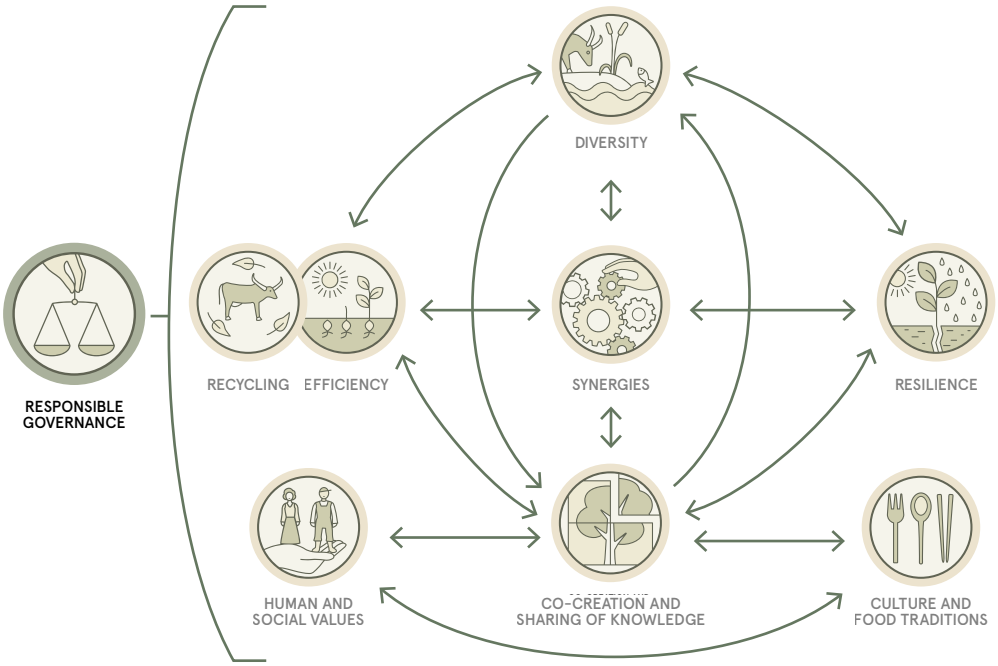
Sustainable food and agriculture requires responsible and effective governance mechanisms at different scales – from local to national to global.

Agroecology calls for responsible and effective governance to support the transition to sustainable food and agricultural systems. Transparent, accountable and inclusive governance mechanisms are necessary to create an enabling environment that supports producers to transform their systems following agroecological concepts and practices. Successful examples include school feeding and public procurement programmes, market regulations allowing for branding of differentiated agroecological produce, and subsidies and incentives for ecosystem services.

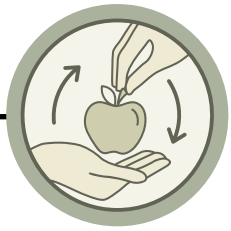
Land and natural resources governance is a prime example. The majority of the world's rural poor and vulnerable populations heavily rely on terrestrial and aquatic biodiversity and ecosystem services for their livelihoods, yet lack secure access to these resources.

Agroecology depends on equitable access to land and natural resources – a key to social justice, but also in providing incentives for the long-term investments that are necessary to protect soil, biodiversity and ecosystem services.

Agroecology is best supported by responsible governance mechanisms at different scales. Many countries have already developed national level legislation, policies and programmes that reward agricultural management that enhances biodiversity and the provision of ecosystem services. Territorial, landscape and community level governance, such as traditional and customary governance models, is also extremely important to foster cooperation between stakeholders, maximising synergies while reducing or managing trade-offs.



CIRCULAR AND SOLIDARITY ECONOMY



Circular and solidarity economies that reconnect producers and consumers provide innovative solutions for living within our planetary boundaries while ensuring the social foundation for inclusive and sustainable development.

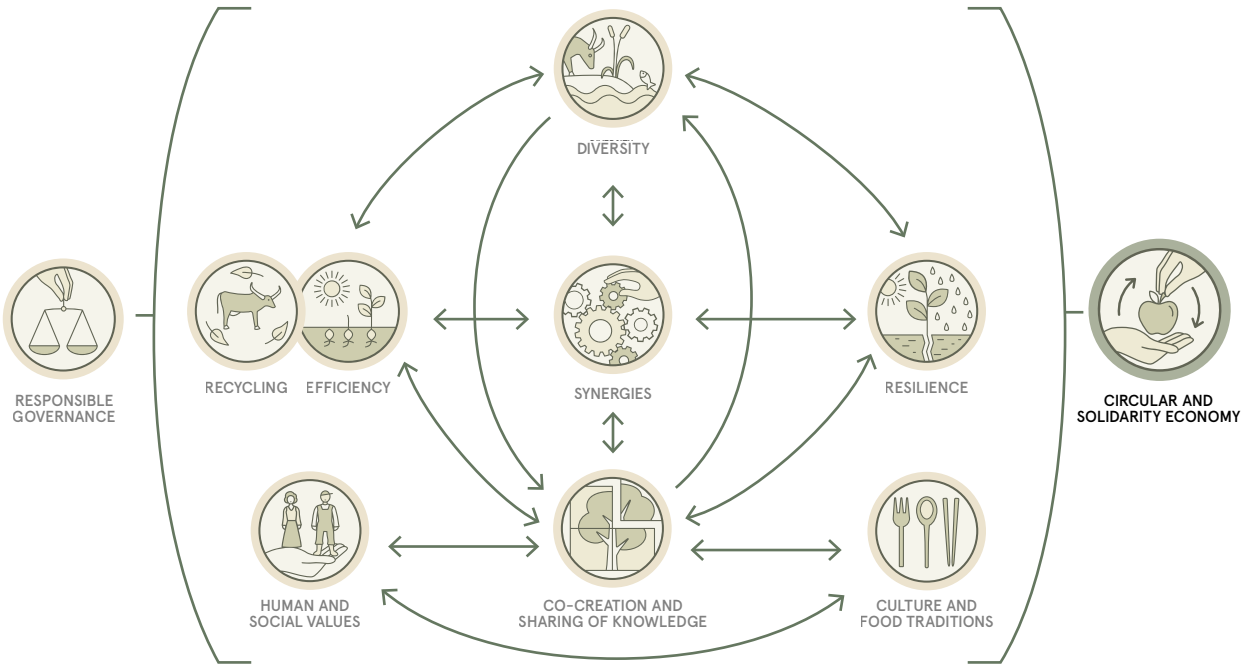
Agroecology seeks to reconnect producers and consumers through a circular and solidarity economy that prioritizes local markets and supports local economic development by creating virtuous cycles.

Agroecological approaches promote fair solutions based on local needs, resources and capacities, creating more equitable and sustainable markets. Strengthening short food circuits can increase the incomes of food producers while maintaining a fair price for consumers. These include new innovative markets,[29,30] alongside more traditional territorial markets, where most smallholders market their products.

Social and institutional innovations play a key role in encouraging agroecological production and consumption. Examples of innovations that help link producers and consumers include participatory guarantee schemes, local producer's markets, denomination of origin labelling, community supported agriculture and e-commerce schemes. These innovative markets respond to a growing demand from consumers for healthier diets.

Re-designing food systems based on the principles of circular economy can help address the global food waste challenge by making food value chains shorter and more resource-efficient. Currently, one third of all food produced is lost or wasted, failing to contribute to food security and nutrition, while exacerbating pressure on natural resources.[31]

The energy used to produce food that is lost or wasted is approximately 10 percent of the world's total energy consumption,[32] while the food waste footprint is equivalent to 3.5 Gt CO_2 of greenhouse gas emissions per year.[33]



ENDNOTES

[1] FAO's Common Vision for Sustainable Food and Agriculture balances the social, economic and environmental dimensions of sustainability across agricultural landscape and seascape mosaics. It outlines general principles for sustainable food and agricultural systems that are highly productive, economically viable and environmentally sound, contributing to equity and social justice. The five FAO principles for Sustainable Food and Agriculture are: 1) improving efficiency in the use of resources; 2) conserving, protecting and enhancing natural ecosystems; 3) protecting and improving rural livelihoods, equity and social well-being; 4) enhancing the resilience of people, communities and ecosystems; 5) promoting good governance of both natural and human systems.

[2] Examples include: the International Assessment of Agricultural Knowledge, Science and Technology for Development, which called for an increase and strengthening of agroecological sciences in 2008; the 2011 Report on Agroecology and the right to food, presented by the Special Rapporteur on the right to food to the UN Human Rights Council; the Ecological Organic Agriculture Initiative of the African Union and the Community of Latin American and Caribbean States (CELAC) that have promoted agroecological practices and policies at regional level; the Ecosystem Approach (including pillars of ecological wellbeing, human wellbeing, and governance), endorsed by the Convention on Biological Diversity and applied by FAO through its Ecosystem Approach to Fisheries and Aquaculture since 2000.

[3] Brazil's *Fome Zero* programme provides a telling example. *Fome Zero* proved instrumental in reducing extreme poverty (from 17.5 percent in 2003 to less than 3 percent in 2013) and eradicating hunger. The programme involved a large number of policy and development instruments, including support for agroecological food production and consumption (**Instituto Brasileiro de Geografia e Estatística**. 2013. *Pesquisa nacional por amostra de domicílio: segurança alimentar* (available at: www.ibge.gov.br/home/estatistica/populacao/).

[4] The 10 Elements of Agroecology were developed through a synthesis process. They are based on the seminal scientific literature on agroecology – in particular, Altieri's (1995) five principles of agroecology and Gliessman's (2015) five levels of agroecological transitions. This scientific foundation was complemented by discussions held in workshop settings during FAO's multi-actor regional meetings on agroecology from 2015 to 2017, which incorporated civil society values on agroecology, and subsequently, several rounds of revision by international and FAO experts. **Altieri, M.A.** 1995. *Agroecology: The Science of Sustainable Agriculture*. CRC Press. **Gliessman, S.R.** 2015. *Agroecology: The Ecology of Sustainable Food Systems*. 3rd Edition. Boca Raton, FL, USA, CRC Press, Taylor & Francis Group.

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