INTPA / F3

Supporting the transformation of agricultural and food systems through agroecological approaches

Summary

This technical note aims to provide support for reflection and decision-making to develop interventions aimed at supporting the transformation of agricultural and food systems, based on the principles of agroecology and in line with the priorities of the European Green Deal. In this perspective, it supports a vision of agroecology open to innovation and the market and including a set of interventions (production, processing, distribution, consumption).

A global consensus is emerging regarding the challenges facing agricultural and food systems. However, the pathways to be taken for the transformation of agricultural and food systems are highly controversial. Agroecology is a credible and effective option for responding to the challenges. This assertion is based on a rapidly growing scientific production, observation of agrarian realities and large-scale development interventions. However, the definitions of agroecology are diverse. It is necessary to refer to elements and principles that have been defined through different stakeholders' consultations and particularly with FAO. The challenge is to design transformative pathways for a variety of agrarian situations by mobilizing agroecological principles (technical but also organizational).

The note provides positioning elements in relation to debates that are the subject of controversy on agroecology:

- The role of innovation: There is a need to promote a type of agroecology that recognizes the need to evolve, with responsible innovations that respect an ethical framework, based on a hybridization of local knowledge and scientific knowledge.
- Performances measurement: The construction of an operational metric to measure the performances of agroecology is key and must include performance indicators (technical, economic, social) and environmental footprints indicators
- The use of inputs: We must adapt the use of synthetic inputs according to the type of production systems and the current levels of consumption, in addition to other agricultural practices compatible with agroecology, and with the aim to reduce their use.
- Genetic progress: The genetic progress that science can bring is an asset. However, it requires a change of the selection objectives to be in line with agroecology. In-situ conservation and defense of farmers seeds rights are important issues.
- Digital: Digital must contribute to agroecology by developing digital tools that promote the production of local references, the exchange of experiences between actors, and learning through the design and use of collaborative tools

- Family farming vs. industrial farming: Agroecological movements support family farming and especially small farmers. But the principles of agroecology, both the technical and social dimensions, can and must also be applied to industrial agriculture
- The role of the market: For large-scale transformation there is a need to promote or support value chains that are compatible with agroecology. The role of educated consumers is also key to orient the market.
- Transformation at large-scale: More than a dissemination of technological packages, a change of scale involves the dissemination of appropriate methods of intervention, the capacity building of actors, the mobilization of the private sector, and an enabling environment.

1. The note shows how agroecology contributes to European priorities, including the Green Deal and its 'farm to fork' and 'biodiversity' strategies. The note identifies several types of intervention which are all levers of action. Many interventions are already known but the way to design and implement them makes them compatible with agroecology. The interactions and synergies between different interventions need to be analysed and monitored based on a systemic approach of the food systems. Develop relevant action-research
2. **Improve agricultural practices through innovation**
3. Strengthen innovation support services
4. Develop territories with an integrated vision
5. **Support responsible value chains and access to inclusive markets**
6. Improve nutrition and health through the management of the biodiversity
7. Renew academic and professional training courses
8. **Strengthen public policies to support the transition of food systems**

The characteristics of these potential interventions are specified in the note. However, three interventions are of high priority to make significant changes at scale : improve agricultural practices through innovation, support responsible value chains and access to inclusive markets, strengthen public policies to support transition of food systems.

Objective of the note[1] :

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1) The choice for the agroecological transition

A global consensus is emerging on the challenges facing agricultural and food systems (food and nutrition security, climate change, loss of biodiversity, high pressure on resources, etc.) and the objectives to be achieved collectively to contribute to the Sustainable Development Goals. (SDGs). Agriculture and food systems are thus seen as contributing to the problems, but they can and should also be part of the solutions. However, the pathways that should be taken are highly controversial and there is no consensus on innovative approaches and on policies to support this transformation. In international and national forums, two pathways are mainly discussed with contrasting points of view and strong positions taken by certain actors (governments, donors, multinationals, civil society, international organizations, etc.)[2].

The first pathway is based on "a sustainable intensification of agricultural systems" and is based on concepts such as climate-smart agriculture or precision agriculture. It assumes that productivity per unit of land (or scarce resource) must increase, but in a sustainable manner. This pathway is mainly based on incremental innovations, making use of new technologies, within the framework of agricultural systems aiming at the rationalization and standardization of production processes. This pathway was that of the Green Revolution and had dramatic negative effects on the environment. The second pathway is based on agroecological approaches[3]. This pathway aims to design agricultural systems by making the best use of ecological processes while maintaining the natural resources capacities for regeneration. Many actors see this pathway as more transformative and better able to address the systemic issues facing agriculture and food systems and to ensure multiple contributions to the SDGs. There are largely unexplored opportunities to refine this agroecological pathway in order to design resilient food systems, preserving natural capital, capable of providing sufficient and healthy food to cope with the demographic pressure, and offering opportunities for sustainable economic and social development.

However, in reality we observe a continuum between the two pathways with many overlaps due to the great diversity of agriculture and food systems. The challenge is therefore to design pathways of transformation for this diversity of situations (extensive or intensive agriculture, family or industrial

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[1] *This overview does not represent an official statement of the European Commission. It is the result of an informal consultation held in 2020-2021, between INTPA services and its partners. The note has been especially discussed with JRC and the Green Deal Task Force of the European Commission.*

[2] HLPE 2019. Agroecological and other innovative approaches for sustainable agriculture and food systems that enhance food security and nutrition. A report by the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security, Rome http://www.fao.org/3/ca5602en/ca5602en.pdf

[3] Wezel A, Gemmill Herren B, Bezner Kerr R, Barrios E, Gonçalves ALR and Sinclair F (2020). Principles of agroecology for transitioning to sustainable food systems. A review. *Agronomy for Sustainable Development* (in press).

agriculture) by mobilizing agroecological principles (technical and organizational) but without dogmatism. Because there is no "single solution valid for everyone and everywhere", it is necessary to design with the actors (including research) solutions adapted to each situation by identifying the trade-offs which are compatible with the achievement of the SDGs. Agroeocology requires a set of interventions addressing different components of agricultural and food systems (production, processing, distribution, consumption), at different levels (local, national, global). Agroecology also has profound implications for how research, education and vocational training and agricultural extension are organized, and beyond, for the structuring of innovation systems at the national level and for the definition of relevant public policies.

2) What is agroecology?

It is usual to describe **agroecology as being at the same time a science, a set of practices and a social movement.** Initially focused on fields and farms, today it encompasses the whole agricultural and food systems. However, there is no single and consensual definition of agroecology that is shared by all stakeholders and there is no clear agreement on all the aspects covered by this concept. Some actors emphasize the environmental dimension of agroecology. They insist on the implementation of practices that take advantage, preserve and improve biological and ecological processes in agricultural production, in order to reduce the use of synthetic inputs and to constitute more diverse, more resilient and more productive agricultural ecosystems. Other actors, linked to social movements, promote agroecology to propose more autonomous and diversified agricultural systems adapted to local conditions, valorising the local values and put in place mainly by small producers. But it is not easy to draw a clear line on what is agroecological and what is not.

Thus, FAO gives a broad definition of agroecology which encompasses the technical and social dimension: "agroecology is an integrated approach which simultaneously applies ecological and social concepts and principles to the design and management of food and agricultural systems. . Agroecology aims to optimize the interactions between plants, animals, humans and the environment while taking into account the social aspects that must be addressed for a sustainable and equitable food system "[4].

Several studies that refer to agroecology prefer to insist on principles that define what is agroecology. The FAO proposes 10 elements to characterize agroecology, identified from a consultation process carried out between 2015 and 2017 and culminating with an international symposium in 2018[5] . The CSF HLPE report on agroecology[6] presents 13 principles that must be applied for an agroecological transition. The 10 elements and the 13 principles are complementary.

Box 1: The 10 agroecological elements (FAO)

The characteristics

[4] FAO. The 10 elements of agroecology guiding the transition to sustainable food and agricultural systems, http://www.fao.org/3/I9037EN/i9037en.pdf

[5] http://www.fao.org/about/meetings/second-international-agroecology-symposium/en/

[6] HLPE 2019. Agroecological and other innovative approaches for sustainable agriculture and food systems that enhance food security and nutrition. A report by the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security, Rome http://www.fao.org/3/ca5602en/ca5602en.pdf

1. biological diversity in production systems;

2. the co-creation and sharing of knowledge through participatory processes;3. strengthening synergies at the farm and territorial level;

4. the efficiency based on biological processes;

5. the recycling of biomass, nutrients and water;

6. the resilience of ecosystems and societies;

7. the protection of the human and social values of local communities;

8. the integration of food traditions;

9. the existence of responsible governance from local to global;

10. the development of a circular economy that connects producers and consumers.

Box 2: The 13 agroecological principles (HLPE 2019)

The 13 principles of the HLPE

Improve the efficiency of resource use

1. Recycling. Focus on local renewable resources and close, to the extent possible, the cycles of nutrient and biomass resources.

2. Reduction of inputs. Reduce or eliminate the screw-in dependence on purchased inputs and enhance self-reliance.

Building resilience

3. Soil health. Guarantee and improve the health and functioning of the soil to promote plant growth, in particular through the management of organic matter and the intensification of the biological activity of the soil.

4. Animal health. Improve the health and welfare of animals.

5. Biodiversity. Preserve and increase species diversity, functional diversity and genetic resources to maintain the overall biodiversity of agroecosystems over time and space at field, farm and landscape levels.

6. Synergies. Foster positive ecological interactions, synergies, integration and complementarity among the elements of agroecosystems (animals, crops, trees, soil and water).

7. Economic diversification. Diversify farm incomes by ensuring that small farmers enjoy greater financial independence and can create added value while enabling them to meet consumer demand.

Ensure equity / social responsibility

8. Co-creation of knowledge. Strengthen the co-creation and horizontal sharing of knowledge, including local and scientific innovation, in particular through exchanges between farmers.

9. Social values and types of diet. Create food systems that are based on the culture, identity, tradition, social equity and gender equality of local communities, and that ensure healthy, diverse, seasonally and culturally appropriate diets.

10. Fairness. Ensure dignified and reliable livelihoods for all stakeholders involved in food systems,

especially smallholder farmers, through fair trade, fair working conditions and fair treatment of intellectual property rights.

11. Connectivity. Guarantee proximity and trust between producers and consumers through the promotion of fair and short distribution channels and the reintegration of food systems into local economies.

12. Governance of land and natural resources. Strengthen institutional structures to improve, in particular, the recognition and support provided to family farms, small farmers and peasant who ensure sustainable management of natural and genetic resources.

13. Participation. Encourage social organization and the increased participation of food producers and consumers in decision-making in order to promote decentralized governance and local adaptive management of agricultural and food systems.

It is possible to use these elements and principles to analyse the different types of approaches for the development of agricultural and food systems and identify those that are consistent with agroecology. There are several methods under development on the subject that allow to specify criteria by principle (for example, Tool for Agroecology Performance Evaluation, TAPE, FAO 2019[7]). Various approaches are currently under debate in national and international arenas, which can be considered more or less in line with agroecological elements and principles: regenerative agriculture, nature based solution, organic farming. , permaculture, agroforestry, climate-smart agriculture, sustainable value chains, conservation agriculture, ecological intensification, etc. There are many common points between the different approaches but there are also differences. The main differences are related to the type of food system transition supported, the role of innovation such the external inputs, the place of nature in the transformative process, the social dimension and especially the role of local knowledge. For example, the climate smart agriculture accepts whatever type of agriculture which address the 3 pillars of climate smart agriculture and thus may accept climate smart intensive monocropping monitored by digital tools or agroecological farming systems putting emphasis on mitigation and adaptation. The nature based solutions approach is fully aligned with agroecology but could be perceived as more inclusive by including cultivated and not cultivated areas. However, the various concepts are supported by coalitions of actors (civil society, private sector, donors, government, etc.) to promote their own vision of the agriculture and of the development.

There are also gradients in the evolution of agricultural and food systems. Gliessman[8] has defined five phases in agroecological transitions to more sustainable agriculture and food systems. The first three phases are implemented at the level of agricultural ecosystems and consist of:

- 1 : increase the efficiency of input use;
- 2 : replace conventional inputs and practices with agroecological solutions and
- 3 : redesigning the agricultural ecosystem from a new set of ecological processes.

The last two phases concern the food system as a whole and aim to:

- 4 : re-establish a more direct link between producers and consumers and

[7] FAO. 2019. TAPE Tool for Agroecology Performance Evaluation 2019 – Process of development and guidelines for application. Test version. Rome http://www.fao.org/3/ca7407en/CA7407EN.pdf

[8] Gliessman S.R. (2007) The Ecology of Sustainable Food Systems, CRC Press

- 5 : build a new global food system based on participation, local specificities, equity and justice.

The first two phases proceed in stages with incremental innovations, but the other three involve a deeper transformation.

3) Examples of the diversity of agroecological systems

Concrete examples illustrate agroecological systems with their advantages but also with certain limits that we must overcome.

Agroforestry systems in Cameroon are a relevant example with cocoa production under the shade of a variety of trees that provide products for family consumption or sale. Food crops can be intercropped, especially when establishing plantations. Trees help maintain soil fertility by recycling minerals. Farmers regulate the density of trees to balance production but also to control certain harmful insects or diseases in order to limit the use of pesticides[9]. The productivity per hectare of these complex systems is high taking into account all the products (cocoa, food crops, fruits and wood). However, these systems are under strong pressure and tend to decline in favor of a pure cocoa crop which allows higher yields in the first years and therefore attractive monetary inflows in the short term but which degrade natural resources (soil, biodiversity). The revitalization of these agroforestry systems requires technical improvements, the creation of a network of tree nurseries but also a access to market for all the production of these agroforestry systems and appropriate public policies (incentive to plant, control of deforestation, land tenure security).

Agro-sylvo-pastoral systems in the cotton zones of Mali nicely balance food production and export production[10]. Often crops of legumes in combination with cereals contribute to soil fertility by fixing atmospheric nitrogen. Animals represent a form of savings and provide both labour power and organic manure in addition to mineral fertilizers. Trees limit erosion and contribute to soil fertility while providing products often marketed by women. The emergence of "organic farming" or "fair trade" certifications allows recognition of certain products from these agricultural systems (cotton and shea, for example). But the challenges to be addressed are important to maintain and improve these systems. There is a need to innovate to take into account the rise of mechanization, to better manage the balance between pastures for animals and extension of crops, to develop a diversity of value chains (especially for legumes) that enhance the diversity of the farm's products.

Urban agroecology, the case of Havana. The food shortage in Havana that occurred after the dissolution of the Soviet Union and the American embargo in the early 1990s, forced Cuba to produce its own food in order to guarantee its food security. In Havana, in a spontaneous movement the population began to sow in the spaces available in the city or its surroundings. The government has launched an urban agriculture plan largely based on agroecology and including access to appropriate services (nurseries, composting, veterinary care and bio-inputs). About 22,700 jobs have been created. Between 1997 and 2009, Havana increased vegetable production by 1300%. It is estimated that the vast majority of urban farmers in Havana have agroecological practices and that

[9] Jagoret P., Saj S., Carimentrand A., 2020. Cacaoculture agroforestière en Afrique : l'art de concilier production durable et services écologiques. Montpellier, Cirad, *Perspective* 54.

[10] Yapy-Gnaore, V., Vall E., Havard M., Kanwé A., Sangaré M. (2014) Des systèmes agro-sylvo-pastoraux innovants pour nourrir l'Afrique de l'Ouest et du Centre

they produce 60% of the consumption in vegetables, corn, beans, fruits and pork[11]. Urban agriculture in Cuba is not only a form of food production based on agroecology, but is part of a broader strategy to self-supply cities, to provide healthy food to the most vulnerable sectors (schools, hospitals, the elderly, etc.), reduce the ecological footprint and improve short food supply chains and local food systems. In addition, it stimulates the local economy and reduces external dependence.

Agroecology in Andhra Pradesh. Since 2015, the state government of Andhra Pradesh, India has adopted the "zero budget natural agriculture", an agroecological and climate resilient approach to agricultural production. The main objective is to promote nature-based solutions for farming systems. Agricultural practices include: use of native seeds, minimal tillage to restore soil structure and health, improvement of soil biomes through inoculant, biological pest control, including botanical extracts, etc. Chemical inputs are not used. The approach includes: participatory planning and monitoring, self-help groups with a focus on women, dissemination of knowledge from farmer to farmer. The program currently works with 650,000 farmers, covering an area of approximately 280,000 hectares. The long term goal of the government is to reach 6 million farmers. Studies show that there is no statistically significant difference in yields of crops grown under agroecological and non-agroecological systems and that agroecological systems report higher net income per hectare for farmers[12].

Some actors (from research, consulting, decision-makers, young entrepreneurs, financiers) consider that agroecology promotes production systems from the past with old practices, without taking in consideration that the farmers continually adapt them by demonstrating their capacity for innovation. On the contrary, agroecology is also based on the latest scientific developments. Recent experiences show that agroecological systems are developing at odds with previous systems. For example, conservation agriculture is based on rigorous scientific works. It rejects tillage and promotes cover crops thus allowing regeneration of soils which become more fertile with a more intense biological life. Conservation agriculture is developing in many contexts, especially in Latin America and Europe, but seems more suited to mechanized farms than to small farms based on manual cultivation. However, some experience are not agroecological with a standardization of landscapes and excessive use of herbicides as in Argentina. Another example, organic farming banning chemicals inputs and aiming to better manage ecological processes, is experiencing significant growth in middle-income countries. This development is driven by demand from consumers who are worried about the use of pesticides for their health, but also by incentive measures (support to certification, training, subsidies, etc.). But here too, organic farming can experience drifts with intensive and undiversified production, based on purchased organic inputs, indecent working conditions, or commercialization in export markets by air.

To shed light on agroecological farming situations, it may be also meaningful to mention systems that are not agroecological. Industrial agriculture is an obvious case because it is based on mono-cropping, the standardization of agricultural practices, and the dominant use of synthetic inputs for plant nutrition and pest control. This type of agriculture is also often characterized by a lack of integration into the territories and a strong connection to international financial flows and globalized

[11] World Bank, FAO. Food Systems for An Urbanizing World http://documents1.worldbank.org/curated/ar/454961511210702794/pdf/Food-systems-for-an-urbanizing-world-knowledge-product.pdf

[12] TMG (2020) Systemic Challenges, Systemic Responses. Innovating Adaptation to Climate Change through Agroecology. Working Paper. https://globalsoilweek.org/wp-content/uploads/2020/12/Systemic-Challenges-Systemic-Responses.pdf

products. Clear examples are industrial plantations of palm oil in Indonesia or coffee in Brazil. However, changes are possible and desirable, as shown by certain experiences. For example, there is cases of industrial rubber production based on agroforestry with balanced farming contracts with small producers. In a more nuanced way, value chains are hardly compatible with agroecological principles when they do not take into account the complexity of production systems (and therefore the diversity of farmers' productions), are not integrated into their territories through a network of actors and local initiatives, and are primarily concerned with economic performance (profit, competitiveness) without seriously taking into account the social and environmental dimensions of their activities,

4) How agroecology contributes to EU priorities

The European Commission has defined its new priorities[13]. Agroecology contributes directly to the Green Deal[14], to its "farm to fork" strategy[15] and to its biodiversity strategy[16]. Agroecology makes a contribution to other priorities (employment, especially for young people) or is coherent with other priorities (digital development).

- Agroecology aims to develop more sustainable production systems because they are more diversified, enhancing and protecting natural resources, fighting against pollution because they consume less chemical inputs, and contributing to the provision of ecosystem services. It requires value chains that are more respectful of the people and the environment by relying on a circular economy and better management of losses and waste ;
- Agroecology is an integral component of a strategy for managing biodiversity in cultivated areas because it aims to increase and manage biological diversity at the level of plots, farms and territories (soil life, plant and animal species);
- Agroecology contributes to adaptation to climate change by promoting production systems that are more resilient because they are more diversified. It also contributes to mitigation through agroforestry systems (in wet or dry areas) and better soil management allowing carbon capture and an increase in organic matter (see initiative 4 per 1000[17]);
- Agroecology contributes to a healthy diet by promoting productions which are diversified on farms and in the territories and which are adapted to local cultures and values; it finally contributes to better human health through less pesticides and a healthier environment showing that it is compatible with "one health" approaches;
- Agroecology is coherent with digital development because it must rely on specific digital tools at the level of production, marketing, consumption, or access to services. It can help reduce or avoid the digital divide.

[13] https://ec.europa.eu/info/strategy/priorities-2019-2024_fr

[14] A European Green Deal. https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en

[15] EU Farm to Fork Strategy. https://ec.europa.eu/food/farm2fork_en#:~:text=The%20Farm%20to%20Fork%20Strategy%20is%20at%20the%20heart%20of,%2C%20healthy%20and%20environmentally%2Dfriendly.&text=The%20Farm%20to%20Fork%20Strategy%20aims%20to%20accelerate%20our%20transition,neutral%20or%20positive%20environmental%20impact

[16] https://ec.europa.eu/environment/strategy/biodiversity-strategy-2030_en

[17] https://www.4p1000.org/

- Agroecology is a major source of employment through the mobilization of the family farming workforce, which through innovation, should allow the creation of decent and attractive jobs for young people. It supports the creation of small and medium-sized enterprises providing services or transforming and marketing agroecological products.
- Agroecology participates in educational efforts through the necessary capacity building of actors which request investments in training systems. It particularly targets vulnerable populations (young people, women, marginalized communities) because agroecological models are adapted to this type of actor
- Agroecology is also at the service of democratic values carried by civil society actors but also producer organizations by promoting participation, inclusion and knowledge sharing. These democratic values resonate with those defended by the EU.

5) Controversies on agroecology and positioning in relation to EU priorities

In this part controversial topics around agroecology are discussed. The note also offers food for thought to support INTPA's positioning on agroecology in relation to EU priorities and to help dialogue with partners both in third countries and at international level.

Systemic Innovation to address the current challenges

Agroecology is often referred by its detractors to the practices of the past with a rejection of modernity expressed through genetic progress, the use of chemical inputs, and mechanization. While agroecology is effectively largely based on the knowledge of farmers who have always been able to demonstrate capacities for innovation to manage diversified production systems and complex ecological processes, it is also based on a growing base of scientific results. However, the scale of the current challenges calls for investments for research to support of agroecological approaches. The objective is to better understand and take advantage of biological processes (soil life, integrated pest control, interactions between species, etc.) and to develop a circular economy (transformation of products, limitation of losses, local production of energy, etc.). It is also a matter of promoting innovation by adapting agricultural systems and value chains to current challenges and the needs of stakeholders. For example, significant efforts must be made to develop mechanization adapted to agroecology in order to increase labour productivity, reduce hardship, and ultimately increase farmers' incomes and the attractiveness of agriculture for young people. In conclusion, to promote agroecology there is a need to innovate with a systemic approach, with responsible innovations, adapted to local contexts and based on a hybridization of local knowledge and scientific knowledge.

What is the relevant measure of performance?

Some actors consider agroecology insufficiently efficient to feed the planet because the yields would not be as high as those of conventional agriculture. On the one hand, such assertion ignores progresses linked to future investments in research and more efficient support to actors to innovate and improve productive performance. But on the other hand, the performance measurement is in question. It is not relevant to measure the performance of agroecology as for conventional agriculture based only on production and productivity indicators (yield, income per ha, etc.) which

do not include the real cost of production for the society. In addition to these indicators, which remain relevant, a metric must be developed that takes into account the environmental footprint (carbon emissions, water consumption, loss of biodiversity, impacts on human health, dependence on fossil fuels, change in the use of land, etc.), the diversity of ecosystem services (diversity of food products, carbon storage, water filtration, preservation of biodiversity, etc.), and the contribution to economic and social development (resilience and autonomy of families, job creation, food heritage and tradition, social inclusion and culture). The construction of an operational and recognized metric used by farmers, businesses, States and the international community is one of the building blocks of agroecology.

The sensitive issue of synthetic inputs

Even if some actors claim a total elimination of the use of synthetic inputs for agroecology, the FAO and the HLPE report consider that agroecology aims first at a reduction of synthetic inputs. Taking note of the increasing scarcity of resources (oil, phosphorus), this choice makes possible to limit the negative effects on the environment and to strengthen farmers' autonomy. However, it must be recognized that agriculture is very diverse. In some situations the use of synthetic inputs is excessive generating health problems for ecosystems and humans. In other situations inputs, especially fertilizers, are not used or not common. It is in fact a question of reasoning the use of synthetic inputs according to agricultural systems and current levels of consumption. They should only be considered in addition to a number of agricultural practices compatible with agroecology and aiming to reduce their use. Nevertheless, it is possible to envisage their total suppression, compatible with good soil, plant and animal health, as shown by the rise of organic farming.

Genetic progress is useful for cultivating biodiversity

Agroecology makes the choice to promote the genetic diversity of species, varieties and races because this biodiversity is a source of adaptation to local conditions and of resilience to face biotic shocks (pests, climate) and economic shocks (price and access to markets). Agrobiodiversity represents a potential reservoir of innovation which preserve producers' autonomy of choice for the future. Hence the importance given to actions of in-situ conservation, production of farmers seeds, defense of the rights of communities to obtain and distribute seeds. However, agroecology does not ignore the genetic progress that science can bring through modern breeding methods. In this perspective there is a need to change the selection objectives to obtain varieties and races compatible with a culture of biodiversity (mix of varieties in the same plot, associated crops, crops under trees, more rustic races) and adapted to an integrated response to climate change. It can also be about selecting and producing living organisms useful for soil life or for controlling pests. The question of GMOs (Genetically Modified Organisms) is then the subject of lively debate with various positions depending on the States but also the actors of agroecology. If genetic engineering can open up interesting prospects, it nevertheless appears that GMOs are currently developed for intensive monocropping systems with property rights that are not favorable to farmers. In the end, current GMOs are not compatible with agroecology[18].

[18] At present, European actors must comply with current legislation in the EU and partner countries both for research and for the marketing of varieties and breeds.

Digital technology to build local knowledge

Digital technology in agriculture is developing rapidly, particularly in the most intensive agricultural systems. Thus precision agriculture is useful to better regulate the use of synthetic inputs, to control irrigation, to plan farmers' activities according to the weather or the state of crops and animals. Indeed, these tools are useful for farmers. However, thanks to new technologies and organizational methods supported by large structures, this digital development tends to favour a centralization of data collection and management with advice provided to farmers through algorithms that they do not master and which do not necessarily take into account local specificities. Agroecology is based on the production of localized knowledge to adapt the agricultural practices to the context. In this perspective, the priority is to develop digital tools that promote the production of local references, the exchange of experiences between actors, and learning through collaborative tools. Digital tools can also allow a better connection between producers and consumers. These digital tools are to be design and built in a spirit of co-construction to take into account the needs of local actors. It is also a matter of promoting balanced digital governance, which deals with the management and ownership of data as well as the means of financing such services.

Solutions for family farming and industrial farming

Agroecology seeks to protect the human and social values of local communities, to ensure attractive living conditions for families, to promote the production of sufficient and healthy food. It is sensitive to issues such as inclusive governance, stakeholder participation, transparency and capacity building in the value chains and in the territories. As a result, most agroecological movements and development interventions in this area support small producers and family farming which provides the bulk of agricultural products in the world. But the principles of agroecology, both in their technical and social dimensionss, can also be applied to industrial agriculture and large farms which can mobilize biological processes and integrate biodiversity. They also apply to upstream and downstream companies wishing to adopt true social and environmental responsibility with a willingness to anchor their activities in the territories. For example, some industrial rubber farms in Southeast Asia are developing agroecological approaches with agroforestry systems and establishing balanced contractual relationships with small producers to supplement their own production. A solid and transparent accountability system to monitor and assess commitments and results is however necessary to ensure the seriousness of the approach.

The essential commitment of the private sector and of value chain actors

It is largely through the development of markets that agroecology can responds to the current challenges on a significant scale. It is crucial to promote or support value chains that are compatible with agroecology. These value chains must be able to market the diversity of productions resulting from agroecology. It is a challenge for territories which have specialized with a limited number of productions provoking "lock-in" phenomena. In this context, the private sector (producer organizations, small businesses, international firms, etc.) plays a decisive role. Some companies already support agroecology both for questions of values and positioning themselves in new markets. Convincing and expanding these business networks is essential through incentives and standards. However, a transparent accountability system at company level is needed to generate a climate of trust.

Consumers also have a decisive influence on production and transformation through the choices they make. Informing and educating consumers is key. From this perspective, agroecology must be synonymous with attractive prices for producers and reasonable for consumers, with trade-off to be negotiated between actors within the value chains and between countries.

Interventions for large-scale change

Recognizing the complexity of the problems and the specificity of the territories, agroecology is based on contextualized solutions that can only be built with the participation of actors (including researchers) and therefore with intervention frameworks that allow this participation (innovation network, innovation platform, arena of reflection, etc.). Changes at scale cannot be designed as for the innovations of conventional agriculture and cannot be based on technological packages developed by research and disseminated by advisory services to reach a wide audience. The change at scale must be based on the dissemination of intervention methods with participatory approaches to stimulate the dynamics of change, capacity building of actors to innovate valuing the exchange of experiences, the creation and the support to networks of actors, the mobilization of the private sector to promote investment and market development, the creation of an enabling environment that includes new financing mechanisms and new rules of the game. The experiences of others in other places can serve as a reference to help reflection and action but no models to apply without adaptation, even transformation. But large-scale change is possible and the development of organic farming in Europe or agroecology in some states in India (such as Andhra Pradesh) provide evidences.

6) A set of original solutions to support agroecology

The type of transition of agricultural and food systems is a controversial issue. It is important to provide elements to help the development of interventions to support agroecology, particularly in the context of the programming of 'EU and its dialogue with third countries. Agroecology is an approach help materialize the priorities of the Green Deal in the field of agriculture (climate change, biodiversity, natural resources, circular economy, pollution, etc.). It also contributes to other objectives such employment, governance (land, access to resources), health, education and gender issues. This part presents several types of intervention which are all levers of action. Many interventions are already known but it is the way of thinking and implementing them that makes them innovative and compatible with agroecology. The interactions and synergies between different interventions need to be analysed and monitored based on a systemic approach of the food systems.

The interventions are : (i) Develop relevant action-research, (ii) Improve agricultural practices through innovation, (iii) Strengthen innovation support services, (iv) Develop territories with an integrated vision, (v) Support responsible value chains and access to inclusive markets, (vi) Improve nutrition and health through the management of the biodiversity, (vii) Renew academic and professional training courses, (ix) Strengthen public policies to support the transition of food systems

However, three interventions are of high priority to make significant changes at scale : improve agricultural practices through innovation because it is the core of agroecology, support responsible value chains and access to inclusive markets to be able to scale agroecology and to guarantee

farmers' incomes, strengthen public policies to support transition of food systems to be able to mainstream agroecology with a clear vision and smart incentives.

Develop relevant Action-Research

Little investment has been made in research for agroecology compared to past and current investments in promoting Green Revolution methods. Research are needed to analyze and better understand agroecological processes, to study the strengths and weaknesses of agroecological approaches, to analyze their potential to contribute to the SDGs with clear evidence, to support actors to innovate through scientific knowledge, to contribute to academic and professional training and to support the advisory services. To be useful and to contribute to change at scale, this research must mobilize disciplinary and systemic approaches to address complex problems. It must also combine analytical and participatory methods in the context of multi-actor partnerships anchored in the reality of the countries. Action-research must become a driver for agroecology. Research partnerships must be strengthened to help research organizations in partner countries acquire skills in agroecology[19].

Improve agricultural practices through innovation

Improving or transforming agricultural practices is key for supporting agroecological approaches (organic farming, agroforestry, integrated soil management, biocontrol of pests, landscape approaches, etc.). These agricultural practices are specific to each territory even if lessons can be learned from other situations. The management of biodiversity (including agrobiodiversity) and the recycling of nutrients are the masterpieces of the agroecological thinking. The in situ conservation of species, varieties and races and the protection of farmers seeds are important actions to be promoted. Changing practices first require a change of all the stakeholders' perception regarding the food systems but also the mobilization of knowledge, skills and resources from a variety of stakeholders (farmers, technicians, researchers , actors of the value chains, etc.) to identify new ways of producing, transforming or distributing products and new organizational arrangements. The technical dimension of change has to be taken into account. However, beyond actions to support technical experiments and training, the interventions need to strengthen innovation networks, promote innovation platforms, and support innovation niches. There are frameworks and methods of intervention to support such innovation dynamics for the development at scale of agroecological practices addressing the farmers' needs and respecting ethical criteria[20]. Many NGOs, research centers, producer organizations and a few private actors have expertise in this field to help implement such approaches.

[19] The DeSIRA initiative (more than 270 million euros mobilized over the period 2018-2020) aims to develop this type of research (https://europa.eu/capacity4dev/desira)

[20] Cf. lessons learnt from the CDAIS project funded by UE : Toillier A., Guillonnet R. Bucciarelli M., Hawkins R. (2020) Developing capacities for agricultural innovation systems: lessons from implementing a common framework in eight countries. Rome, FAO and Paris.

Strengthen innovation support services

Fostering agroecology requires the development of innovation support services. A first category of services relates to advisory services. The conventional advisory model has long supported the Green Revolution and remains largely dominant. It needs to evolve to go beyond transferring knowledge and technologies from research to farmers. Such model is not adapted for identifying original solutions to solve complex problems. However, it can be well suited for scaling up locally validated simple solutions.

Advisory services needs to support collective actions with a variety of actors. They therefore aims to help actors to clarify their problems and objectives, to identify and test agroecological solutions, to form partnerships to mobilize resources, to act collectively, and to engage in political dialogue. It is therefore mainly a question of building actors' capacities to innovate[21] (technical and functional capacities, at the individual, organizational and institutional level). The advisory services can also support individual entrepreneurs like start-ups. These innovative advisory services require to identify animators (or facilitators, coaches) with various skills and to identify organizations capable of recruiting, training, and supporting them[22]. These organizations may be those already engaged in advisory services and willing to evolve. These organizations can also be new organisations such as incubators, formal networks dedicated to innovation, NGOs positioning themselves on intermediation, etc. Producer organizations or private firms can also develop this type of advisory services. However, it is important to ensure that these organizations want or can integrate agroecological approaches including their technical and social dimensions.

A second category of services related to agroecology concerns the provision of inputs, and specialized services in technical, commercial or legal issues. Some services providing bio-technologies are useful too (bio-inputs for activating soil fertility, composting waste, bio-pesticides, breeding of insects useful for pest control, etc.). Some services can rely on digital tools that should be designed and deployed to provide advice that support local knowledge management, exchanges and learning, or to ensure product traceability, or facilitate access to market for agroecological products.

Develop territories with an integrated vision

Agroecology is embedded in territories. It is consistent with territorial development or landscape management approaches that emphasize the sustainable management of natural resources (soils, forests, pastures, water, biodiversity, etc.) and the local governance, including the land rights, with strong stakeholder participation. Agroecology is a pathway to nicely integrate agriculture into the territories by taking into account environmental and social objectives[23]. Some examples of territorial approaches with agroeocological dimension : the management of natural resources in the Sahelian zones (cf. the great green wall), the development of human activities for a sustainable valorisation of forest products in the Amazon, the development of rice-growing areas in harmony with the mangroves in West Africa, etc. Through is social dimension agroecology is complementary to actions

[21] Agrinatura and FAO (2019) Capacity Needs Assessments – A trainers' manual (2nd edition). Agrinatura, Paris, and FAO, Rome. 68 pp.

[22] Sulaiman R., Davis K. (2012) The "New Extensionist": Roles, Strategies, and Capacities to Strengthen Extension and Advisory Services, GFRAS (Global Forum on Rural Advisory Services)

[23] Cf. EU/INTPA funded programmes (GCCA+, Landscape, DeSIRA, etc.)

aimed at strengthening access to services for rural people. Agroecology is also compatible with "One health" approaches which aim to understand and manage the interactions at territorial level between human health, animal health and the ecosystems health.

Today 55% of the world's population lives in urban areas, a proportion which is expected to grow to 70% in 2050. Urban agroecology is becoming a topical issue and a major alternative for food security[24]. Urban production of fresh fruits, vegetables and some animal products, close to consumers, improves local food security, especially for marginalized communities, and promotes employment. Urban agriculture can benefit from organic waste produced by cities through composting and nutrient recycling actions. Waste recycling actions help reduce greenhouse gas emissions. The development of urban agriculture requires a better land planning to cultivate (plots, roofs, etc.) but also the development of new technologies (production, processing, and distribution).

Support responsible value chains and access to inclusive markets

Agroecology cannot develop at scale without access to markets that recognize the products of agroecology. Interventions to promote the products certification of products and processing processes are important. Experiences are numerous: promotion of Geographical Indications within national frameworks, development of sustainability standards from the public or private sector with third-party certifications or participatory certifications, the rise of labels and private brands supporting sustainable approaches, etc. However, these certifications must really take into account the principles of agroecology and balance the economic, social and environmental dimensions of sustainability. In addition, to be effective and ensure real changes in production and marketing practices they must be coupled with other actions (fair and inclusive distribution of added value, support for producers' incomes, training, fraud control, etc.).

Other actions are needed to support the development of stronger value chains with an agroecological vision. Short supply chains should be encouraged in particular to promote local products and to ensure diversified, culturally acceptable and quality nutrition for consumers. Public procurement to supply public centers (school, prison, army, etc.) is also an important lever. Longer chains often have a negative environmental impact. However, they can also be aligned with agroecology by relying on the principles of the circular economy or by promoting a traceability system that is transparent and fair for all stakeholders. Here too, the management of compromises between economic, social and environmental imperatives must be assessed through the lens of agroecological principles. Support for these value chains can take the form of funding assistance with all possible tools (loan, subsidy, blending) or support for a network of small processing and marketing firms.

Improving nutrition and health by valorising the diversity

Agroecology must contribute to better nutrition of people. Actions to develop biodiversity at farm and territory through agroecological practices, is conducive to improving the nutrition of rural populations, and in particular children, through the promotion of species that are little used and by

[24] Urban Agriculture: Another Way to Feed Cities:
https://www.google.be/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwiMhdOJ35vuAhWF2uAKHWcWAzkQFjAHegQIChAC&url=https%3A%2F%2Fjournals.openedition.org%2Ffactsreports%2Fpdf%2F5536&usg=AOvVaw3O_4eEUMNCpzVI5utnTsc0

consuming a large range of products related to this biodiversity (fruits, leaves, seeds, roots, animal products). In urban areas, agroecology is also conducive to access to a diversified diet based on fresh or processed products through support for short supply chains and new distribution arrangements. Biofortification then becomes a complementary action when segments of the population experience difficulties in accessing a healthy, nutritious and diverse diet. Actions to educate consumers are a key element to improve their eating habits but also express their preferences for healthy and affordable products. A large part of these products can be provided by agroecological agriculture, including urban or peri- urban.

Renew academic and professional training courses

Capacity building is at the heart of the agroecological approach. Significant investments are needed to offer academic training for young people (technicians, engineers, masters, etc.) to provide knowledge and capacities to redesign production, distribution and consumption models based on agroecological principles. Vocational training is also an important issue with interventions for specialized centers to renew the skills of technicians or schools for farmers and rural people based on models aimed both at providing new knowledge and enhancing local experiences. Special efforts should be made to reach out to young people looking for decent and attractive jobs in rural areas and to women who play a special role in specific value chains and in feeding families. In this area of education, digital technology can be a source of innovative solutions (access to knowledge, development of new services).

Strengthen public policies to support transitions

The agroecological transition of agricultural and food systems requires interventions to improve or adapt public policies. On the one hand, interventions are needed to promote the creation of local and national arenas for political and multi-actor dialogue on agroecology to build a shared vision, identify blocking points, define priorities and lines of action. Such democratic and inclusive debates are essential to include agroecology in national policies. The period is favourable with the national dialogues set up as part of the 2021 World Food Summit. Food systems diagnosis such those currently undertaken by several EU delegations are also useful to identify interventions aligned with agroecological principles.

But it is also a question of facilitating the definition and deployment of measures for an enabling environment for agroecology with (i) new standards and taxation for production, marketing, or processing including a repositioning of current subsidies supporting more intensive farming systems, (ii) financial incentives for innovation for entrepreneurs including farmers' organizations, (iii) innovative financing for investment in production systems and agroecological value chains, (iv) public procurements to incentivize local and agroecological production (iv) support for research and education related to agroecology, etc. .

Conclusion

Food systems are under great pressure and debates on ways and means to support their transformation are intense. The green revolution, which has enabled strong growth in agricultural production, has also shown its limits with a standardization of practices and a reduction in biological

diversity which generate a dramatic degradation of natural resources, promote the development of pests and generate pollution. Agroecology is a credible and effective option to meet the current challenges. The elements and principles of agroecology have been jointly defined by various multi-stakeholder initiatives, including with the FAO. Agroecology is more and more recognized and is continually improving thanks to the rapidly growing scientific production, the mobilization of the experiences of actors in the field and the lessons from large-scale development experiences.

Agroecology help materialize the EU's priorities as expressed in the Green Deal and its "farm-to-fork" and “ biodiversity” strategies. It ensures the development of resilient food systems in the face of rising challenges (climate change, loss of biodiversity, soil degradation), it offers decent employment opportunities in agriculture and services, it enables the production of healthy food. To support agroecology, it is important to develop an approach without dogmatism, open to responsible innovation and a fair market, by mobilizing the programming and implementation tools of the European Commission. Agroecological solutions and pathways must be built to adapt to the specific conditions of each agricultural situation, based on a dialogue with the governments and all the actors of the territories and value chains and by relying on scientific knowledge and evidence.