Discussion paper

SCALING-UP AGROECOLOGICAL APPROACHES: WHAT, WHY AND HOW?

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Acronyms and abbreviations

(only those mentioned at least twice in the Discussion Paper)

AAFNs	alternative agri-food networks
AMAP	*Associations pour le Maintien d'une Agriculture Paysanne*
ANA	National Network of Agroecology
ANAMURI	National Association of Rural and Indigenous Women
ANAP	National Association of Small Farmers
CaC	*Campesino-a-Campesino* (farmer-to-farmer or peasant-to-peasant) methodology
CBD	Convention on Biological Diversity
CFS	Committee on World Food Security
CGIAR	Consultative Group on International Agricultural Research
CSA	Climate-Smart Agriculture
CSOs	civil society organisations
CSM	Civil Society Mechanism
ESAFF	East and Southern African Farmers' Forum
ECVC	European Coordination Via Campesina
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FFS	Farmers Field School (approach)
FoE	Friends of the Earth International
GHG	greenhouse gas (emissions)
GIRAF	Interdisciplinary Group of Research on 'Agroecology' of the Belgian *Fonds de la Recherche Scientifique* (Fnrs)
GMOs	genetically modified organisms
GSF	Global Strategic Framework for Food Security and Nutrition
ha	hectare(s)
HLPE	High Level Panel of Experts on Food Security and Nutrition
IAASTD	International Assessment of Agricultural Knowledge, Science and

	Technology
IATP	Institute for Agriculture and Trade Policy
ICESCR	International Covenant on Economic, Social and Cultural Rights
IFAD	International Fund for Agricultural Development
IIED	International Institute for Environment and Development
IMF	International Monetary Fund
INRA	French National Institute for Agricultural Research
IPCC	Intergovernmental Panel on Climate Change
IPM	Integrated Pest Management
IP	Intellectual Property (system / rights)
LVC	La Via Campesina
MASIPAG	Magsasaka at Siyentipiko para sa Pag-unlad ng Agrikultura
MST	Landless Workers' Movement
NGOs	non-governmental organizations
OECD	Organization for Economic Co-operation and Development
PAA	Food Acquisition Programme
PELUM	Participatory Ecological Land Use Management
PPPs	Private Public Partnerships
R&D	Research and Development
REDD	Reduced Emissions from Deforestation and Forest Degradation
ROPPA	Network of Farmers' and Agricultural Producers' Organisations of West Africa (*Réseau des organisations Paysannes et de producteurs de l'Afrique de l'Ouest*)
SOM	soil organic matter
SRI	System of Rice Intensification
UDHR	Universal Declaration of Human Rights
UK	United Kingdom
UNCTAD	United Nations Conference on Trade and Development
UNEP	United Nations Environment Programme
US / USA	United States of America
USAID	U.S. Agency for International Development
VGGT	Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security
WCA	World Census of Agriculture
WTO	World Trade Organization

KEY MESSAGES

A radical shift is urgently needed in agricultural and food systems to allow the world to feed itself sustainably today and in the future

With the number of undernourished people estimated at 842 million people in 2011–13 (FAO, 2013b), the industrial agrifood system as a whole has failed to feed the world, while being responsible for nearly half of the world's human greenhouse gas (GHG) emissions, for strengthening social inequities among actors in the whole agrifood supply chain, and for further polluting and depleting natural resources among others. Advancing industrial agriculture and consolidating the corporate food regime is not an option for meeting sustainability challenges today and in the future. This would only aggravate the current food, climate, ecological and energy crisis.

Agroecological approaches are by far the best option to make this required shift

As the science of sustainable agriculture, agroecology has led to the identification of key principles (agroecological principles) which establish, as well as augment, agricultural sustainability.

An extensive body of evidence demonstrates how efficient scaling-up of agroecological approaches can contribute to ensuring sustainable and resilient agricultural and food systems today and in the future: assuring, among other elements, food security and the realization of the Right to Adequate Food, environmental preservation, resilience to climate change and mitigation of human GHG emissions (in the whole food system), women's empowerment, and increased peasants' control over agrifood systems.

Agroecological farming is not limited to narrow and confined local contexts: it can be applied at a global scale

In terms of farming systems, agroecology does not consist of one particular set of agricultural practices which could substantially help increase agricultural sustainability but only in a few very specific, limited contexts: it is a holistic approach consisting in realizing key principles for meeting local needs sustainably. Realizing agroecological principles consists primarily in mimicking natural processes, thus creating beneficial biological interactions and synergies among the components of the agroecosystem, instead of depending on external inputs.

The technological forms through which agroecological principles can be made operational depend on the prevailing environmental and socioeconomic conditions at each site. In other words, the concrete realization of these principles always requires context-specific solutions, since they must adapt to local realities. Nonetheless, they have universal applicability.

You need to know where you've been to know where you're going

Agroecology teaches us how peasant agricultures traditionally own a huge sustainability potential. As the science of sustainable agriculture, agroecology is first and foremost based on the re-discovery and study of traditional peasant agricultures. This close relationship results from the recognition of the phenomenal sustainability that traditional peasant farming systems have demonstrated throughout the ages, and as a corollary of the treasures of knowledge they represent for achieving sustainability today and in the future, notably in the context of climate change.

Existing peasant farms can be made much more sustainable and resilient by modernizing them agroecologically

The potential for great sustainability that peasant farms traditionally hold does not mean that today's peasant farming systems can be considered veritably sustainable. On the contrary, for most, this is far from being the case and there is a vast room for improvement. For example, land productivity of the most traditional peasant agricultures can be strongly increased through agroecology, while further improving their ecological sustainability, resilience or capacity to meet global sustainability challenges. For peasant farms that have been partially industrialized, which are much more likely to induce negative ecological or social externalities, agroecological transition processes can address such impacts, while also enhancing their land productivity and making them much more resilient to economic or ecological shocks.

In some cases, making large-scale industrial farms more sustainable is crucial

Although literature on agroecology provides very few elements to address this issue, it seems reasonable to think that above a certain size, sustainability of agriculture necessarily faces limits. Does this mean that large farms should be converted into smaller farms?

In countries where peasants and communities are suffering from inequitable access to and control over land and other natural resources due to unfair competition with large industrial farms, it is imperative, holding a social equity perspective, to fragment these farms into smaller units through redistributive land reforms. By contrast, in areas of very low population density or where too few people want to work in agriculture and in which peasants do not suffer from such inequitable access and control, increasing the agroecological integration of large industrial farms to the extent of the possible may be the best option for improving agricultural sustainability.

Sustainable agriculture cannot be reduced to a catalogue of techniques

Agricultural sustainability is not about intrinsic characteristics of a few magic bullet solutions that are divorced from local contexts and can be disseminated following top-down approaches. It relies on the quality of complex interactions that result from an entire package, adequate combination of various practices whose operationalization in particular circumstances will necessarily have to change depending on each context, since each environment has its own characteristics and conditions to achieve sustainability. Depending on how it is concretely applied and completed or not by other practices, one particular technique can sometimes either be an active component of a truly agroecological farming system, or on the contrary contribute to non-sustainable impacts.

Agricultural sustainability primarily relies on the coherence of the transition process

As agroecology teaches us, improving agricultural sustainability requires designing an adequate strategy for managing a transition, one that can improve sustainability in the particular context considered, through means that are adapted to local conditions. Success or failure of the transition will crucially depend on the coherence or inconsistence of the transition process. To be coherent, the transition process will have to meet certain conditions, including:

- Proceeding to a comprehensive diagnosis of sustainability challenges and conditions specific to the particular given context. The diagnosis must be holistic. This means among others: taking all relevant aspects of sustainability into account; identifying all assets (natural, social, human, physical and financial) locally available, as well as all human and environmental constraints and the ways through which those elements interact with each other; defining expected benefits in the short, medium and long term; moving beyond the level of the plot or the farming system; thinking in terms of collective actions, thus also ensuring coordination between different actors;

- Building primarily on functionalities given by the ecosystems and traditional knowledge and know-how, while combining it with the best use of modern agroecological science;
- Ensuring a farmer-led, bottom-up approach: putting farmers in the driver's seat of the process through the most adequate methodologies for promoting farmers' innovation and horizontal sharing and learning.

A radical shift in agricultural development will not happen without an equivalent shift in the whole agrifood system

Industrial agriculture is an integral part of today's 'corporate food regime', characterized by "*unprecedented market power and profits of monopoly agrifood corporations, globalized animal protein chains, growing links between food and fuel economies, a 'supermarket revolution', liberalized global trade in food, increasingly concentrated land ownership, a shrinking natural resource base, and growing opposition from food movements worldwide*" (Holt-Giménez and Shattuck, 2011). Shaped by a minority of actors (those who benefit most from the dominant model) to the detriment of the general public interest, the various policies and economic practices that form the system support each other in protecting it against any serious questioning.

As a consequence, scaling-up agroecological approaches implies radical changes in the current dominant agrifood system as a whole. For that to happen, peasants, consumers, pastoralists, indigenous communities and other civil society actors will have to regain control over the food system. This is primarily what agroecology as a movement is all about: reclaiming "*the right of peoples to healthy and culturally appropriate food produced through ecologically sound and sustainable methods, and their right to define their own food and agriculture systems*" (Nyéléni Declaration, 2007), the right to Food Sovereignty.

Scaling-up agroecology is possible but will require positive actions

Agroecology has already reached millions of farmers and millions of ha (hectares) in Africa, Asia and the Americas. Scaling it up will require long-term efforts, essentially needed for: unlocking ideological barriers to its political recognition; supporting farmer-to-farmer networks; providing an enabling public policy environment; taking specific actions for empowering women; and improving agricultural and food governance. Ultimately, strong action will be needed for dismantling the disproportionate market power of those using their influence to highjack and format agricultural and food systems to serve their own private interests.

INTRODUCTION

In recent years, especially since the agriculture prices spike in 2008 that sparked ‘food riots’ across Africa, Asia and Latin America, a growing consensus has emerged on the need for proceeding to major changes in agricultural and food systems in order to ensure that the world can feed itself, today and in the future, with healthy and nutritionally high-quality food, while contributing to eradicating poverty, preserving biodiversity and natural resources, mitigating and adapting to climate change in a resource-constrained world : business as usual is no more an option.

Within this context, the notion of scaling-up agroecology[1] benefits from an increasing international recognition[2]. La Via Campesina (LVC), the largest peasant movement worldwide, is strongly advocating for it (LVC, 2013a; LVC, 2013c), along with many other civil society actors including hundreds of non-governmental organizations (NGOs) in Africa, Latin America and Asia which have been promoting thousands of agroecological projects since the early 1980s (Holt-Giménez and Altieri, 2013)[3]. The United Nations Special Rapporteur on the Right to Food, Olivier De Schutter, has compiled evidence demonstrating not only that agroecological approaches can provide enough food for all, but that small-scale farmers can double food production within 10 years in critical regions by using agroecological methods (De Schutter, 2010a). A growing number of scientists work in this field and in 2008, the International Assessment of Agricultural Knowledge, Science and Technology (IAASTD), a major four-year study involving 400 experts from all regions as well as international organizations including the Food and Agriculture Organization of the United Nations (FAO), the World Bank and the United Nations Environment Programme (UNEP), whose findings have been approved by 58 governments, called for a fundamental paradigm shift in agricultural development and an increase of agroecological science and practice (IAASTD, 2008; De Schutter and Vanloqueren, 2011). In its Trade and Environment Review 2013, the United Nations Conference on Trade and Development (UNCTAD), entitled *Wake up before it is too late. Make agriculture truly sustainable now for food security in a changing climate*, also made a strong case for scaling-up agroecology[4]. Drawing from many other studies and global assessments, the evidence and results speak for themselves as to the credibility of scaling-up agroecology for helping the world to feed itself sustainably today and in the future (see Part II).

Notwithstanding, reinvestment efforts in agriculture since 2008 have been channeled into a slightly modified version of the Green Revolution, and little attention has been paid to the most cutting-edge ecological farming methods –

[1] The term ‘agroecological approaches’ better reflects the plurality of conceptions characterizing the concept than the term ‘agroecology’. However, in this discussion paper both terms will be used interchangeably.

[2] In the framework of this background paper, ‘scaling-up’ includes both ‘horizontal scaling-up’ or ‘scaling-out’ (further spreading agroecology by promoting its adoption by more farmers through farmer-to-farmer networks), and ‘vertical scaling-up’ (institutionalizing supportive policies) (see Part III).

[3] For example, over 1,400 civil society organisations (CSOs) from 32 countries in the International Food Security Network (IFSN) are calling for major new investment and support to scale-up smallholder-focused agroecology and ecological agriculture to help tackle poverty, hunger and climate change (Wijeratna A., 2012).

[4] The report is available at the following address: http://unctad.org/en/pages/PublicationWebflyer.aspx?publicationid=666 [Accessed 29 September 2013]

methods that improve food production and farmers' incomes, while also protecting the soil, water, and climate (De Schutter and Vanloqueren, 2011). UNCTAD's Trade and Environment Review 2013 says much the same thing: "*we neither see the necessary level of urgency nor political willingness for drastic change. Priority remains heavily focused on increasing production (mostly under the slogan "more with less"). The currently pursued approach is still very much biased towards expansion of "somewhat-less-polluting" industrial agriculture, rather than more sustainable and affordable food in rural areas*" (Hoffmann, 2013).

Target audiences and objectives of the discussion paper

The primary target audiences are civil society organizations (CSOs) working on 'sustainable agriculture'. The objectives are:

- To contribute to ongoing debates on agroecological approaches and their centrality for achieving truly more sustainable agricultural and food systems;
- To provide key evidence and arguments for supporting advocacy work of CSOs calling for the scaling-up of agroecological approaches in various social and political arenas at national and/or international levels.

Structure

The paper includes four main parts:

- Part I explains what agroecology is, situating it in light of peasant and industrialized agricultures and introducing its three interconnected dimensions as a science, an agricultural approach and a movement. It also introduces differences between the agroecological paradigm and the model of sustainable intensification of agriculture, and summarizes key elements for understanding the implications of promoting one paradigm above the other. At last, it introduces the discussion on the technical feasibility of applying agroecological principles to large-scale industrial farms;
- Part II clarifies how scaling-up an agroecological transition can contribute to achieving sustainable agricultural and food systems[5];
- Part III identifies the main challenges to be met for scaling-up at a higher stage agroecological approaches;
- The conclusion formulates recommendations that help in addressing major challenges involved in scaling up agroecological approaches.

Methodology

This discussion paper is based on desk-research analyzing prominent related literature, including articles, reports and studies published on the topic. It also builds on the author's own direct advocacy work and experience in the last two years and a half within the Committee on World Food Security (CFS) through the Civil Society Mechanism (CSM), as well as two years and a half of background experience as policy advisor for a peasant movement member of the European Coordination Via Campesina (ECVC).

[5] Examples and data used in this Part II regarding sustainability performances of agroecological farming draw mainly on experiences and projects conducted in developing countries.

PART I. UNDERSTANDING THE AGROECOLOGICAL PARADIGM

As supported by a majority of peasants' organizations, social movements, women organizations, NGOs and practitioners, agroecology is first and foremost a response to the negative ecological, social and economic impacts of industrial agriculture, and an attempt to preserve the autonomy of peasant agricultures from its growing influence. As a consequence, the development of the agroecological paradigm cannot be understood without proceeding to a comparative qualitative analysis of the respective rationales of traditional peasant agricultures and industrial farming. Such a qualitative analysis consists in emphasizing the main principles which characterize and essentially distinguish these two models of agriculture in their purest forms, or archetypes. Of course, reality is much more complex than these archetypes would suggest. Indeed, existing farming systems as practiced on a daily real-world basis are rarely 'purely' peasant or industrial, but rather tend to be more or less close to one model or the other at varying degrees. It is important to keep this in mind in order to avoid simplistic judgments and stereotypes about existing peasant and industrial farms. Nonetheless, employing such categories can be useful to better understand the nature and issues at stake when considering the trend towards growing pressure towards industrial agriculture, and the emergence and development of agroecology as a science, an agricultural approach and as a movement.

Contrary to common beliefs, the growing pressure towards industrial farming does not correlate with a progressive decline of peasant farmers (Hilmi, 2012). According to the High Level Panel of Experts (HLPE) on Food Security and Nutrition, there are an estimated 500 million smallholder farms in the developing world, with almost 2 billion people dependent on them for their livelihood. These small farms produce about 80 percent of the food consumed in Asia and sub-Saharan Africa. Available data from the FAO's World Census of Agriculture (WCA) shows that in the South the absolute number of smallholders has continued to grow over the decades, while in most OECD countries the number of smallholders is decreasing (HLPE, 2013). According to Rosset and Martinez-Torres (2013), there is an increase in both the number of small family-size farms and an increase in large-scale commercial farms (agribusiness), with a decline in the numbers of intermediate size classes. Today's world is thus losing the middle (entrepreneurial farmers) to both re-peasantization and de-peasantization (Rosset and Martinez-Torres, 2013).

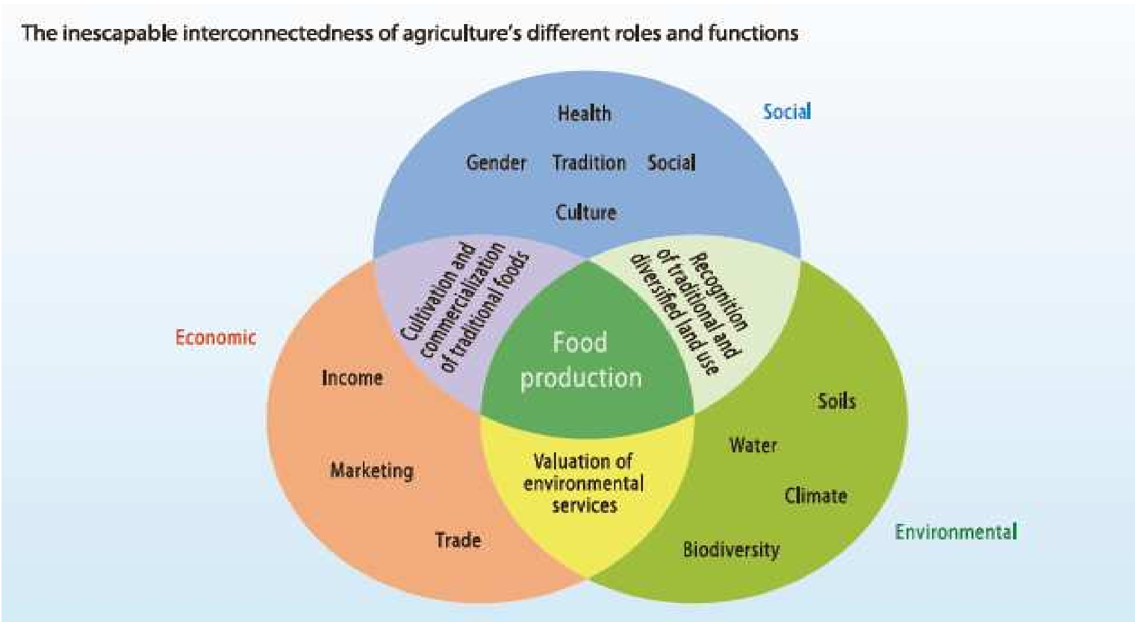
A. Traditional peasant agricultures

Defining 'peasant agricultures' or 'peasant family farming' is not simple, as this concept in practice refers to a multiplicity of agrarian systems resulting from a huge diversity of activities associations or dissociations (agriculture in the strict sense of the word, silviculture, livestock), crops grown, growing techniques, modes of social organisation, and sources of incomes (crops, livestock, handicraft, trade or wage work) (Courade, Devèze, 2006; Ong'wen, Wright, 2007).

Beyond that multiplicity however, peasant agricultures present common characteristics, in particular in their most traditional forms. First, they are said 'family' as family plays a central role in the organisation of ways of life and agricultural production that they constitute. They are rooted in their environment and in local conditions. Family life structures social and economic activities.

Existing relations between members of the family influence choices of activities, the organisation of family work, the distribution of responsibilities and incomes, the way factors of production are managed (land, water, seeds, raw materials, equipment, credits…), growing techniques, and the transmission of the family patrimony. The mobilization of domestic labour force is central. These forms of agricultures are proper to a 'country', here understood as a 'small region homogenous in terms of landscape and lifestyle', which is the reason why they are also called 'peasant' (Devèze, 2004; Kesteloot and Vannoppen, 2005; Courade, Devèze, 2006). This homogeneity, notably ethnic, leads to a strong solidarity between households (Sall et al., 2010). A large proportion of family groups are headed by women, and women play major roles at various levels such as in production, processing and marketing activities (HLPE, 2013), managing natural resources (soil, water, forests and energy) (Sobha, 2007) or selecting seeds (Barpujari, 2005). Yet despite their crucial roles in agricultural and food production, women are facing gender inequalities, which are prevalent in both traditional and modern agricultural value chains (Tripathi et al., 2012).

Figure I. Multi-functionality of agriculture



Source: Reproduced from IAASTD (2009).

The rooting of traditional peasant agricultures in the social, cultural, ecological and economic local context induces important characteristics. Whereas the liberalization of agriculture encourages a number of farms to produce primarily for export markets, traditionally peasant agricultures are chiefly committed to addressing local needs (Ong'wen, Wright, 2007). Agricultural production is first and foremost dedicated to households needs or for local markets. Then, surpluses are disposed within economic networks that extend beyond the frontiers of the local economy (Ong'wen, Wright, 2007). Since local needs are very diverse, peasant agricultures are by their very nature multi-functional. While generating foodstuffs remain their primary task (Colombo and Onorati, 2013), their role includes producing food, feed, fibers, biomass, medicinal products, and performing environmental functions such as protecting biodiversity, preserving landscape, maintaining hydro-geological equilibria, or structuring social relations in rural areas (Varghese, 2009; Colombo and Onorati, 2013). Food and other agricultural goods are not reduced to mere commodities. They are more broadly valued for the multiple functions (ecological, economic, social, cultural) that they render to the community. In other words, in peasant farming, agriculture is not reduced to an economic activity (although economic profitability matters), but is primarily a way of life: peasants are above all people who live and work on the land (Colombo and Onorati, 2013). Non-monetary exchanges of products and services are important in these forms of agriculture, as recognized for example by the CFS during its 40th Session in October 2013[6].

Another important feature of peasant agricultures is that traditionally, they imply a closed production process that ensures the farms autonomy and the active control of its management in the hands of the household: use of local natural resources instead of external inputs, and of indigenous knowledge and know-how, passed down through the generations, instead of the intervention of external experts (Ong'wen, Wright, 2007). Resources are, as much as possible, self-controlled and self-managed (Hilmi, 2012). The struggle for autonomy is central to the peasant condition (van der Ploeg, 2008). Adapted to the needs of each local ecosystem, indigenous knowledge and know-how guarantee, in a way, a natural symbiosis between communities needs and those of the natural environment. They tend to allow the peasant to make the most efficient use of productive resources of the land, while respecting their own paces (Ong'wen, Wright, 2007). In these traditional farming systems, the link between agriculture and ecology is strong and signs of environment degradation are seldom evident (Altieri, 1998). Peasants 'co-evolve' with nature (Hilmi, 2012). Women play a crucial role as transmitters of traditional knowledge to the new generations. They are particularly aware of the usefulness of plant genetic diversity as they are in many regions the ones with primary responsibility for the production of subsistence crops that are essential to household food security (Utviklingsfondet, 2011).

Escaping the high costs of inputs and of imported knowledge, traditional peasant agricultures are weakly capitalized and mechanized. Corollary, they are labour intensive and are mainly based on small-size farms. According to data compiled from the WCA covering 81 countries, in this set 73 percent of all farms units dispose of less than 1 ha of land and 85 percent less than 2 ha. Holdings under 5 ha represent nearly 95 percent of the holdings' estimates (HLPE, 2013).

Being extremely context-specific, tending to evolve in symbiosis with their diverse environment, traditional peasant farms also typically support a high degree of plant diversity in the form of polycultures and/or agroforestry patterns which are endowed with nutrient-rich plants, insect predators, pollinators, nitrogen-fixing and nitrogen-de-composting bacteria, and a variety of other organisms that perform various beneficial ecological functions (Altieri, 2008). Because of their efficient use of land, water, biodiversity and other agricultural resources, traditional peasant farms present a high productivity in terms of total output per ha (productivity per unit of land), generally much higher than that of large industrial farms (especially when these practice monoculture). This advantage results among others from a better use of time and space, including through a good combination of mixed crops allowing notably the cultivation of zones otherwise unexploited, crop rotations or the combination of cultivation and animal husbandry (Rosset, 1999; Ong'wen, Wright, 2007; Utviklingsfondet, 2011). As noted by Wegner and Zwart (2011), "*the efficiency of smaller production units in most developing countries is demonstrated by an impressive body of empirical studies showing an inverse relationship between unit size and land productivity*" (Wegner and Zwart, 2011).

[6] For more information, see section IV.B of the final report of the 40th CFS (CFS, 2013), available on the CFS website at the following page: http://www.fao.org/cfs/cfs-home/cfs40/en [Accessed 22 November 2013].

At last, traditional peasant forms of agriculture exhibit resiliency and robustness to cope with disturbances and change (human and environmental), minimizing risks, as demonstrated by the ability of many of them to stand the test of time despite market or political adverse conditions (Altieri et al., 2011a). Their resilience results notably from their rich on-farm biodiversity, the importance of off-farms activities in providing with additional income and as a way of diversifying risks, and reciprocal ties relying on kinship and social proximity (HLPE, 2013).

This description of peasant agricultures refers to their most traditional forms. Depending on the region of the world considered, such traditional forms have experienced more or less significant evolutions resulting from various factors including the growing influence of the model of industrialized agriculture, urbanization or market liberalization. As an example, the mere introduction of money in rural areas has made possible the purchase of production inputs that are external to local communities (fertilizers, health and phytosanitary products) (Dupriez, 1999). The introduction of these external production factors has broken, to some degree, the closed production process which was characterizing originally peasant agricultures, weakening the traditional natural symbiosis between agricultural practices and the ecosystem. The evolution of their relation to markets offers another illustration. Although subsistence farming (or quasi subsistence) in all regions is not uncommon, it is rare to find peasants who are isolated from any type of market exchange, and if so these are no longer significant in social or economic terms (HLPE, 2013).

At last, the above description should not be misinterpreted and give the impression that real-world peasant agriculture guarantees optimal sustainability performance. On the contrary, this is far from being the case for the majority of peasant farms. For example, for one billion rural people working solely with hand tools (of a total active agricultural population amounting to 1,34 billion people) (Mazoyer, 2012), potential yields or land productivity sustainable increases is huge. Peasant farms can also induce negative impacts on the environment. This is especially the case for those partially industrialized which make significant use of chemical inputs. But even some traditional techniques can imply adverse impacts on the environment under certain conditions, although existing examples on this matter are globally few[7]. Moreover, just as industrial farmers, peasants are not necessarily keen to take positive actions when it comes to addressing adverse impacts of inappropriate practices. And they will hardly move if they are not convinced that actions taken for addressing negative environmental externalities will maintain or improve their net incomes (see Part III section A).

Nonetheless, it remains true that traditional peasant agricultures tend naturally to take much better care of the environment than industrial farms, and that traditional agricultural knowledge and know-how represent a tremendous potential for meeting sustainability challenges today and in the future, as we will see later on in this paper.

[7] Slash-and-burn agriculture is one example. The issue of its sustainability is highly debated. See for example: Bandy (1994); Tangjang (2009); Tvardíková (2010); Cherfas (2012).

B. The logic of industrial agriculture

While the primary aim of peasant farming is addressing local needs and livelihoods, the principal aim of industrial agriculture is profit (Hilmi, 2012). This central preoccupation, driver of this model of agriculture, tends to reduce food and other agricultural goods to mere consumer goods. Agriculture is seen as a business like any other (Trócaire, 2012). This logic incites to mass produce on large scale with the view to multiply unit gains and realize economies of scale which lead to an increasing concentration of the production on a limited number of large farms[8]. It also encourages a constant, frantic search for yield increases. This in turn leads to the considerable reduction of the diversity of crops grown, often to the extent of reducing production to only one crop, most commonly as a monoculture, both in an effort to increase the yield per ha of the crop concerned and to facilitate management of the farm. This also goes hand-in-hand with an extreme mechanization of means of production, resulting in a significant reduction of the labour force employed in the fields (UCS, 2001a; UCS, 2001b; Bélières et al., 2002; Ong'wen, Wright, 2007; Sachs, Santarius, 2007; Utviklingsfondet, 2011). Industrial agroecosystems hence tend to be based on homogenized production systems leading to a simplification of landscape and a specialization of territories (Schaller, 2013), thus encouraging a one-size-fits-all approach instead of context-specific schemes.

The extreme mechanization of industrial agriculture largely explains the much higher productivity per worker of industrial farms in comparison to peasant agricultures, not only through increased crop yields but also and more significantly by allowing each worker to cultivate more areas of acreage (Douillet and Girard, 2013). Productivity per worker differentials are abysmal between, for example, an African peasant growing cereals solely with hand tools on one ha, and a European, Argentine or Australian farmer equipped with powerful tractors who cultivates up to several hundreds of ha. According to Mazoyer and Roudart (2009), in such extreme cases, the productivity per worker differential can reach a ratio of 1 to 2000 (Mazoyer and Roudart, 2009).

Another major feature of industrial farming compared with traditional peasant agricultures is the massive use of external inputs, which substitute for local natural resources in exercising the most elementary agricultural activities, such as protecting the crops, fertilizing soils or feeding animals[9]. Pesticides (most often synthetics, sometimes organic but in this case external to the environmental in which they are used) replace indigenous natural control methods of insect pests, weeds and crop diseases. Inorganic fertilizers substitute for manure, compost and leguminous plants. Fossil fuels replace locally generated energy sources (Sachs, Santarius, 2007). Industrial seeds (hybrids and/or transgenic) substitute for traditional peasant seeds. Imported feedstuff to feed livestock, especially soybeans from South America (Ostendorff, 2013) replaces foodstuff grown on the farm traditionally used for fulfilling this task (Colombo and Onorati, 2013).

This use of external inputs instead of local resources generates the outsourcing of bodies of knowledge. Indeed, knowledge does not depend any more on local indigenous communities: it comes from outside, being received following a

[8] Although industrial agriculture can also be practiced at small scale.

[9] Some authors link the birth of industrial agriculture to the import in Europe, in the latter half of the nineteenth century, of guano (petrified excrements built up by seabirds over centuries) from Peru. For the first time, the regeneration of soils fertility was depending on sources outside the farms and outside the rural economy, for guano was not part of the material used in Europe for the regenerative cycles in agriculture (Sachs and Santarius, 2007).

top-down approach from the hands of inputs suppliers and external experts (LRD, 2007). Farmers tend to be reduced into no-choice passive recipients of technology (Medina, 2009). It also reflects a radical shift of relations with nature compared to traditional peasant agricultures. Agricultural practices need not adapt to the specificities of the ecosystem in which they are implemented. To the contrary, it is the ecosystem which must adjust to the needs of foreign practices (LRD, 2007). Industrial agroecosystems are highly artificialised, and the natural environment is practically considered as external to the system, both substrate and constraints to be mastered (Schaller, 2013). Processes of production are progressively disconnected from ecosystems (Hilmi, 2012). Environmental and social costs are externalized (Utviklingsfondet, 2011; Trócaire, 2012).

Furthermore, industrial agriculture implies having a significant economic capital as a first condition for initiating the activity and allowing the massive purchase of synthetic inputs, high-performance machinery or opulent farm buildings. Industrials farms are thus highly financially capitalized compared to peasant ones, and their productions are specially designed for commercialization, notably on international markets (Bélières et al., 2002; Sachs and Santarius, 2007). In turn this necessity of having significant funding resources generates the permanent concern for increasing financial return and profit.

The high simplification and specialization of industrial farming systems, as well as their fundamental dependency on newest modern technologies, external inputs or credit, contributes to increasing their ecological and economic vulnerability (Altieri, 1998; Swiderska et al., 2011; Hilmi, 2012). One of the main problems resulting from the homogenization of agricultural systems is an increased vulnerability of crops to insect pests and diseases. This vulnerability can be devastating when pest and disease outbreaks infest a uniform crop, especially in large plantations (Altieri, 1998; Altieri, 2001). Part of the instability and susceptibility of industrial farming systems to pest outbreaks can be linked to monocultures, as their adoption has concentrated resources for specialist crop herbivores and has increased the areas available for immigration of pests (Altieri, 1998). Other examples of vulnerability lies in the increased dependence of industrial farms to external fluctuations such as commodity prices, markets, energy (Hilmi, 2012), or in the intensive use of hormones and diets designed to force unnaturally rapid growth of animals in livestock farming, which have made them more vulnerable to disease, e.g. through more frequent occurrences of microbial infections (Colombo and Onorati, 2013)[10].

Last but not least, the obsessive search for maximization of profit puts into question the production of food as the first purpose of agriculture, by encouraging the conversion of large areas of land, up to then dedicated to food production, to other, commercial uses. As a matter of fact, the bulk of the expansion in monoculture production has not been about producing more food for people. The expanded agricultural area growing soya, maize or sugar is mainly used for industrial purposes, especially agrofuels and animal feed (Trócaire, 2012). Industrial livestock farming causes a major drain on food resources. For example, 1,250.1 million tons of feed concentrate were used in 2005 (Colombo and Onorati,

[10] At the same time, obviously other factors that are linked to the dynamic of today's agricultural and food markets increase on the contrary vulnerability of peasant agricultures, while industrial farms are much better adapted to them. Such factors include for example access to market information and links to buyers in the marketing chain, access to modern risk management tools (such as insurance, and finance to cope with weather and price risks) or the capacity to meet the standards of global value chains (Wegner and Zwart, 2011). But those factors are exogenous to the intrinsic nature of peasant or industrial farming systems, and result from a range of policies that have precisely advantaged industrial agriculture.

2013). Agrofuels also badly compete with food production. For example, it is estimated that if the land used to produce biofuels for the European Union (EU) in 2008 had been used to produce wheat and maize instead, it could have fed 127 million people for the entire year (Kelly, 2012).

Box I. Key features of traditional peasant agricultures and industrial farming in their purest forms

Aspects	Traditional peasant agricultures	Industrial agriculture
Primary aim	Addressing local needs and livelihoods, with food production as the primary purpose.	Maximizing economic profitability. De-prioritization of food production as the primary purpose, leading to the conversion of large areas of land to other, commercial uses, especially agrofuels and animal feed.
In-built logic	Follow a multi-functional logic which does not reduce agriculture to an economic activity but also values the non-monetary exchanges of products and services. Agricultural production is first and foremost dedicated to household needs or for local markets.	Follows a commercial logic, which tends to reduce food and other agricultural goods to mere consumer goods. Commercialization is the priority, notably on international markets. Agriculture is seen as a business like any other.
Nature of the activity	Family– oriented.	Entrepreneurial character.
Degree of autonomy	Closed production process, guarantying the farm autonomy and active control of its management by the household: • Use of natural resources; • Practices resting upon indigenous knowledge and know-how passed down through the generations.	Externalization of the production process, leading to an increased dependence on external inputs and experts, and which tends to reduce the farmer to a passive recipient being educated through a top-down approach: • Massive use of external inputs (especially synthetics); • Practices resting upon knowledge coming from outside the community (held by inputs suppliers and external experts)
Relation to the natural environment	Strong adaptation of practices to the specific needs of the local ecosystem. Peasants 'co-evolve' with nature.	Imposition of homogenized practices to the ecosystem. The natural environment is practically considered as external to the farming system.
Diversity of farming systems	Abundant biodiversity and diversity of agroecosystems, notably due to a high diversity of crops grown and to frequent crops rotations.	Weak biodiversity and high uniformity of farming systems. Very few crops grown and tendency towards monoculture.
Financial capitalization	Weak financial capitalization and mechanization.	High financial capitalization and mechanization.
Labor-intensity	Labor-intensive.	Workforce reduced to the minimum.
Degree of concentration	Fragmentation of production (multitude of farms, small-size).	Concentration of production (limited number of large farms).
Productivity	High land productivity (total output per ha). Weak productivity per worker.	Weak land productivity. High productivity per worker.
Resilience to natural and economic shocks	Resiliency and robustness to cope with disturbances and change (human and environmental), minimizing risks.	High vulnerability to various natural and economic shocks.

Source: synthesis by the author on the basis of Altieri (1998); Rosset (1999); Altieri (2001); UCS (2001a); UCS (2001b); Bélières et al (2002); Devèze (2004); Kesteloot and Vannoppen (2005); Courade and Devèze (2006); LRD (2007); Ong'wen and Right (2007); Sachs and Santarius (2007); Altieri (2008); Medina (2009); Sall et al (2010); Altieri et al (2011a); Swiderska et al. (2011); Utviklingsfondet (2011); Hilmi (2012); Trócaire (2012); Colombo and Onorati (2013); HLPE (2013); Schaller (2013).

Industrial agriculture is an integral part of today's 'corporate food regime', described by Holt-Giménez and Shattuck as being characterized by "*the unprecedented market power and profits of monopoly agrifood corporations, globalized animal protein chains, growing links between food and fuel economies, a 'supermarket revolution', liberalized global trade in food, increasingly concentrated land ownership, a shrinking natural resource base, and growing opposition from food movements worldwide*" (Holt-Giménez and Shattuck, 2011)[11]. As noted by Kremen et al. (2012), international agricultural trade liberalization policies promote cheap food imports from industrial into developing countries, government subsidies for fossil fuel-based agrochemicals and commodity crops, as well as irrigation projects that mainly benefit larger landholders. All these elements help maintaining the industrial agri-food system. This system creates substantial obstacles for attempts aiming to shifting towards more sustainable food systems, for example through a diversification of farming methods or the selling of products to viable markets. The same system also leaves consumers and communities largely disconnected from the origins, qualities, and the social and ecological impacts of the production of their food, fuel, and fiber (Kremen et al., 2012).

C. The need for a radical shift

The spread of industrial agriculture has substantially contributed to food production increases over the last 50 years (Koohafkan, 2011). The 'green revolution' style of agriculture is recognized as having doubled cereal production in many parts of the world (Altieri et al., 2012b), notably through the use of improved seeds varieties in the 1980s and 1990s (IFAD, 2010). To some extent, this led to reducing poverty, food insecurity and malnutrition. Indeed, it is commonly accepted that this increase in yields has contributed to lowering cereal prices, benefiting poor consumers (Hazel, 2003; IFAD, 2010). The International Fund for Agricultural Development (IFAD) estimates, for example, that without the increased agricultural productivity affecting developing countries in the 1980s and 1990s, world cereal prices would have been 18 to 21 per cent higher in 2000, calorie availability would have been lower and more children would have been malnourished (IFAD, 2010).

Evidence suggests however that simultaneously, through many other ways, agricultural industrialization has contributed significantly to worsen poverty, hunger and malnutrition levels, notably by increasing inequality among farmers (between those accessing to the Green Revolution technologies and those who have been left out), economic debt (resulting for example from an increased dependence on expensive external inputs) or rural exodus (Mazoyer, 2008; Utviklingsfondet, 2011; McKay, 2012). And this is only a (small) part of the story. Undoubtedly, industrial agriculture has been responsible for major social and environmental costs in the last five decades (as illustrated by Box II), so significant and obvious that a growing consensus has emerged on the need to shift to a much more sustainable agricultural paradigm (De Schutter and Vanloqueren, 2011; Koohafkan, 2011; McKay, 2012). Clearly, further spreading the industrial agricultural model to allow the world to feed itself today and in the future is not an option in a resource constrained world, especially in the context of climate change and energy scarcity (IAASTD, 2009; Altieri and Toledo, 2011; De Schutter and Vanloqueren, 2011; Utviklingsfondet, 2011).

[11] This description is based on the work of McMichael, who has originally developed the concept of 'corporate food regime'. See for example McMichael (2009).

Box II. Some of the main social and ecological costs associated with industrial agriculture

The spread of industrial agriculture in the last decades has led to major unsustainable impacts. By way of illustration and in a non-exhaustive manner, impacts include the following:

- Loss of vegetal and animal genetic diversity, notably due to deforestation, the standardization of farming systems or the elimination of beneficial organisms resulting from the use of synthetic pesticides;
- Soil degradation, resulting for example from their overexploitation and the use of synthetic inputs;
- Water pollution and depletion of water resources, for example due to water contamination by nitrate contained in inorganic fertilizers, and excessive groundwater withdrawals due to inadequate irrigation techniques such as deep tube-well irrigation;
- Increased vulnerability to pest and disease outbreaks and related economic losses;
- Adverse impacts on farmers and/or consumers health, due to pesticides' intrinsic toxicity, combined with unsafe conditions of use (lack of adequate equipment of protection and/or unsafe storage conditions), and/or excessive concentration of their residues in food products[12];
- Increased indebtedness induced by various factors including farmers' growing expenses related to the use of pesticides (notably due to the use of their increased quantities as a consequence of pests' resistance development). In India, it is estimated that this indebtedness has significantly contributed to the decision of nearly 300.000 farmers (a significant part of whom were cotton producers) to commit suicides between 1995 and 2011, often by ingesting pesticides;
- Significant contribution to climate change and increased vulnerability to its impacts. According to the IAASTD, the use of huge amounts of chemical fertilizers, the expansion of the industrial meat industry, and the ploughing under of the world's savannahs and forests to grow agricultural commodities are together responsible for at least 30 per cent of the global greenhouse-gas (GHG) emissions that cause climate change[13]. And the NGO GRAIN estimates the total contribution of current industrialized food system (including all other processes of the food system such as long-distance transport, food processing, storing or freezing) to nearly half of the world's human GHG emissions.

Industrial agriculture has particularly badly affected women. As the main food producers and caregivers in most communities in developing countries, they are most affected where there is erosion of biodiversity. Environmental degradation impacts their daily life, for example by forcing them to walk long distances for water because of water scarcity. Higher exposure of women to health problems resulting from the use of synthetic pesticides is another example. They are often the ones that are assigned these hazardous tasks, and are therefore particularly affected. Weight gain, lack of energy, falling air, obstructive pulmonary diseases, Leukemia in children, Parkinson's disease are a few examples of health risks women commonly confront.

Source: synthesis by the author on the basis of Altieri (1998); Barpujari (2005); Parmentier (2006a); Sobha (2007); GRAIN (2009a); IAASTD (2009); Varghese (2009); Wegner and Zwart (2009); Dufumier (2010); Altieri and Toledo (2011); Koohafkan et al. (2011); Swiderska et al. (2011); Utviklingsfondet (2011); Altieri et al. (2012); Curtis (2012); Altieri et al. (2012b); Borromeo (2012); Levard and Apollin (2013); Schaller (2013).

[12] As an example, in April 2013 the Massachusetts Institute of Technology (MIT) published a peer-reviewed report revealing negative impacts on human health associated with Glyphosate, the active ingredient in Roundup, the most popular herbicide used worldwide. According to the two researchers authors of the report, residues of Glyphosate found in the main foods of the Western diet (comprised primarily of sugar, corn, soy and wheat) are contributing to various human diseases including inflammatory bowel disease, cancer, infertility, cystic fibrosis, obesity, heart diseases, Alzheimer's disease, Parkinson's disease, autism or diabetes (Samsel and Seneff, 2013).

[13] According to Greenpeace, industrial agriculture is responsible for 17 to 32 % of total human GHG emissions. This overall contribution includes direct (methane and nitrous oxide gases from agriculture practices) and indirect (carbon dioxide from fossil fuel use and land conversion to agriculture). Land conversion to agriculture alone accounts for 6 to 17%, followed by direct methane and nitrous oxide gases (Bellarby et al., 2008).

D. Agroecology as an alternative path to industrialized agriculture

Despite the impressive growing number of scientific work published in this field (Wezel and Soldat, 2009; Schaller, 2013) and the increasing global recognition the concept is enjoying, agroecology too often remains wrongly perceived as one particular set of agricultural practices which could substantially help increase agricultural sustainability but only in a few very specific, limited contexts, and therefore cannot pretend to be a credible solution at a global scale. Such a narrow view is far from reality. In terms of agricultural practices or farming systems, agroecology is rather a holistic approach consisting in realizing key principles through the context-specific design of strategies and techniques. But agroecology is not only an agricultural approach. It is also referred to as a science and a social movement. While agroecology first emerged as a science, trajectories between science, social movement and agricultural approach are very diverse depending on countries (Schaller, 2013)[14].

The concept of agroecology encompasses different meanings depending on the actors and the given socio-historical context, and is a living concept, submitted to permanent evolution (Wezel et al., 2009; Stassart et al., 2012). It is however possible to identify common features beyond that diversity. This section is an attempt to do so, successively examining agroecology as a science, an agricultural approach and a movement, keeping in mind that these three dimensions are often closely related to each other in the real world. For example, the movement for agroecology builds on agroecological science and knowledge for promoting and practicing the agricultural approach. As argued by Wezel et al. (2009), agroecology is neither exclusively defined as scientific disciplines, nor exclusively as social movements or practices. It is a federative concept of actions, intermediate between the three dimensions (Wezel et al., 2009).

1. Agroecology as a science

As a first step, agroecology developed through an attempt to integrate the principles of ecology to the redefinition of agronomy (Stassart et al., 2012). The term was first used in two scientific publications by Bensin (1928, 1930), a Russian agronomist, for describing the use of ecological methods in research on commercial crop plants. In 1965, in what is probably the first book titled 'agroecology', the German ecologist/zoologist Tischler analyzed the different components such as plants, animals, soils, and climate, and their interactions within an agroecosystem as well as the impact of human agricultural management on these components, thus applying an approach combining ecology, especially the interactions among biological components at the field or agroecosystem level, and agronomy with a focus on the integration of agricultural management (Wezel et al., 2009). Today's most frequent benchmark definition of agroecology as a science combining ecology and agronomy has been established by Altieri, entomologist from University of California Berkeley. He defines agroecology as "*the application of ecological science to the study, design, and management of sustainable agriculture*" (Altieri, 1995). Focused on the analysis of agroecosystems (communities of plants and animals interacting with their physical and chemical

[14] For example, in the USA agroecology has first emerged as a science, which has then contributed to the birth to an agroecological movement promoting agroecological farming. In Brazil, agroecology is first born as a social movement aiming the promotion of family farming, whose development has stimulated researches and the development of agroecology as a science (Wezel et al., 2009).

environments), agroecology hence aims at producing knowledge and practices which provide the means to make agriculture more sustainable (Stassart et al., 2012). Put crudely, as a scientific discipline, agroecology can be understood as "*the science behind sustainable agriculture*" (PANNA, 2009), or the science of sustainable agriculture.

But while this definition remains widely used, since the 1930's the scope and nature of agroecology as a scientific discipline have broadened considerably, moving beyond the level of agroecosystems towards a larger focus on the whole food system (defined as a global network of food production, distribution and consumption), and developing a transdisciplinary approach, thus no more exclusively based on biotechnical sciences but also applying social sciences (Wezel et al., 2009; Schaller, 2013). This evolution can be well illustrated for example by Francis et al. (2003), who defined agroecology as "*the integrative study of the ecology of the entire food systems, encompassing ecological, economic and social dimensions, or more simply the ecology of food systems*" (Wezel et al., 2009). As a scientific discipline, agroecology is increasingly considered as the science of sustainable food systems.

Agroecology as a science is first and foremost based on the re-discovery and study of traditional peasant agricultures (Pérez-Vitoria, 2011; Altieri et al., 2012b; Holt-Giménez and Altieri, 2013). This close relationship results from the recognition of the phenomenal sustainability that traditional peasant farming systems have demonstrated throughout the ages, and as a corollary of the treasures of knowledge they represent for achieving sustainability today and in the future, including in the context of climate change. The myriad of existing traditional systems indeed reveals a tremendous diversity of domesticated crop and animal species maintained and enhanced by soil, water and biodiversity management regimes nourished by complex traditional knowledge systems (Altieri and Toledo, 2011). These systems comprise a significant ingenious agricultural heritage reflecting the extreme diversity of agricultural systems adapted to different environments (Altieri et al., 2011a). They have not only fed much of the world population for centuries and continue to feed people in many parts of the planet, especially in developing countries, but undoubtedly also hold many of the potential answers to the production and natural resource conservation challenges affecting today's rural landscapes. Agroecology therefore strongly recognizes the crucial importance of preserving them (Koohafkan and Altieri, 2010).

The practice of agroecology as scientific discipline has allowed for the identification of key principles that form the foundation of agricultural sustainability. Literature on agroecology most often refers to the following five core principles (Altieri, 1995; Altieri, 2002; Rosset et al., 2011):

- (1) increasing the recycling of biomass and achieving a balance in nutrients flow;
- (2) assuring favorable soil conditions, keeping the soil covered with mulch or cover crops, guaranteeing a high level of soil organic matter and an active soil biology;
- (3) minimizing nutrients losses from the system, through relatively closed rather than open system design;
- (4) promoting the functional biodiversity of the system, including within –and between- species diversity, above –and below- ground and landscape level biodiversity;
- (5) promoting increased biological interactions and synergisms among system components that can sponsor system services like regenerating soil fertility and providing pest management without resorting to external inputs.

Realizing these principles must notably lead to minimizing the use of non-renewable inputs that cause harm to the environment or to the health of farmers and consumers (Pretty, 2008). The five 'historical' principles of agroecology have been theorized in a restrictive ecosystem perspective, intending to protect peasant agroecosystems from negative consequences of the Green Revolution and dependence on external inputs for promoting an endogenic dynamic of development, valorizing the use of local resources for supporting small-scale agriculture, more sustainable from a social and environmental point of view (Stassart et al., 2012).

The historical principles mentioned above are widely accepted as core pillars of agroecology. However, identification of key principles remains a topic of debate and is subject to further theorization, especially when integrating broader social or political aspects of the agroecological paradigm. For example, based on criteria derived from the extensive literature on agroecology and sustainable agriculture, several authors including Altieri have highlighted a comprehensive list of 10 basic attributes that any agricultural system should exhibit in order to be considered sustainable (see Annex 1) (Koohafkan et al., 2011). More recently, the Interdisciplinary Group of Research on 'Agroecology' of the Belgian Fonds de la Recherche Scientifique (Fnrs) (GIRAF) has proposed a conceptual framework completing the five historical principles by 8 additional ones, both based on the French National Institute for Agricultural Research (INRA) and its own work, thus proposing a total of 13 principles with the objective of guiding further work on agroecology. The conceptualization of these additional principles takes due account of the social ambitions of agroecology (see Annex 2) (Stassart et al., 2012).

2. Agroecology as an agricultural approach

Since the 1970s, agroecology no longer referred simply to a scientific discipline or research area, but also to farming practices and a number of collective mobilizations (mainly in response to the Green Revolution) (Schaller, 2013). In terms of farming systems, agroecology could be synthetically defined as a holistic approach consisting in seeking to make agroecosystems economically, ecologically and socially more sustainable by realizing key agroecological principles (that are precisely understood as those which form the basis of agricultural sustainability as explained above) for meeting local needs. Agroecological farming indeed promotes community-oriented approaches that look after the subsistence needs of its members, and very much privileges the local: providing for local markets that shorten the circuits of food production and consumption, simultaneously avoiding the high energy needs of 'long-distance food' (Altieri and Toledo, 2011). It also seeks to increase resilience. Usually defined as the propensity of a system to retain its organizational structure and productivity following perturbation (Holling, 1973), resilience is a constant preoccupation of agroecology (Berton et al., 2012). Realizing agroecological principles consists primarily in mimicking natural processes, thus creating beneficial biological interactions and synergies among the components of the agroecosystem (De Schutter, 2010a) through multiple, context-specific combinations of strategies and practices that are designed, applied and managed primarily by farmers themselves, building first and foremost on their traditional knowledge and know-how.

Designing a strategy for managing a transition

While agroecological principles have universal applicability, the technological forms through which they can be made operational depend on the prevailing environmental and socioeconomic conditions at each site (Uphoff, 2002; Altieri et al., 2012b). In other words, their concrete realization always requires context-specific solutions, since they must adapt to local realities (Rosset et al., 2011). As a process of transition towards more sustainable agricultural systems, agroecology consists therefore essentially in designing and applying an adequate strategy for managing the transition, one that can improve sustainability in the particular context considered, through means that are adapted to local conditions. As a starting point for designing such strategy, agroecology implies proceeding to a comprehensive diagnosis of sustainability challenges and conditions specific to the given context (Berton et al., 2012). Simply put, the question is: what are the priorities in this context for improving agricultural sustainability and how can they be concretely addressed?

This diagnosis requires a holistic approach. This means that all relevant aspects of sustainability, whether linked to food security, environmental protection and/or to community well-being, must be taken into account, recognizing the multi-functionality of agriculture (Curtis, 2012). This also implies identifying all human (economic, social, cultural, political…) and environmental constraints, as well as the ways through which those elements interact with each other (Altieri, 2002), and mapping all assets (natural, social, human, physical and financial) locally available. Agricultural systems at all levels indeed rely on the value of services flowing from the total stock of assets that they influence and control (Pretty, 2008). Moreover, the holistic approach means defining expected benefits in the short, medium and long term (Berton et al., 2012) and going beyond the level of the plot or the farming system, since many sustainability challenges also depend on upper spatial scales (Schaller, 2013). This is the case for example of environmental challenges such as the sustainability of varietal resistance within territories, biodiversity maintenance at the landscape level, GHG emissions at the global level, etc. The need for analysis at the landscape or territory level implies thinking in terms of collective actions, thus requiring coordination between different actors (Schaller, 2013). Coordination among actors is particularly important in case of conflicting expectations as to the use of land, water or other natural resources (Berton et al., 2012). This explains why ensuring responsible governance of natural resources is important from an agroecological perspective. Indeed, sustainable management of these resources necessarily implies (re)conciliating in a sustainable way the actors' different expectations and interests as to the use of resources. All these different elements are essential components of the agroecological equation consisting in designing the best options for improving sustainability.

As previously mentioned, solving this equation requires conceiving farming systems that rely primarily on functionalities given by ecosystems and built on traditional local knowledge. The relevance of making the best use of traditional knowledge for designing agroecological systems is obvious since this knowledge is intrinsically adapted to local conditions in a given environment. And it crystallizes an extreme diversity of options that for centuries have helped farmers to sustainably manage harsh environments and to meet their subsistence needs, without depending on mechanization, chemical fertilizers, pesticides, or other technologies of modern agricultural science (Altieri et al., 2011a). However, agroecology does not imply excluding all modern technologies on ideological grounds. If a technology works to improve productivity for farmers and does not cause undue harm to the environment, then it is likely to have some sustainability benefits (Pretty, 2008). Agroecology therefore does not include the full prohibition of any chemical input. But in each and any case, they should only be used as a last resort and at the lowest level possible. The agroecological approach clearly requires reducing off-farm inputs (chemical or biological) to an absolute minimum

(Rosset et al., 2011). Besides, it necessarily excludes any use of genetically modified organisms (GMOs) (Altieri, 2005). Many reasons explain why GMOs are incompatible with agroecological farming, as illustrated by Box III.

Box III. Some of the main reasons why agroecology and GMOs are incompatible

The development of GMOs presents potential or proven risks including the following:

- Increased peasants' dependence on the agro-industry and thus reduced autonomy of farmers (notably by prohibiting farmers' to save seeds themselves);
- Biodiversity reduction (weakening flexibility offered by the natural environment to design adequate context-specific agroecological strategies);
- Harmful impacts on the environment (e.g. through adverse impacts on beneficial insects and other organisms); increased environmental threats to farming systems (e.g. through the development of secondary pests resistance);
- Increased vulnerability of farming systems (notably due to biodiversity reduction);
- Reduced natural soil fertility;
- Increased economic costs for peasants and restricted experimentation by individual farmers while potentially undermining local practices for securing food and economic sustainability;
- Increasing criminalization of peasants linked to the development of patents and the context of unfavorable national seeds laws and legislations, as illustrated in recent years by Monsanto practices in Northern America.

Source: synthesis by the author on the basis of Garcia and Altieri (2005); Parmentier and Bailly (2005); IAASTD (2009); Utviklingsfondet (2011); Altieri et al. (2012b); Diamond Collins and Chandrasekaran (2012); Jacobsen et al. (2013).

Relying first and foremost on traditional knowledge does not mean excluding modern science. In fact, agroecology combines scientific inquiry with indigenous knowledge, as well as farmers' innovation and community-based innovation (PANNAP, 2009; De Schutter, 2010a; De Schutter and Vanloqueren, 2011) for shaping sustainable farming systems. For instance, in Central America the coffee groves grown under high-canopy trees were improved by the identification of the optimal shade conditions, minimizing the entire pest complex and maximizing the beneficial microflora and fauna while maximizing yield and coffee quality (De Schutter, 2010a). Generally speaking, the role of agronomists and other researchers is very important for making agriculture more agroecological, not only for contributing significantly to agroecological innovations, but also for helping better understand and address global sustainability challenges beyond the farm, at the territorial level.

Moreover, agroecology should not be seen as incompatible with the mechanization of agriculture. While a forced path toward a rapid mechanization of farming that does not meet peasants needs should be avoided, agroecological farming is perfectly compatible with a gradual and adequate mechanization of farming (De Schutter, 2010a: De Schutter and Vanloqueren, 2011). One illustration is provided by the in-depth analysis of the evolution of the agrarian systems of the Nile Valley, which has shown a successful adaptation of mechanization to the size and needs of these peasant farming systems, with most of the soil preparation work and water pumping and gain threshing being mechanized. The small scale of plots is not an obstacle, for example, to mechanized water pumping because water is brought by gravity to the third level canals where it is usually pumped and brought to private canals running along the land parcels. This in-depth analysis has shown that decent living conditions could be reached for a family with a plot of good land of a size between 0.5 and 0.8 ha, with the appropriate mechanization and animal-crop integrated systems (Utviklingsfondet, 2011).

One fundamental feature of agroecology as a holistic agricultural transition process is the systematic search for the best combinations of techniques and strategies, instead of relying on a few standardized best practices, for optimizing sustainability performances of farming systems. The challenge is to identify the most efficient socio-technical arrangements in heterogeneous environments, the right combinations of practices that will best allow for realizing agroecological principles (Schaller, 2013). Those combinations will necessarily vary from one context to another, since each context has its own characteristics and therefore its own conditions to achieve sustainability. This is one of the reasons why, while some types of practices have been typically described as agroecological (see Box IV), agroecological farming cannot be reduced to a 'catalogue of techniques' (Pérez-Vitoria, 2011) whose standardized application would automatically bring sustainability. Agricultural sustainability does not depend on the intrinsic characteristics of a few magic bullet solutions that would be independent from the environment to which they apply. It relies on the quality of complex interactions that result from an entire package, adequate combination of various practices whose operationalization in particular circumstances will necessarily have to change depending on each context[15].

Box IV. Types of practices typically promoted as agroecological

Jules Pretty, from University of Essex in the United Kingdom (UK), has highlighted seven agroecological practices and resource-conserving technologies:

1. *Integrated pest management (IPM)*, which uses ecosystem resilience and diversity for pest, disease and weed control, and seeks only to use pesticides when other options are ineffective.
2. *Integrated nutrient management*, which seeks both to balance the need to fix nitrogen within farm systems with the need to import inorganic and organic sources of nutrients, and to reduce nutrient losses through erosion control.
3. *Conservation tillage*, which reduces the amount of tillage, sometimes to zero, so that soil can be conserved and available moisture used more efficiently.
4. *Agroforestry*, which incorporates multifunctional trees into agricultural systems, and collective management of nearby forest resources.
5. *Aquaculture*, which incorporates fish, shrimps and other aquatic resources into farm systems, such as into irrigated rice fields and fishponds, and so leads to increases in protein production.
6. *Water harvesting in dry land areas*, which can mean formerly abandoned and degraded lands can be cultivated, and additional crops grown on small patches of irrigated land owing to better rainwater retention.
7. *Livestock integration into farming systems*, such as dairy cattle, pigs, and poultry, including using zero-grazing cut and carry systems.

Source: Pretty (2008).

Depending on how it is concretely applied and completed or not by other practices, one particular technique can sometimes either be an active component of a truly agroecological farming system, or on the contrary contribute to non-sustainable externalities. This can be well illustrated with no-till. Also referred to as 'zero till', 'no-till' is usually defined as "*a system of planting (seeding) crops into untilled soil by opening a narrow slot, trench or band only of sufficient width and depth to obtain proper seed coverage. No other soil tillage is done*" (Derpsch et al., 2010). Detailed scientific evidence exists showing that no-till conserves the natural resources in the soil and water through various mechanisms. Decreases in soil erosion and water losses are often spectacular and are reported from many sites (Gattinger et al., 2011). But since tillage impacts include some weed, pest, nutrient or water management effects, if a farmer abolishes tillage without changing anything else in the cropping system, this will induce in most cases problems with weeds, pests and nutrient availability and might require more herbicides, pesticides and fertilizers (Friedrich and Kassam, 2012). No-till can therefore easily be one component of industrial farming systems. As a matter of fact, scientific sources and

[15] For various illustrations of design of agroecological transition strategies adapted to specific challenges and constraints, see for example Agrisud International (2010).

statistics indicate that no-till today often comes 'in a package' with monocultures, GMOs and extensive herbicide use (Gattinger et al., 2011).

But no-till can also be combined with natural control mechanisms for managing insect pests, pathogens and weeds and therefore reducing the need of further artificial interventions (Friedrich and Kassam, 2012). For example, in Santa Catarina, southern Brazil, many hillside family farmers have modified the conventional no-till system. Instead of relying on herbicides for weed control, these innovative organic minimum tillage systems rely on the use of mixtures of summer and winter cover crops which leave a thick residue mulch layer, on which after the cover crops are rolled, traditional grain crops (corn, beans, wheat, onions, tomatoes, etc.) are directly sowed or planted. Depending on the cover crop or cover crop combination used, residues have the potential to suppress weeds. But weeds' response to residue depends on various factors, such as the type, quantity and thickness of residue applied, the time remaining as effective mulch, cover crops used and biology of particular weed species. Experience shows that simply copying the cover crop mixtures used by successful farmers won't work for widely diffusing the technology. Agroecological performance does not depend on specific species or techniques, but is linked to processes optimized by the whole system (Altieri et al., 2011b). Optimization consists in increasing the degree of 'agroecological integration', that is the extent to which a given farming system realizes agroecological principles. Assessing the sustainability of a given farm hence can be seen as consisting in assessing its degree of agroecological integration, ranging from an industrial monoculture (negligible agroecological integration), to a monoculture-based organic farm with input substitution (low level of integration), to complex peasant agroforestry system with multiple annual crops and trees, animals, rotational schemes, and perhaps even a fish pond where pond mud is collected to be used as an additional crop fertilizer (high level of agroecological integration) (Rosset et al., 2011).

Applying a bottom-up, farmer-led approach

While the Green Revolution model has favored a top-down approach which tends to reduce peasants to no-choice passive recipients of technology received from extension agents or inputs suppliers, agroecological transition requires bottom-up processes in which farmers take the front seat. Conventional top-down extension can be demobilizing for farmers, as technical experts have all too often had the objective of replacing peasant knowledge with purchased chemical inputs, seeds and machinery (Rosset and Martinez-Torres, 2013). On the contrary, agroecological farming is highly knowledge-intensive and based on techniques that are not delivered top-down but developed on the basis on farmer's knowledge, experimentation and innovation (De Schutter, 2010a; Altieri and Toledo, 2011; Rosset and Martinez-Torres, 2013).

Different methodologies have been developed for promoting farmer innovation and horizontal sharing and learning. The *Campesino-a-Campesino* (farmer-to-farmer, or peasant-to-peasant) methodology (CaC) is one of the most often used. CaC is a *Freirian*[16] horizontal communication methodology, or social process

[16] Paulo Freire is a Brazilian philosopher and activist (September 19 1921 – May 2 1997), whose works focus on popular education and liberation of the historically oppressed. In terms of pedagogy, Freire is best known for his attack on what he called the 'banking' concept of education, in which the student was viewed as an empty account to be filled by the teacher. According to Freire, before there can exist progress between two communities there must exist a teacher-student, student-teacher relationship. The learning process must be mutual and reciprocal. The next step is not to work for a community but rather with the community to meet its needs and demands.

methodology, that is based on farmer-promoters having developed new solutions to problems that are common among many farmers or have recovered/rediscovered older traditional solutions, and who use their own farms as their classrooms to share them with their peers. Based on local peasant needs, culture and environmental conditions, CaC is mobilizing because it makes peasants the protagonists in their own processes of generating and sharing their own (and appropriated) technologies (Rosset and Martinez-Torres, 2013). Another method is the Farmers Field Schools (FFS) approach that has been developed and promoted by FAO as part of its ecological approach called Integrated Pest Management (IPM) in South East Asia. In this group-based discovery-learning process, farmers observe, record, and discuss what is happening in their own fields instead of listening to lectures or watching demonstrations. The process generates deep understanding of farming problems and promotes practical communication mechanisms for its solution (López and Bruening, 2002).

3. Agroecology as a movement

As we have seen, since the 1970s the concept of agroecology has also refered to a number of collective mobilizations, originally in response to the Green Revolution (Schaller, 2013). Agroecology as a movement has been particularly strengthened politically in the last 5 years through LVC, the largest transnational peasant movement, as one of the key pillars of Food Sovereignty (Rosset and Martinez-Torres, 2013). It is also politically supported by other farmers' umbrella organizations and peasant movements, sometimes but not always members of LVC, such as the East and Southern African Farmers' Forum (ESAFF), the Network of Farmers' and Agricultural Producers' Organisations of West Africa (ROPPA – *Réseau des organisations Paysannes et de producteurs de l'Afrique de l'Ouest*) (Holt-Giménez et al., 2010), the Landless Workers' Movement (MST – *Mouvement des Sans-Terre*) (Rosset and Martinez-Torres, 2012) in Brazil or Bolivia, or the Latin American Coordination for Peasant Organisation (CLOC) (LVC, 2013d), an umbrella organisation with 84 sub-organisations in 18 Latin American and Caribbean countries (Anand, 2013).

The concept of Food Sovereignty was first used by LVC on the international scene in 1996 during the World Food Summit held in Rome (Claeys, 2012), and has been further elaborated on at the International Forum for Food Sovereignty hosted in 2007 by LVC in Nyéléni, Mali, to which LVC invited sister international movements of indigenous people, fisher folk, women, environmentalists, scholars, consumers and trade unions (Rosset and Martinez-Torres, 2013). Its core definition developed on that occasion defines it as "*the right of peoples to healthy and culturally appropriate food produced through ecologically sound and sustainable methods, and their right to define their own food and agriculture systems*" (Nyéléni Declaration, 2007). Among others, this implies "*the rights to use and manage lands, territories, waters, seeds, livestock and biodiversity are in the hands of those of us who produce food*", as well as "*the rights of consumers to control their food and nutrition*" (Nyéléni Declaration, 2007)[17].

The inclusion of agroecology in the broader framework of Food Sovereignty is therefore not surprising. Indeed, as an attempt to protect peasant agricultures from the growing pressure of industrial agriculture, the whole point of agroecological farming is precisely to achieve sustainable agriculture for meeting local needs through ways that enhance the autonomy and control of peasants over their own production systems, instead of making them more dependent on off-farm inputs and external experts. In that sense, agroecology appears as a key strategy of what

[17] For the complete definition, see http://www.nyeleni.org [Accessed 15 September 2013].

van der Ploeg calls *re-peasantization*, a concept that not only refers to a growing number of peasants (quantitative dimension), but also entails a qualitative shift consisting in people entering the 'peasant condition' (van der Ploeg, 2005), characterized by the constant search of an increased autonomy (van der Ploeg, 2008)[18]. When farmers undergo a transition from input-dependent farming to agroecology based on local resources, they are becoming 'more peasant' (Rosset and Martinez-Torrez, 2013) since they are gaining autonomy. To some extent, transitioning existing peasant systems towards agroecological farming could be seen as a process leading to the full realization of the 'peasant logic'.

The search for autonomy can also rely on the development of alternative agri-food networks (AAFNs) such as producer–consumer networks, collective producer shops, farmers' markets, box schemes and school provisioning schemes (Lamine et al., 2012). Just as the industrial agri-food system supports industrial agriculture and opposes attempts to shift it towards sustainable agriculture, AAFNs are frequently supportive of and rooted in agroecological farming, and seek to decrease reliance on industrialized agri-food systems. They work against the logic of bulk (high volume and low cost) commodity production, redistribute value through the food chain, rebuild trust between producers and consumers, and articulate new forms of political association and market governance (Kremen et al., 2012).

For LVC it is clear: agroecology cannot be reduced to its technical ecological content but also encompasses social and political dimensions. It politicizes what used to be seen as purely technical questions of farming (Rosset et al., 2011). It opposes the industrial agricultural and food, capitalist rural development model, giving to agroecological transition processes emancipatory potential (Lopes and Jomalinis, 2011). This understanding of agroecology has led LVC to strive politically for its scaling-up. LVC has been struggling for scaling-up agroecology by denouncing agrofuels, GMOs, carbon markets, REDD and REDD+ as 'false solutions' to climate change, and by stressing publicly the risk of cooptation of agroecology through the paradigm of sustainable intensification (Rosset and Martinez-Torres, 2013) (see the following section). Striving for scaling-up agroecology consists both in advocating for policy measures and regulations specifically supportive of agroecology, and in challenging the obstacles, resulting from a range of various policies and economic practices (e.g. trade and agricultural liberalization), that have historically disadvantaged peasant agricultures in many national, regional and international contexts. Addressing those obstacles is needed to unleash the tremendous sustainability potential that peasant agricultures traditionally hold (as demonstrated by agroecology as a science), a potential which then, through an agroecological modernization process, can be strongly increased by combining traditional knowledge and know-how with the best available modern agroecological science.

But the importance of advocating politically for defending and scaling-up agroecology is not carried by all civil society actors. Historical divisions exist between farmer-to-farmer and NGO-based networks whose work has concentrated on promoting the adoption of agroecological farming to more farmers (horizontal scaling-up), and agrarian-based farmer organizations and movements such as LVC who have engaged politically (vertical scaling-up). Farmer-to-farmer and NGO-based agroecology networks, such as the Farmer to Farmer Movement (CAC - *El Movimiento Campesino a Campesino*) active in a dozen countries of Latin America (Holt-Giménez et al., 2010), or the Participatory Ecological Land Use

[18] The crucial importance of the search for autonomy in peasant agricultures has been clarified earlier in this paper (see Part I section A).

Management (PELUM), a regional network of over 207 civil society organisations which operate in 10 African countries (Botswana, Kenya, Lesotho, Malawi, Rwanda, South Africa, Tanzania, Uganda, Zambia and Zimbabwe) (Altieri et al., 2012b), have been highly effective in supporting local projects and developing sustainable practices on the ground. On the other hand, unlike LVC, they have done relatively little to address the need for an enabling policy context for sustainable agriculture (Holt-Giménez et al., 2010). For political advocates, these practitioners have historically tended to reduce agroecology to technical and apolitical approaches to agricultural development. This has led advocates to call many NGOs to shift from technology-led agendas to strategies that support farmer-led political organizations (Holt-Giménez and Altieri, 2013).

Progress in the agenda for Food Sovereignty however is being made. Convergence is growing progressively between practitioners and advocates. Slowly but surely, distinct groups begin to see themselves as part of a larger movement to develop civil society. For example, as a result of members of PELUM willing to engage in more agrarian advocacy the ESAFF was formed in 2002, as a farmer's voice in East and Southern Africa. PELUM and ESAFF work closely together, with ESAFF challenging PELUM on a number of issues (Holt-Giménez et al., 2010). Such evolution and many others suggest that the international struggle for Food Sovereignty, as understood by LVC, is beginning to take root in smallholder agroecology networks. Similarly, LVC enhances its efforts to spread agroecological approaches throughout its own farmer organizations (Holt-Giménez and Altieri, 2013), which remains a challenge.

E. Is 'sustainable intensification of agriculture' a better path?

While agroecology has been subject to increased worldwide attention and scrutiny in the last few years given the growing awareness of current agricultural and food sustainability crisis, the most influential actors in the debate prefer advocating for a 'sustainable intensification of agriculture'. These include governments of the USA, the EU and UK, FAO, IFAD, the World Bank, research institutions and centers including the Consultative Group on International Agricultural Research (CGIAR) and its 15 research centers, as well as agribusiness companies and organizations such as the Agricultural Biotechnology Council and the International Fertilizer Industry Association, or the Bill and Melinda Gates Foundation (The Royal Society, 2009; IFAD, 2010; Gattinger et al., 2011; Diamond Collins and Chandrasekaran, 2012; Trócaire, 2012; Holt-Giménez and Altieri, 2013). At first sight, using one or the other of those concepts might seem rather anecdotal, especially since in the way it is being used by these actors, the concept of 'sustainable intensification of agriculture' does include agroecological practices. Looking at it more closely, one can understand how privileging this term (rather than advocating more directly for scaling-up agroecology) is far from being anodyne.

Promoted as a solution for small farmers in developing countries, sustainable intensification is presented as a step change in agricultural science and development, re-conciliating sustainable agriculture with intensive farming, creating an environmentally benign agriculture that also improves yields (Diamond Collins and Chandrasekaran, 2012). For example, the Royal Society defines the challenge of sustainable intensification as intensification "*in which yields are increased without adverse environmental impact and without the cultivation of more land*" (The Royal Society, 2009). This sounds close to agroecological farming. Do agroecological approaches not enable farmers to enhance yields sustainably (as shown in Part II)? But this is only an appearance. Indeed, rather than calling for a radical shift of agricultural development, the sustainable intensification agenda is a reformist one (Holt-Giménez and Altieri, 2013), complementing conventional approaches inherited from the Green Revolution model by a more systemic approach to sustainably managing natural resources, including through a more selective use of external inputs (IFAD, 2010). It aims to offer an inclusive and flexible menu in which 'no techniques or technologies should be left out', but should be combined to each other depending on the context. And here's where things start to get complicated: GMOs are promoted as part of the solution, along with conventional practices and agroecological practices (The Royal Society, 2009; IFAD, 2010; Diamond Collins and Chandrasekaran, 2012).

In its *Reaping the benefits* report published in 2009, The Royal Society has well explained the rationale for such 'inclusive' logic: "*Past debates about agricultural technology have tended to involve different parties arguing for either advanced biotechnology including GM, improved conventional agricultural practice or low-input methods. We do not consider that these approaches are mutually exclusive: improvements to all systems require high-quality science. Global food insecurity is the product of a set of interrelated local problems of food production and consumption. The diversity of these problems needs to be reflected in the diversity of scientific approaches used to tackle them. Rather than focusing on particular scientific tools and techniques, the approaches should be evaluated in terms of their outcomes. Recent progress in science means that yield increases can be achieved by both crop genetics (using conventional breeding and molecular GM) and crop management practices (using agronomic and agroecological methods)*" (The Royal Society, 2009). The Royal Society promotes GMOs as a potential option notably for increasing farmers resilience to climate change (e.g. through the use of drought tolerance crops) and pests attacks (through herbicide-tolerant seeds), or for improving food nutritional quality (e.g. with 'golden rice' for combating vitamin A deficiency) (The Royal Society, 2009). Other influential actors mentioned above also typically promote GMOs as a potential solution when advocating for a sustainable intensification of agriculture. According to IFAD, for example, second generation of transgenic crops designed to perform well under drought, flood, heat and salinity "*may play a greater role in addressing this set of issues, which can greatly contribute to reducing the risks faced by smallholder farmers*" (IFAD, 2010).

As we have seen, the consideration of GMOs as part of the solution is highly problematic, since it is simply incompatible with a truly agroecological development paradigm for obvious reasons (see Box III Part I section D.2). But the true challenge for better understanding what agricultural development models these actors are concretely supporting, is looking beyond the rhetoric on how their funds are spent when investing in 'sustainable intensification'. The NGO Friends of the Earth International (FoE) has recently made a helpful contribution to such monitoring. Based on existing evidence, its October 2012 report *A Wolf in Sheep's Clothing? An analysis of the 'sustainable intensification' of agriculture* provides useful information on funding priorities of the UK Government, the Bill and Melinda Gates Foundation, the CGIAR and the US Government in terms of sustainable intensification agricultural research and development projects. It notably concludes that while claiming to include agroecological farming, the sustainable intensification agenda in practice seems to focus primarily on technology-based approaches including GMOs, further consolidating industrial agriculture. The Feed and Future agricultural development programme of the US Government, launched in 2009 and led by the US Agency for International Development (USAID), provides a good illustration. Relying on the philosophy of sustainable intensification that it defines as being close to conventional intensive agriculture, its research strategy notably includes developing drought and stress tolerant crops, disease and pest resistant crops, crops with improved nitrogen use efficiency and yield improvements. When USAID staff gave an outline of funding priorities in 2011, they revealed that 28% of research funding would be directed to 'climate resilient cereals'. The Feed and Future programme priorities in target countries also encourage the adoption of Conservation Agriculture, which in USAID's vision consists mainly in no-till farming systems completed with high levels of chemical inputs and often use GM crops that don't require tilling for weed control (Diamond Collins and Chandrasekaran, 2012).

The GM Freeze campaign, whose members include various NGOs such as FoE England, GeneWatch UK, EcoNexus and FARM, raised similar concerns with regard to the Gates Foundation. According to the campaign, the Gates Foundation has allocated more than eight times as much money to the Alliance for a Green Revolution in Africa (AGRA) for a project to distribute artificial fertilizers as its main activity than to researching improved soil fertility using local resources, and funding for research involving transgenics outstrips that for soils by more than ten-fold (GM Freeze, 2011). Invariably, in the framework of the sustainable intensification agenda, agroecology receives a fraction of the funding provided to Green Revolution technologies (Holt-Giménez and Altieri, 2013).

But the sustainable intensification agenda does not just give only a small amount of available funds to agroecology when investing in agriculture. It also reduces it to its ecological technical content, essentially ignoring its social and political dimensions. In that sense, agroecology can be seen as co-opted by actors who fundamentally do not want to question the prevailing system (since their objective interests depend on it) but rather seek to proceed to the minimum adjustments that are necessary for ensuring the reproduction of the dominant industrial, corporate food regime. Agroecology then becomes a means (rather than a barrier) for the expansion of industrial agriculture (Holt-Giménez and Altieri, 2013).

F. Can agroecological principles be technically applied to large-scale industrial agriculture?

The close relationship between agroecology and peasant agricultures is obvious: agroecological systems are deeply rooted in the ecological rationale of traditional small-scale agriculture (Altieri and Toledo, 2011). Modernizing agroecologically traditional small-scale farms is thus especially appropriate for improving significantly their sustainability performances, notably for boosting yields and productivity per unit of land (see Part II section A.1). This is good news for traditional peasants who do not use a tractor, working animal, selected purchased seeds, mineral fertilizers, or pesticides. According to Mazoyer, the number of such peasants would amount to roughly 500 million people (of a total active agricultural population estimated to 1,34 billion people) (Mazoyer, 2008).

For peasants having partially adopted industrial practices, and even more for the most industrially 'accomplished' small-scale farmers, increasing the agroecological integration of their farms will be more difficult. Indeed, the conversion of degraded, simplified production systems to diverse, agroecological, resilient, low carbon systems, is challenging. The challenge will notably consist in avoiding excessive decline of yields and land productivity that would result from a too sudden abandon of synthetic inputs. In such cases, it can take time before beginning to recover and build productivity again (Trócaire, 2012), through the restoration of local ecosystems health. As a consequence, the transition processes will need to be more progressive[19]. However, shifting those farms into agroecological systems remains technically very much possible.

With regard to the technical feasibility of agroecological transition processes to various agricultural systems, the real challenge concerns large-scale industrial farms. To what extent can agroecological principles be applied to those farms? Is it realistic? Very few references in the agroecological literature provide elements to answer this question. Among them, Altieri et al. (2012b) seem to answer positively, underlining that in countries such as Chile, Argentina and Brazil, large plantations are now being rethought with a paradigm based on circular systems with reduced input and energy consumption rather than focusing solely on linear approaches and on increasing throughput. They posit that although the diversity of crops and the integration animal-crop may be less obvious than it is on small plantations, the same overall principles apply (Altieri et al., 2012b). On the other hand, few authors stress the limitations of attempts to increase the degree of agroecological integration of large industrial farms. For example, Lin (2011) implicitly emphasizes how unsuitable to biodiverse farming systems industrial mechanization is, since it is designed for optimizing productivity for one crop type and one crop structure (Lin, 2011). Douillet and Girard (2013) write along the same lines when emphasizing that the standardization of cropping systems has precisely promoted industrial mechanization (Douillet and Girard, 2013).

Though it is hard to provide a comprehensive answer to the question, logical conjectures suggest that in most cases agroecological integration of large industrial farms can be increased, but that room for maneuver is necessarily limited. For example, it is difficult to imagine how exactly large farms managed by just one or at best a few people could adopt farming management systems that entail enhancing significantly on-farm biodiversity, or total output per ha, to the same extent as peasants do on small plots of land. However, this remains a hypothesis to be tested.

Whether fully applying agroecological principles to large industrial farms is technically possible or not is an important question, since it gives us indications as to the feasibility of transitioning from industrial farming systems towards truly more sustainable farms. Answering 'no' would imply that above a certain size, sustainability of agriculture will necessarily be restricted. The question is relevant. As a matter of fact, there is an ongoing debate on the nature of relationship between farm size and productivity of outputs like crop yields and biodiversity (Wibbelmann et al., 2013).

Does it mean that large farms should be converted into smaller farms? Not necessarily. It should be so in countries that are highly dependent on agriculture and where peasants and communities are suffering from an inequitable access and control over land and other natural resources due to an unfair competition with large industrial farms. In such contexts there is no justification, from a social equity perspective, for not fragmenting large farms into smaller units through adequate redistributive land reforms. By contrast, since agroecological farming is labor intensive (see Part II section A.3), any attempt to promote significantly smaller

[19] This constraint makes it particularly urgent to find the best possible methods of complementarity between agroecological farming and the use of chemical inputs (instead of opposing them ideologically) during the transition period. In that context, the 'minimum' or 'reasonable' level of use of chemical inputs that agroecological transitions imply (see Part I, section D.2) could be understood as the minimum and optimal amount of their use (decreasing over time) which allow for increasing progressively the agroecological integration of the farm while avoiding simultaneously significant losses in yields and land productivity.

farms and making them agroecological in areas of very low population density or where too few people want to work in agriculture, and in which peasants do not suffer from such inequitable access and control over land and other natural resources, would not make sense. In such regions, increasing the agroecological integration of large industrial farms to the extent possible may be the best option for improving agricultural sustainability, through adequate incentives, both positive and negative (for encouraging the best and discouraging the worse practices respectively). In particular, in such areas the adoption of LEI (low-external-inputs) agriculture practices by large-scale farming will be crucial to mitigate adverse environmental impacts (Wegner and Zwart, 2011).

This is especially the case in many industrialized countries. Hendrickson et al. (2008) for example emphasize demographics as one of the three key factors limiting the adoption of integrated farming[20] in the US (Hendrickson et al., 2008, cited in Wibbelmann et al., 2013), and the problem is also widely recognized in the EU (Wibbelmann et al., 2013). Still with regard to the US and the EU, Wibbelmann et al. (2013) note that "*the trend of rural depopulation has a powerful effect on the human capital needed to increase the adoption of agroecological approaches, and this is exacerbated by low agricultural wages which are not conducive to labour movements into rural areas*".

However, constraints imposed by the size of the farms are far from applying everywhere in the developed world. In Europe for example, the average surface area used per farm varies considerably from one region to another. In 2010, this average reached 14,1 ha in the EU-27, varying from 0,9 ha in Malta to 152 ha in the Czech Republic[21], with 7 Member-States (Romania, Italy, Poland, Spain, Greece, Hungary and France) accounting for more than 80% of the European farms (Eurostat, 2011). It should also be noted that in Europe land grabbing is a reality as well, including for agricultural purposes, as documented in a joint, comprehensive publication launched in April 2013 by ECVC and the Hands off the Land network[22]. Among other issues, young people wishing to set up farming are facing major barriers to land ownership and access, including increasing costs of agricultural land (Wibbelmann et al., 2013). These elements indicate that in many European countries the room for agroecological transitions is real. Moreover, in some of these countries, the continuing decline of agricultural jobs is put into question in the name of non-market functions of agriculture, such as land occupancy, or due to enthusiasm for short circuits, connecting urban citizens and producers (Douillet and Girard, 2013).

[20] 'Integrated farming system' (or 'integrated agriculture') is a commonly and broadly used term to explain a more integrated approach to farming as compared to existing monoculture approaches. It refers to agricultural systems that integrate livestock and crop production or integrate fish and livestock and may sometimes be known as Integrated Biosystems (CARDI, 2010).

[21] This average often masks significant disparities in a given country.

[22] Comprenhensive publication, entitled 'Land concentration, land grabbing and people's struggles. TAKE ACTION AGAINST LAND GRABBING in Europe'. Available at: http://www.eurovia.org/IMG/pdf/Land_in_Europe.pdf [Accessed 12 December 2013]

PART II. HOW CAN THE SCALING-UP OF AGROECOLOGICAL APPROACHES HELP THE WORLD FEED ITSELF SUSTAINABLY, TODAY AND IN THE FUTURE?

Agricultural and food systems are confronted with multiple sustainability challenges, and all of them need to be addressed: ensuring that everyone has access to sufficient, high-quality nutritional, healthy and culturally appropriated food, not only today but also in the future; contributing to sustainable economic growth and eradicating poverty; preserving biodiversity and natural resources; making agriculture resilient to climate change while mitigating global warming; empowering women; and putting peasants back in control of agricultural and food systems for realizing Food Sovereignty.

The need for addressing all of them simultaneously is not only justified because they all matter, but also and fundamentally because they are all closely interconnected to each other. In other words, at least on the global scale, none of these needs can be properly addressed without taking simultaneously care of the others. This is one important lesson that can be drawn from analyzing the expansion of industrial agriculture in the last decades, demonstrating for example that a narrow focus on increasing productivity (per ha of a few commercial crops) without enhancing natural soil fertility by returning organic matter to the soil, is counter-productive on the long term for agricultural productivity in and of itself, or increases significantly the risk of crop failures by making farms far less resilient to climate change, pest or diseases outbreaks. Biodiversity preservation is a great way of illustrating the need for developing holistic approaches for achieving sustainable agricultural and food systems. It is not only important per se. For instance, it is also a crucial precondition for ensuring long-term higher yields and land productivity, making agriculture resilient to climate change, ensuring varied diets (which is essential from a right to food perspective) or even for empowering women.

This might be where agroecology can best make a difference with other sustainable agriculture approaches: it represents the best effort ever made to address simultaneously, through holistic approaches, sustainability challenges.

A. Contributing to food security and the realization of the Right to Food, and poverty eradication

As a corollary of the Right to Adequate Food, defined in the Plan of Action of the World Food Summit held by the FAO in 1996, food security "*exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life*" (FAO, 1996). As defined by the Committee on Economic, Social and Cultural Rights (CESCR) in its General Comment 12, the Right to Adequate Food "*is realized when every man, woman and child, alone or in community with others, has physical and economic access at all times to adequate food or means for its procurement*" (CESCR, 1999). Realizing the Right to Adequate Food requires the possibility either to feed itself directly from productive land or other natural resources, or to purchase food. "*This implies ensuring that food is available, accessible and adequate. Availability relates to there being sufficient food on the market to meet the needs. Accessibility requires both physical and economic access: physical accessibility means that food should be accessible to all people, including the physically vulnerable such as children, older persons or persons with disabilities; economic accessibility means that food must be affordable without compromising other basic needs such as education fees, medical care or housing. Adequacy requires that food satisfy dietary needs (factoring a person's age, living conditions, health, occupation, sex etc.), be safe for human consumption, free of adverse substances and culturally acceptable*" (De Schutter, 2010a). Existing evidence shows that agroecological approaches significantly contribute to food security and the realization of the Right to Adequate Food, mainly in four ways:

- (1) by enhancing yields substantially (availability);
- (2) by boosting urban agriculture (availability);
- (3) by reducing poverty (accessibility);
- (4) by ensuring the adequate character of food (adequacy);

1. Increasing the availability of food by enhancing yields substantially

Based on the fact that the adoption of agroecological approaches can sometimes decrease yields temporarily in the short term (as explained later on in Part I section A.1), some critics assert that agroecological systems are limited to producing low outputs. This is far from being the case. In fact, increases in production of 50-100% are fairly common when adopting most agroecological methods (Altieri et al., 2011a). In Brazil, for example, approximately 100,000 family farms have adopted agroecological farming practices today, showing increases in yields of 300 % and 100 % for black beans and corn (while increasing resilience to irregular weather patterns) (McKay, 2012). And this is just one example among many others. An impressive body of scientific evidence exists which demonstrates how significantly agroecological transitions can increase yields (thus also land productivity)[23]. In what might be the widest and systematic study on agroecological systems to date, Pretty at al. (2006) compared the impacts of 286 recent agroecological projects in 57 poor countries covering 37 million ha (3 % of the total cultivated area in developing countries), finding that such interventions increased land productivity on 12.6 millions farms, with an average increase in crop yield of 79 %[24], while improving the supply of critical environmental functions (water use efficiency gains, carbon sequestration and significant decline in pesticide use[25]). Average food production per household rose by 1.7 tons per year (up by 73 %) for 4.42 million small farmers growing cereals and roots on 3.6 million ha, and the increase in food production was 17 tons per year (up to 150 %) for 146,000 farmers on 542,000 ha cultivating roots (potato, sweet potato, cassava) (Pretty at al., 2006). UNCTAD and UNEP then reanalyzed the database of 286 projects to produce a summary of the impacts of 114 agroecological organic projects in Africa. Results showed that the average crop yields were even higher than the global average of 79 % and had more than doubled, with an average increase of 116 %

[23] All other things being equal, yield increases lead necessarily to land productivity increases. As a matter of fact, crop yields increases have been for a great part responsible for the land productivity growth worldwide (Douillet and Girard, 2013).

[24] The 79% figure refers to the 360 reliable yield comparisons from 198 projects.

[25] Of projects with pesticide data, 77% resulted in a decline of pesticide use by 71% while yields grew by 42% (Pretty et al., 2006).

for all African projects and of 128 % for projects in East Africa (UNCTAD-UNEP, 2008). Many other global assessments confirm the capacity of agroecological farming to enhance yields, as illustrated in Box V.

Box V. Yields, food production and food security outcomes of selected major global assessments on agroecological projects*

** While this table only focuses on yields, food production and/or food security reported impacts, global assessments mentioned simultaneously demonstrate many other sustainability advantages, including resilience to climate change.*

Selected major global assessments	**Main reported yields, food production and/or food security outcomes**
Pretty J.N., Morrison J.I.L., Hine R.E., 2003. 'Reducing food poverty by increasing agricultural sustainability in the development countries', *Agriculture, Ecosystems and Environment*, 95:217-234. Focus / scope: 208 agroecologically based projects and initiatives throughout the developing world.	Clear increases in food production over some 29 million ha, with nearly nine million households benefitting from increased food diversity and security. Promoted sustainable agriculture practices led to 50-100% increases in food production in rain-fed typical of small farmers living in marginal environments; this covered an area of about 3.58 million ha, cultivated by some 4.42 million farmers.
Badgley C., Moghtader J., Quintero E., Zakem E., Chappell M.J., Avilés-Vasquez K., Salumon A., Perfecto I., 2007. 'Organic agriculture and the global food supply', *Renewable Agriculture and Food Systems*, Vol 22, Issue 02 (June), pp.86-108. Focus / scope: Compilation of research from 293 different comparisons to assess the overall efficiency of organic (both from developed and developing countries[26]) versus conventional agricultural systems.	Agroecological organic farming systems in developing countries were producing 80% more than conventional farms.
IAASTD, 2009. *Agriculture at a Crossroads. Sub-Saharan Africa (SSA) Report*. Island Press, Washington DC. Focus / scope: Evaluation of the relevance, quality and effectiveness of agricultural knowledge, science, and technology (AKST), with respect to meeting development and sustainability goals of reducing hunger and poverty, improving nutrition, health and rural livelihoods, and facilitating social and environmental sustainability.	The report provides and refers to a growing body of evidence demonstrating that investing in agroecological approaches can be highly effective in boosting production and food security.
The Government Office for Science, 2011. *Foresight. The Future of Food and Farming: Challenges and choices for global sustainability. Final project report*, London (research commissioned by the Foresight Global Food and Farming Futures Project of the UK Government). Focus / scope: analysis of 40 projects and programmes in 20 African countries where sustainable intensification, including agroecological approaches,	Food output by agroecology via the use of new and improved varieties was significant as crop yields rose on average by 2.13-fold. Most households substantially improved food production and household food security. In 95% of the projects aimed at increasing yields, cereal yields rose by 50-100%. Total farm food production increased. Although some of the yield gains reported in the study

[26] 'Organic farming' refers to very different farming systems in developed countries than in developing countries. In developed countries, it often refers to monoculture farming systems based on recipe-like substitution of toxic chemical inputs with less noxious, biological ones from approved lists but that are largely purchased off-farms, leaving intact the dependency on the external input market and the ecological, social and economic vulnerabilities of monocultures (Altieri, 1998; Rosset et al., 2011). Such farming systems are remotely agroecological. In developing countries such as India for example, 'organic agriculture' refers most often in practice to agroecological farming systems. See for example Bargout (2012) and Altieri et al. (2011b). Unless otherwise specified, the use of the term 'organic farming' in the framework of this background paper refers to an agroecological farming system.

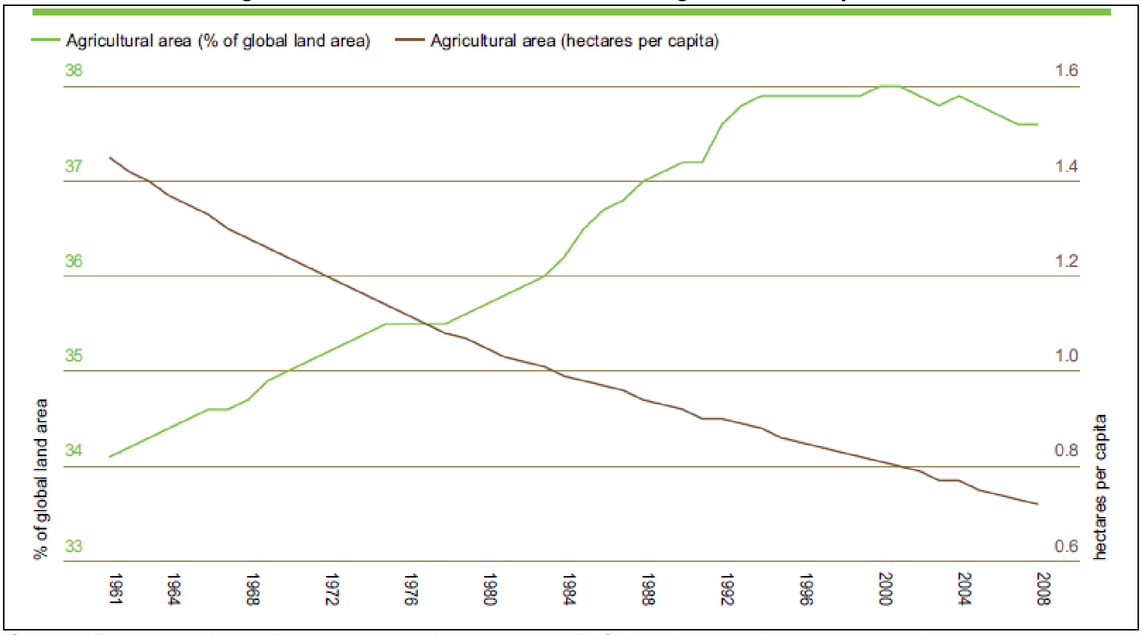
was developed in the 1990s-2000s. The project notably included crop improvements, agroforestry and soil conservation, conservation agriculture and integrated pest management.	depended on farmers having access to improved seeds, fertilizers and other inputs, food outputs improved mainly by diversification with a range of new crops, livestock or fish that added to the existing staples already being cultivated.
Bachmann L., Cruzada E., Wright S., 2009. *Food security and farmer empowerment: a study of the impacts of farmer-led sustainable agriculture in the Philippine.* MASIPAG (Magsasaka at Siyentipiko para sa Pag-unlad ng Agrikultura) and MISEREOR (German Catholic Bishops' Organisation for Development Cooperation). Focus / scope: The study, probably the largest one undertaken to date on sustainable agriculture in Asia, analyzed the work of MASIPAG, a network of small-scale farmers, farmers' organizations, scientists and NGOs, comparing findings from 280 full (agroecological) organic farmers, 280 in conversion to organic agriculture and, as a reference group, 280 conventional farmers.	Food security was significantly higher for organic farmers. The study revealed that the full organic farmers had considerably higher on-farm diversity, growing on average 50% more crops than conventional farms.

Source: De Schutter (2010a); Altieri et al. (2012b).

Significant increases in yields are strongly linked to the increase of agricultural biodiversity resulting from numerous techniques including crops diversification (e.g. through the introduction of new crops in crops rotations), agroforestry, integrated nutrient management, rehabilitation of formerly degraded land, or integration of livestock into farming systems (De Schutter, 2010a, Altieri et al., 2012b). Other factors that explain increase in yields include higher levels of soil organic matter (SOM) (Altieri et al., 2012b; Bargout, 2012) and higher water productivity[27] (e.g. through water harvesting) (De Schutter, 2010a; also see Part II section D.1) which plays a determinant role of crop productivity[28] (Branca et al., 2011). Review of the literature confirms that positive impacts on yields depend on the entire package (context-specific combination of practices) that is adopted in a given context. It also shows that benefits in yield emerge particularly over time. Short-term impacts indeed may sometimes be negative depending on underlying agro-ecological conditions, previous land use patterns, and current land use and management practices (Branca et al., 2011). This is especially the case when transitioning more industrial farms towards agroecological ones. As we have seen (Part I section F), in such cases, recovering and building land productivity again takes time, since time is needed to restore the health of local ecosystems. In this regard, according to Trócaire (2012) the main transition challenge is "*the conversion of degraded, simplified production systems to diverse, agro-ecological, resilient, low carbon systems, and to achieve this without losing productivity in the process*" (Trócaire, 2012).

[27] 'Water productivity' or 'water use efficiency' can be measured by the volume of water needed to produce a unit of the output per plant. In general, the lower the resource input requirement per unit, the higher the efficiency (Hamdy, 2007).
[28] 'Crop productivity' is the quantitative measure of crop yield in given measured area of field.

Figure 2. The Share of land devoted to agriculture has peaked



Source: Reproduced from Bailey, 2011, calculated from FAO, http://faostat.fao.org/site/377/default.aspx

The high land productivity of agroecological farming is a great asset given land scarcity, especially when compared to large scale industrial agriculture. Land is increasingly scarce. As shown in Figure 2 above, the share of land devoted to agriculture has peaked and the amount of arable land per head has significantly decreased since 1960. Although there is no clear estimate of how much land remains, it is undoubtedly quite limited (Bailey, 2011). In its 2011 final report *Foresight. The Future of Food and Farming* project, The Government Office for Science notes that "*there are strong environmental grounds for limiting any significant expansion of agricultural land in the future*", and recommends as one of the key priorities action for policy makers to "*work on the assumption that there is little new land for agriculture*" (The Government Office for Science, 2011). While the areas being targeted for large-scale investments are usually portrayed as 'empty', 'marginal', 'idle' or 'degraded' lands, largely unpopulated, unused, unproductive, and unlikely to compete with local food production (Franco et al., 2013), in reality this is far from being the case. That land in fact plays a critical role in the food security and livelihoods of marginalized people such as pastoralists, indigenous peoples and women (Bailey, 2011).

What about productivity per worker?

The question is important. As noted by Mazoyer and Roudart (2002), "*In order for a population to grow, or simply renew itself, agricultural production (that is, the productivity of the agricultural sector) must be, at a minimum, equal to the sum of the population's nutritional needs. Increased agricultural productivity allows for (...) a surplus which in turn enables the development of non-agricultural strata (...) and ultimately, determines the possibilities of social differentiation and urbanization* » (translated from French) (Mazoyer and Roudart, 2002). In other words, unless we consider that societies that are highly dependent on agriculture must indefinitely remain as such and have no right to diversify, we have to recognize that even in such countries it will be necessary to gradually increase the productivity per worker, and to do so will be desirable if done in parallel with the needs and aspirations of populations. The higher the percentage of people aspiring to work in other sectors, the higher the productivity per worker will need to be. Within this scenario, what does agroecological farming offer? Do agroecological transitions allow such gradual increases of productivity per worker?

The agroecological literature does not provide a comprehensive, direct answer to this question. However, a process of deduction brings us to conclude that most often, it is effectively the case. One way to approach the issue consists in comparing the evolution of two indicators in the short, medium and long term following the adoption of agroecological approaches: variations of yields/land productivity, and those of labor-intensity (workload/working time devoted to the farm). All things being equal (including the area of acreage), increasing productivity per worker will imply that the same working time allows higher yields/land productivity. This requires that yields/land productivity increases more or more rapidly than the working time needed to make this possible. And, while an impressive body of evidence demonstrates significant yields/land productivity increases, the agroecological literature suggests that at least in the long term, agroecological transitions can but do not necessarily lead to increased labor-intensity (see Part II section A.3). This suggests that most often, the same amount of work allows producing more and thus feeding more people. Moreover, especially in the medium and long term, the productivity per worker of agroecological farming can be further increased through gradual mechanization.

The better use of available family labor for the full year resulting most often from the adoption of agroecological farming (see Part II section A.3) also suggests that agroecological transitions allow the same number of family members to feed a growing number of people. No doubt that industrial agriculture will remain the unbeatable champion of the productivity per worker, but to what social and environmental costs?

2. Increasing the availability of food by boosting urban agriculture

According to one estimate cited by Canada's International Development Research Centre (IDRC), 25% of the entire global food output is grown in cities. Undertaken before the 2008 aggravation of the food crisis, this figure might even underestimate significantly the current level of urban food production, as history shows that urban agriculture production rises with food prices (ETC Group, 2009). Also often called 'intra-urban agriculture', urban agriculture takes place within the city. Most cities have vacant and under-utilized land areas that are or can be used for urban agriculture, whose forms are diverse: community gardens (formal or informal), home gardens, institutional gardens (managed by schools, hospitals, prisons, factories), nurseries, roof top gardening, cultivation in cellars and barns (e.g. mushrooms, earthworms) (FAO, 2007).

Mainly because it allows huge land productivity increases on very small plots on lands for meeting local food needs while contributing to improving the welfare of urban communities through various social and environmental functions, agroecological farming is particularly appropriate for developing urban agriculture. Through the scaling-up of agroecological approaches, Cuba has been a leader in urban agriculture. It is estimated that 383,000 urban farms, which cover 50,000 ha of urban landscape, produce over 1.5 million tons of vegetables using agroecological methods. This is enough to supply 40-60% or more of all the fresh vegetables in cities such as Havana, Villa Clara and others, with a form of agriculture that reduces food miles, energy and input use, and effectively closes local production and consumption cycles (Altieri and Toledo, 2011).

3. Increasing the accessibility of food by reducing poverty

Transition towards agroecological farming also significantly contributes to tackling poverty, mainly by increasing on-farm net incomes while globally maintaining or sometimes even increasing employment in agriculture and beyond.

Increasing on-farm net incomes

Although there is a lack of comprehensive and aggregated data focusing on the economic profitability of agroecological farming, evidence attesting positive impacts of the adoption of agroecological methods in terms of on-farm net incomes in most cases is backed by numerous examples. PELUM (see Part I section D.2) has been conducting capacity building initiatives for scaling-up agroecological approaches. These initiatives have notably shown that the adoption of animal integration led to net incomes increases as most of the farmers no longer had to buy artificial fertilizer for their garden, and benefitted from milk and meat from animals (Altieri et al., 2012b). In Brazil, the FAO found that the adoption of various improved cropland management practices led to significant net incomes increases. In Parana, vegetative contours, reduced tillage, terracing, integrated nutrient management increased net incomes by 104% while in Santa Caterina conservation agriculture and agroforestry allowed an average net income increase of 161%. One important factor that has contributed to these economic benefits is the substantial crop productivity gains following the adoption of the techniques (a percentage close to 82%, and 205% respectively in Parana and Santa Caterina) (Branca et al., 2011). Another example is provided by the 2009 study on the work of MASIPAG, in the Philippines (see Box V). The study found that the group of full organic farmers had on average higher net incomes, having increased since 2000, in contrast to stagnant or declining incomes for the reference group of conventional farmers. They benefited from net incomes one and a half times higher than those of conventional farmers. On average, they had a positive annual cash balance for households, while conventional farmers experienced a deficit in the household cash balance. For this reason the organic farmers were less indebted than their conventional counterparts (Altieri et al., 2012b).

As illustrated by these examples and many others, increase in yields and independence or reduced dependence on external inputs are two important factors explaining why agroecological transitions typically lead to on-farm net income increase[29]. By reducing farmers' reliance on external inputs, as well as the dependence on state subsidies that this reliance induces[30], agroecology makes vulnerable peasants less dependent on local retailers and moneylenders (De Schutter, 2010a). Economic benefits resulting from agroecological transitions can also rely on reduced economic vulnerability of farmers to crop failures or food prices volatility. Indeed, diversification of the different activities that agroecology generally implies allows farmers to compensate for possible crop failures due to adverse climatic and other natural conditions by better results for other crops, or compensate market price reductions for one specific product by more remunerative prices for others (Levard and Apollin, 2013). In that sense, agroecological farming systems offer built-in systems of insurance for smallholders (Bargout, 2012) that make them more resilient to economic, climatic and other natural shocks. Biodiversity provides a buffer against environmental fluctuations because different

[29] The positive impacts of independence or reduced dependence on external inputs, including synthetically based inputs, are all the more important that in the past few years, the price of fertilizers and crude oil products have more than doubled the rise in food commodity prices, even when the latter reached a peak in July 2008 (De Schutter, 2010a).

[30] Farmers generally can only afford fertilizers and pesticides as long as they are subsidized (De Schutter and Vanloqueren, 2011).

species respond differently to changes. This leads to a more predictable aggregate community or ecosystem properties. Such diversity allows the maintenance of a system's functional capacity against potential human management failure that may result from an incomplete understanding of the effects of environmental change (Lin, 2011). Moreover, additional economic benefits can sometimes result from a better promotion of the production through short circuits (Levard and Apollin, 2013).

Generally speaking, at the farm level, the evolution of net incomes depends both on variations in the gross income of agricultural activity and on the evolution of production costs. Levard and Apollin (2013) suggest that when transitioning farms towards more agroecological systems, gross income generally increases more than production costs, thanks to significant yields increases. They suggest however that this is typically the case for traditional peasant farms, but that for farms partially or fully industrialized, the situation can be different, at least in the short term, as such farms sometimes face initial declines in yields as we have seen (before recovering). That said, they note that in all cases the agricultural added value tends to increase, often significantly, even when yields are decreasing. Indeed, when such declines happen, they are often economically compensated by huge decrease in production costs due to the substitution of expensive off-farm inputs by 'internal solutions' to the farming system (Levard and Apollin, 2013).

Maintaining or even increasing on-farm employment

According to Levard and Apollin (2013), though some agroecological practices lead to a reduction of working time during certain times of the year (for example by limiting the soil work), agroecological farming is in general labour intensive, both compared to traditional agricultural systems and farming systems shaped by the Green Revolution. This suggests that regardless of the types of farming systems that are transitioning towards agroecological farming systems, applying such processes leads in general to a higher workload. Most often, at least in developing countries, this higher labor-intensity allows a better use of available family labor which tends to be under-occupied for part of the year, but it can also lead to job creation[31]. Besides, job creation can be an integral part of the objectives for designing agroecological transitions (Levard and Apollin, 2013).

However, this is particularly true in the short term, in the introductory phase of agroecological practices, due to the complexity of the tasks of managing plants and animals on the farm, and recycling the waste produced (De Schutter, 2010a; Sivakumaran, 2012). On the long term, it is less clear. The agroecological literature suggests that this will depend on various factors, including the initial labor-intensity of farms that are subjected to an agroecological transition, the types of agroecological strategies and practices privileged, or the potential gradual mechanization of farming with which agroecological approaches are fully compatible, as seen previously (Part I section D.2).

When agroecological transitions lead to on-farm job creation, it can slow down rural-urban migration and encourage rural development by attracting off-farm labor in rural areas if the harvests provide sufficient incomes (De Schutter and Vanloqueren, 2011; McKay, 2012). Besides, the cost of creating jobs in agriculture is often significantly lower than in other sectors of the economy (De Schutter, 2010a). But generally speaking, agroecological farming systems also present

[31] This also works in favour of the economic profitability of agroecological transitions per agricultural active person, since it means that most often, each member of the family will benefit from a bigger share of the total increased agricultural added value resulting from the adoption of agroecological approaches (than when additional workers are mobilized outside the family).

qualitative advantages in terms of employment. This can be illustrated by the grassroots agroecology movement built in Cuba by the National Association of Small Farmers (ANAP), member organization of LVC. Day to day experiences of peasants that are part of this movement show for example that agroecological farming provides pleasant working conditions such as shade from trees or the absence or rare toxicity from chemicals. More importantly, according to farmers, in such systems the work "*stimulates imagination, relates the soul to the creativity*". Interviews with peasants from ANAP clearly reveal how motivating and stimulating agroecological farming is for them (Rosset et al., 2010).

First and foremost, the high labor-intensity of agroecological farming should be examined in the light of massive unemployment, rural and urban poverty that would result from further industrializing agriculture at the detriment of peasants. This is particularly obvious when comparing respective contributions of peasant agricultures and industrial farms to on-farm employment. In Brazil, for example, a study by the Ministry of Agrarian Development carried out in 1995/96 showed that while household agriculture creates an average of one job per 8 ha of farmland, corporate farming requires 67 ha to create a single job. In Africa, for every person employed on commercial farms, 45 to 65 are employed on small farms (Ong'wen, 2007). In so many developing countries whose national economies remain highly dependent on agriculture, investing in agricultural approaches that can be highly labour-intensive is a necessity, while recognizing the progressive development of other economic sectors. Most developing countries currently cannot offer urban job opportunities to those leaving the farming sector (De Schutter and Vanloqueren, 2011).

Increasing employment beyond the farm

That being said, agroecological transitions can also lead to job creation beyond the fields, both upstream and downstream from the agricultural production (Levard and Apollin, 2013). On the one hand, the gradual mechanization of agriculture with which agroecological approaches are fully compatible represents an opportunity for job creation. The need to produce equipment for conserving agricultural techniques such as no-till and direct seedling, for example, results in job creation in the manufacturing sector, especially in Africa which still imports most of its equipment but increasingly manufactures simple tools (De Schutter, 2010a). On the other hand, the evolution of types and volumes of agricultural production can have an impact on processing, storage, transport, and commercialization activities. There are numerous examples where diversification of production through agroecological systems has allowed the development of new activities and food supply chains, generating new revenue downstream from production (Levard and Apollin, 2013).

4. Increasing the adequacy of food by providing a high-quality nutritional, healthy and culturally appropriated food

The agricultural approaches promoted by the Green Revolution have had negative impacts on consumers' health, due to pesticides intrinsic toxicity combined with excessive concentration of their residues in food products (see Part I section C). They have also led to low-diversity diets by promoting extremely simplified agroecosystems focusing primarily on boosting cereal crops (De Schutter, 2010a; Jacobsen et al., 2013). Rice, wheat and maize are indeed mainly sources of carbohydrates. They contain relatively little protein and few of other nutrients that are essential for adequate diets. The shift from diversified cropping systems to simplified cereal-based systems thus contributed to micronutrient malnutrition in many developing countries (De Schutter, 2010a). Low-diversity diets are frequently associated with high incidence of lifestyle diseases such as type 2 diabetes, heart disease, obesity and cancer (Jacobsen et al., 2013).

The impoverishment of the nutritional quality of agricultural food production goes hand in hand with the logic of the industrial food supply chain. As noted by Colombo and Onorati (2013), the logic is both influenced by and influencing a significant change in dietary regimes of urban populations, and particularly the middle class, in almost every corner of the world (Colombo and Onorati, 2013). They describe these evolutions as follows: "*More and more meals are eaten outside the home by urban populations (which now outnumber those living in rural areas). On this subject, the FAO speaks of two distinct tendencies: the convergence of food regimes* [diets] *and changes in habits (FAO, 2004)*[32]*. Convergence refers to the growing similarity of diets across the globe, based on a restricted number of basic cereals (cheat and rice), combined with meat, dairy products, oils, salt and sugar, and a simultaneous reduction in the consumption of fibre. Changes in habit are attributable to changing patterns of family life, with more meals consumed outside the home and the purchase of brand name products from supermarkets.* (…) *This is an emulative process in the developing world that seeks to mimic the Western idea of quality of life, giving rise to changes in food and consumption styles (Delgado et al., 1999)*[33]" (Colombo and Onorati, 2013). Clearly, the industrial food supply contributes importantly to the progressive standardization of food stuffs (Alpha, 2007), undermining the provision of food that takes into account local cultural preferences. This homogenization of diets leads to the further impoverishment of the nutritional quality of food (masked by the apparent richness of the many food items available on supermarket shelves), thus undermining balanced habits (Colombo and Onorati, 2013).

Nutritionists increasingly emphasize the need for more diverse agroecosystems for ensuring a more diverse nutrient output of the farming systems and therefore more diversified diets. Since it promotes extremely diverse cropping systems including with regard to species on the farm (both in rural and urban areas), agroecological farming typically meets this concern, increasing nutritional diversity which is of particular importance to children and women (De Schutter, 2010a). Embedded in local cultures, agroecological farming leads to valorizing and making the best use of traditionally cultivated crops that the Green Revolution style agriculture has underutilized. The nutritional value of those crops is high, with ample amounts of micronutrients, antioxidants and essential amino acids for the consumer (e.g. species from the Andes such as quinoa, amaranth, kañawa, and Andean lupine) (Jacobsen et al., 2013). According to some studies, crops grown by agroecological organic farming methods can improve diets because they contain significantly more vitamin C, iron, magnesium and phosphates and fewer nitrates than conventional crops (Curtis, 2012). Positive impacts of agroecological farming on consumer health also result from the reduction to an absolute minimum of synthetic inputs it implies. Besides, the on-farm recycling of certain wastes of a particular activity (including through animal integration) contribute to reducing the release of components such as residues of pesticides, antibiotics and nitrates into the environment that are damaging to the human health (Levard and Apollin, 2013).

[32] FAO, 2004. *The State of Food Insecurity in the World 2004: monitoring progress towards the World Food Summit and Millennium Development Goals*.
[33] Delgado C., Rosegrant M., Steinfeld H., Ehui S., Courbois C., 1999. *Livestock to 2020. The Next Food Revolution*, Food, Agriculture, and the En vironment Discussion Paper 28, FAO.

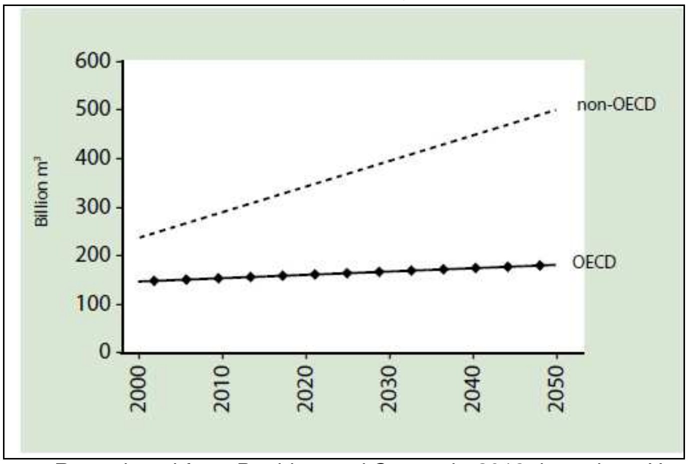
B. Contributing to water security and the realization of the Right to Water and Sanitation

Access to sufficient water is intrinsic to an adequate standard of living, which is recognized as a fundamental human right under the Universal Declaration of Human Rights (UDHR) (Article 25) and the International Covenant on Economic, Social and Cultural Rights (ICESCR) (Article 11). Explicit references to safe drinking water or sanitation have been included in various international legal instruments, such as the Convention on the Rights of the Child (CRC), the Convention on the Elimination of All Forms of Discrimination against Women (CEDAW), and the Convention No. 161 of 1985 of the International Labour Organization (ILO) on Occupational Health Services. The formal recognition of the Right to Water and Sanitation marked a crucial milestone in July 2010 when the UN General Assembly recognized "*the right to safe and clean drinking water and sanitation as a human right that is essential for the full enjoyment of all human rights*" (Chopra, 2010), and in September of the same year, the UN Human Rights Council's adoption of a binding resolution recognizing that the human Right to Water and Sanitation is part of the Right to an Adequate Standard of Living (OHCHR, 2010). Grey and Sadoff (2007) have defined 'water security' as "*the availability of an acceptable quantity and quality of water for health, livelihoods, ecosystems and production, coupled with an acceptable level of water-related risks to people, environments and economies*" (Grey and Sadoff, 2007).

Yet, it is estimated that 780 million people worldwide (345 million just in Africa) lack access to clean water, and that 3,4 million people die each year from water, sanitation, and hygiene-related causes. Nearly all deaths (99 %) occur in the developing world (Water.org, 2012). Water pollution, to which industrial agriculture significantly contributes, is one of the major reasons for water insecurity in many parts of the world (Varghese, 2011) and water becomes increasingly scarce. Almost three billion people live in areas where demand outstrips supply. Agriculture, especially industrial farming, contributes significantly to that scarcity, accounting for 70 % of global fresh water use. Global warming will exacerbate the problem, particularly in already stressed regions (Bailey, 2011). Population growth, particularly relevant in developing countries[34], will make further demands on the already water-stressed food system, and the pressure will mount even more since water is increasingly transferred out of agriculture to provide for other demands, such as energy or growing urban populations. In 2050 water use is projected to more than double in the municipal sector within non-OECD countries, where agriculture tends to be the most vulnerable to climate change (see Figure 3 hereafter) (Boehlert and Strzepek, 2013).

[34] According to the United Nations 2012 Revision of the World Population Prospects launched in June 2013, the world population is expected to reach 9.6 billion in 2050. Developing regions will record the biggest increase from 5.9 billion in 2013 to 8.2 billion in 2050 (Centre d'actualités de l'ONU, 2013).

Figure 3. Total projected municipal water use in OECD versus non-OECD countries, 2005-2050



Source: Reproduced from Boehlert and Strzepek, 2013, based on: Hughes G., Chinowsky P., Strzepek K., 2010. 'The costs of adaptation to climate change for water infrastructure in OECD countries, Utilities Policy, *18(3): 142-153.*

In this context, improving water use efficiency or productivity will be crucial. As shown later in this paper (see Part II section D.1), existing evidence demonstrates that agroecological farming is particularly appropriate in this regard, especially by building healthier soils and improving water conservation and water harvesting in rainfed regions through various approaches. Scaling-up agroecology would thus be highly valuable for decreasing pressure on water resources, increasing resilience to water scarcity, reducing the frequency of conflicts between competing water uses and, ultimately, contributing to water security and the realization of the Right to Water and Sanitation. This would also enhance food security and the realization of the Right to Adequate Food, thanks to the significant yields increases resulting from higher water productivity and its expected positive economic impacts (see Part II sections A.1 and A.3). More fundamentally, such a positive impact relies on the close link existing between the rights to food and water. As stated by Chopra (2010), "*individuals who lack secure access to water for personal use are very likely to be facing acute or chronic hunger, and vice versa. The right to food also depends, immutably, on access to water, in that producing food requires access to adequate water for agriculture*" (Chopra, 2010). In particular, women's access to safe water for domestic use is of utmost importance for ensuring household-level food security, since women play a major role in accessing food for their family members and in preparing food for household-level consumption (Varghese, 2011).

C. Preserving biodiversity and natural resources

The contribution of agroecology to the preservation of biodiversity and natural resources is obvious. As we have seen, agroecological transitions are entirely devoted to the improvement of sustainability, including with regard to environmental protection. That is the whole point of the process. The principles that agroecology as a science has theorized and is further developing represent the most important effort ever undertaken to understand the very conditions of sustainable agriculture. They allow avoiding overexploiting and contaminating land and water resources, restoring degraded lands or enhancing soils fertility by increasing SOM (Utviklingsfondet, 2011; Altieri et al., 2012b; Curtis, 2012; Levard and Apollin, 2013). The agroecological principles encourage significant diversification which occurs in many forms (genetic variety, species, structural) and over different scales (within crop, within field, landscape level) (Lin, 2011), further optimizing the historical significant contribution of traditional peasant farming systems to the maintenance and protection of biodiversity[35]. They also invoke addressing local needs thereby shortening the circuits of food production and consumption and bypassing the high energy needs of 'long-distance food' (Altieri and Toledo, 2011).

Successfully addressing the challenge of natural resources and biodiversity preservation will require putting women at the front seat of agroecological transition processes since they play a major role in managing soil, water, forests and energy, especially in developing countries. Women have traditionally entertained a close relationship with trees and the forests. They have a deep knowledge of the plants, animals and ecological processes around them. They can be considered the traditional daily managers of the living environment (Sobha, 2007). In its Preamble, the Convention on Biological Diversity (CBD) "*recognizes the vital role of women in the conservation and sustainable use of biological diversity and affirming the need for the full participation of women at all levels of policy-making and implementation for biological diversity conservation*" (UNCED, 1992).

D. Increasing resilience to climate change and addressing the mitigation challenge

Agriculture is both a major victim and a key driver of climate change. Achieving sustainable agriculture with regard to the climate implies shifting to an agricultural development paradigm which simultaneously augments the resilience of farmers to adverse impacts and threats they face as a consequence of global warming, and mitigating GHG emissions resulting from agriculture. Scaling-up agroecological transitions would lead to successfully meeting these complementary challenges through a double path: optimizing existing peasant agricultures' resilience to climate change and their mitigation potential (while keeping in mind that those forms of agriculture contribute very little to global warming), and transitioning industrial agriculture towards more agroecological systems primarily with the purpose of mitigating current inputs of agriculture to climate change. This would also contribute to mitigating GHG emissions induced by food systems more broadly.

1. Increasing resilience to climate change

While industrial agricultural systems are highly vulnerable to climate change, many studies show that agroecological farming is climate resilient (Li Ching and Stabinsky, 2011; Altieri and Nicholls, 2012). It allows farmers to cope with severe environmental stress whose occurrence are expected to become more frequent as a consequence of climate change, such as severe droughts and floods, temperatures fluctuations, hurricanes, low precipitation and reduced soil water availability or the invasion of new pests, weeds and diseases (De Schutter, 2010a; Swiderska et al., 2011; Altieri and Nicholls, 2012; Altieri et al., 2012b).

For example, the 125,000 hillside family farmers in Santa Catarina, Brazil, who have modified the conventional no-till system by using green manures and cover crops (see Part I section D.2), have experienced lower fluctuations in soil moisture

[35] It is estimated that since 1960s, peasants have bred 7,000 plant species and 2.1 million varieties, and breed and nurture 40 livestock species and more than 7,000 local breeds. In comparison, the industrial food chains only use 150 crops but mainly 12, and around 80,000 varieties, and works with only 5 livestock species and less than 100 breeds (ETC Group, 2013).

and temperature, and a reduction of soil erosion levels. Repeated application of fresh biomass improved the soil quality, minimized erosion and weed growth, and improved crop performance. While the severe drought to which farmers have been faced with during the 2008-2009 season has induced an average yield loss of 50% for conventional maize producers, producers who had switched to no-till agroecological practices experienced a loss of only 20%, confirming the greater resilience of these systems (Altieri and Nicholls, 2012). A study conducted in Central American hillsides after Hurricane Mitch in 1998 found that farmers using agroecological methods such as cover crops, intercropping and agroforestry suffered less damage than their conventional counterparts (Altieri et al., 2011a). Agroecological plots on sustainable farms from southern Nicaragua to eastern Guatemala had an average 40% more topsoil, 69% less gully erosion, higher field moisture and fewer economic losses than control plots on conventional farms (Holt-Giménez, 2002). Studies also show agroecological approaches improve recovery after such climatic disasters. For example, a survey conducted 40 days after Hurricane Ike hit Cuba in 2008, in the Provinces of Holguin and Las Tunas, not only found that agroecologically managed farms exhibited losses of 50% compared to 90 or 100% in neighboring monocultures, but also that they showed a faster recovery (80-90%) than monoculture farms (Rosset et al., 2011). And these are just a few examples among many others.

Resilience of agroecological farming to climate change relies on four main interconnected features, levers that can be considered as key conditions for better adapting agriculture to climate shocks:

- (1) increasing the level of biodiversity (Altieri, 2008; De Schutter, 2010a; Tirado and Cotter, 2010; Altieri et al., 2011a; Li Ching, 2011; Li Ching and Stabinsky, 2011; Sahai, 2011; Altieri and Nicholls, 2012; Altieri et al., 2012b; Bargout, 2012; Jacobsen et al., 2013);
- (2) building healthier soils (Li Ching and Stabinsky, 2011; Altieri and Nicholls, 2012; Bargout, 2012);
- (3) improving water management and water harvesting in rainfed regions (De Schutter and Vanloqueren, 2011; Li Ching and Stabinsky, 2011; Sahai, 2011; Bargout, 2012);
- (4) optimizing yields increases (Li Ching and Stabinsky, 2011).

Increasing the level of biodiversity

As mentioned earlier, biodiversity provides a buffer against environmental fluctuations because different species respond differently to changes, allowing the maintenance of a system's functional capacity against potential environmental stress (Lin, 2011). This also applies to climatic stress. For example, a higher biodiversity of crops grown provides a safety-net to farmers in the event that direct or indirect climatic adversities result in failure of a particular crop, assuming that the same adversities by contrast won't negatively affect other strategic crops, enabling farmers' gains under worst-case climate scenarios through a balance of precautionary measures and desired risks (Bargout, 2012). But biodiversity can be enhanced many other ways, including by increasing crop diversity itself (growing different varieties of the same crop that have different attributes) or by adding trees into the production system (Li Ching and Stabinsky, 2011). Agroforestry provides greater shade cover notably increasing the buffering of crop to temperature and precipitation variation, or increasing the buffering from storm events and decreasing storm damage (Lin, 2011). Enhancing positive synergies between plant species and animal species, both wild and bred, is one other diversification strategy which may prove to be very helpful. Globally speaking, animal biodiversity is no less pivotal for agroecological resilience to climate adversity than natural and domesticated plant biodiversity. Agroforestry for example depends heavily on insect pollination for the production of a healthy harvest, especially for orchards and respective production of fruit (Bargout, 2012).

Crop diversification, as one of the key strategies for enhancing resilience to climate change (Jacobsen et al., 2013), implies the maintenance and revalorization of traditional varieties, especially since traditional varieties or landraces are more genetically diverse than modern varieties and thus can better withstand environmental stress such as lack of water or nutrients. In Southwest China for example, laboratory analysis has shown that *in situ* varieties have much higher genetic diversity than those same lines held *ex situ* for 30 years. Another advantage offered by traditional crop varieties is that they are cheap and easily accessible since they come from farmers' own saved seeds and are commonly shared within and between villages. This contrasts greatly with modern varieties which usually have to be bought each season, depend on market availability and quality, and are often protected by Intellectual Property (IP) rights (Swiderska et al., 2011).

Equally important for adapting agriculture to climate change is the need to make the best use of traditional knowledge (which is closely linked to and dependent on traditional crop varieties) (Swiderska et al., 2011). The International Institute for Environment and Development (IIED) has identified at least five types of traditional knowledge that are particularly useful for adapting agriculture to climate change (see Box VI below).

Given the crucial role played by women as transmitters of traditional knowledge to the new generations (Utviklingsfondet, 2011), key source of knowledge about on-farm seed conservation (Altieri et al., 2011a) and biodiversity management (Sobha, 2007; Li Ching and Stabinsky, 2011)[36], their contribution is essential for designing and applying efficient agricultural adaptation strategies to climate change (Li Ching and Stabinsky, 2011; Tripathi et al., 2012).

Box VI. Five types of traditional knowledge useful for adapting agriculture to climate change

Traditional knowledge about…	**How it helps adaptation in agriculture**
Resilient properties	Traditional farmers often live on marginal land where climate change impacts and selection pressures are greatest. This enables them to identify resilient crop species and varieties for adaptation.
Plant breeding	Traditional farmers – particularly women and the old – are active plant breeders, conserving local landraces and selecting seeds for preferred and adaptive characteristics over generations. Some innovative farmers cross lines for crop improvement.
Wild crop relatives	Local communities often draw on wild areas for crop improvement and domestication as well as to supplement their diet and provide food when crops fail.
Farming practices	Traditional farming practices – from water, soil or pest management to erosion control and land restoration – conserve key resources for resilience and adaptation, such as biodiversity, water, soil and nutrients.
Climate forecasting	Traditional knowledge can help forecast local weather, predict extreme events and provide accessible information to farmers at a local scale. Traditional farmers can also monitor climate change in specific locations and fill the resolution gap of scientific models.

Source: Reproduced from Swiderska et al. (2011).

[36] For example, Aguaruna women in Peru plant more than 60 varieties of manioc. In Rwanda, women produce more than 600 varieties of beans (Li Ching and Stabinsky, 2011).

Building healthier soils

Soil health is a fundamental determinant of farm resilience and productivity. It is therefore of utmost importance in agroecological farming to optimize it. This implies first and foremost increasing SOM, which consists of dead carbon-based organisms at various states of decomposition, since soil health is strongly maintained by the presence of SOM (Bargout, 2012). As indicated by Altieri and Nicholls (2012), "*SOM management is at the heart of all efforts to create healthy soils with a high level of biological activity and good physical and chemical characteristics. Increasing the SOM enhances resilience by improving the soil's water retention capacity, enhancing tolerance to drought, improving infiltration, and reducing the loss of soil particles through erosion after intense rains. SOM also improves surface soil aggregation, holding the soil particles tightly, protecting them against rain or windstorms*" (Altieri and Nicholls, 2012). One key form of SOM is humus, which functions as a storehouse of nutrients and a natural reservoir of moisture. Humus acts as a sponge and a protective buffer during periods of drought, being capable of holding 30 times its weight in water (Bargout, 2012). SOM also contributes to the presence in the soils of symbiotic mycorrhizal fungi, which are a key component of the microbial populations that influence plant growth and soil productivity (Altieri and Nicholls, 2012). It can be maintained through the use of practical and cost-effective methods. Such methods include for example conservation tillage, mulching, green-manures, intercropping, mixed cropping, crop rotation, agroforestry, permaculture, vermiculture, aquaculture and composting (Bargout, 2012).

One other very important strategy for ensuring healthy soils is managing their cover. This strategy offers many advantages, including protecting the soil from wind erosion by significantly reducing wind speed[37], improving water penetration, diminishing fluctuations in soil moisture and temperature, etc. (Altieri and Nicholls, 2012).

Improving water conservation and water harvesting in rainfed regions

Water scarcity and hydrological volatility are undoubtedly among the most severe risks farmers are increasingly facing as a consequence of global warming. According to a study published in September 2013 in IOP Publishing's journal Environmental Research Letters, even if commitments or pledges by countries to reduce GHG emissions are met, the global mean temperature will still rise by around 3.5°C above pre-industrial levels by the end of the century, exposing 668 million people worldwide to new or aggravated water scarcity (in addition to the 1.3 billion people already at present living in water-scarce regions) (Gerten et al., 2013).

In this context, improving water / moisture conservation (wherever water falls) and water harvesting in rainfed regions is all the more important for adapting agriculture to climate change (Li Ching and Stabinsky, 2011; Sahai, 2011). This can be done through a variety of agroecological approaches. In West Africa, stone barriers built alongside fields help retain water during the rainy season, improving soil moisture, replenishing water tables, and reducing soil erosion. As a result, the water retention capacity is increased five- to tenfold, the biomass production ten- to twentyfold, and livestock can feed on the grass that grows along the stone barriers after the rains (De Schutter and Vanloqueren, 2011). In rice cultivation, the System of Rice Intensification (SRI) has proven to be one of the most efficient and practical water saving technique (Bargout, 2012). Initiated in the early 1980s in Madagascar at by a Jesuit priest, Father Henri de Laulanié, SRI is now practiced in more than

[37] Mulching can reduce wind speed up to 99% (Altieri and Nicholls, 2012).

35 countries (Vermeulen, 2010). As opposed to completely flooding the rice paddy, this system implies notably applying small amounts of water regularly or alternating wet and dry conditions to maintain a mix of aerobic and anaerobic soil conditions (Uphoff, 2007b). One of the main achievements obtained through this technique is water conservation (Bargout, 2012), while bringing many other advantages including significant increases in yields (usually from 50 to 100%), higher economic profitability, increased resistance to pests and diseases, and increased agronomic and economic resilience due to a reduced time to maturity of the plant (Uphoff, 2007a)[38].

Another great example is the traditional Indian 'water tank' system of moisture conservation. Water tanks consist essentially in earthen dams, whose size varies from 1 to 10 ha. This system has proven to be very practical, readily accessible, and cost-effective. In a context where it is common that a majority of a year's precipitation occurs within only 100 hours of rainfall, water tanks allows storing water from catchment areas and thus guarantees agricultural access to water during the rest of the year. This tool has been used in India for approximately 1,200 years. But in the second half of the twentieth century, government policy focusing on extracting water ground water resources and using irrigated resources of water has led to their underutilization. More recently, there have been highly successful initiatives to resurrect water tanks due to a widely recognized need for pro-poor methods of water conservation in India (Bargout, 2012).

Optimizing increases in yields

Given the huge pressures from climate change to crop yields, increasing yields becomes even more essential. As we have seen before, agroecology can obviously meet that challenge in a sustainable way (see in particular Part II section A.1).

2. Addressing the mitigation challenge

Since industrial agriculture is mainly responsible for the major contribution of agriculture to global warming (GRAIN, 2009a; Li Ching and Stabinsky, 2011; Sivakumaran, 2012), mitigating agricultural GHG emissions will essentially imply shifting industrial agriculture towards more climate-friendly farming systems. For achieving this objective, increasing carbon sequestration will be important, although efforts to mitigate climate change should in priority seek to prevent or reduce emissions (rather than seeking primarily to 'neutralize' carbon that has already been emitted). According to the fourth assessment report of the

[38] While some theoretical debates exist about whether SRI is truly context-specific or not (underlining that in various places of the world such as states of India, Madagascar or Nepal, SRI 'guidelines' are promoted following a dogmatic, inflexible, top-down approach), reviews of the literature as well as extensive field observations indicate that a diverse range of non-standard 'variants' of the orthodox model are the norm (Glover, 2013). When developed as a component of a truly agroecological transition process, SRI is not presented to farmers as a standard kit of technology, but as an approach opened to farmers innovations, often but not always in collaboration with NGO or government staff working in a collaborative model. Experience shows SRI concepts have inspired many different farmer-led local adaptations, including in improving farming systems growing other crops than rice, such as sugar cane, finger millet, wheat or cotton. SRI locally adapted methods can also be used for enhancing crops diversification. In Cambodia, farmers have diversified their smallholder farming systems by capitalizing on the productivity increases resulting from the SRI. Even farmers with as little as 0.3 ha have taken 40-50% of their paddy land out of rice production, as SRI methods allowed them to get 3-4 times their previous rice yields and thus meet their families' basic need with less land. Peasants have redeployed the land freed up for other uses, starting with a fish pond then completed by vegetable, fruit and small livestock production (Uphoff, 2007c).

Intergovernmental Panel on Climate Change (IPCC), 89% of the total technical mitigation potential of agriculture is related to carbon sequestration, about 9% being linked to mitigation of methane and only about 2% related to mitigation of nitrous oxide emissions from soil (correlating with nitrogen fertilizer use) (IPCC, 2007). Transitioning industrial agriculture to more agroecological farming systems could therefore significantly contribute to mitigation, since agroecological farming is highly efficient in sequestering carbon. Relevant approaches include leaving residues and reducing tillage to encourage buildup of soil carbon, agroforestry (which notably enhances carbon sequestration through an increased plant biomass), crop rotations, cover crops, green manures and application of organic amendments such as compost (which contribute to restore degraded soils and hence increase soil carbon sequestration) (Li Ching, 201).

But more importantly, scaling up truly agroecological transition processes would not only allow addressing the mitigation challenge of the agricultural sector. It would also significantly contribute to reducing current GHG total emissions of the industrialized food system as a whole, beyond its agricultural component. This can be well explained by the work of GRAIN, which has estimated that reduction and sequestration of one-half to three-fourths of current global GHG emissions could be achieved through adopting four complementary measures: using agro-ecological practices to rebuild the organic matter in soils lost from industrial agriculture; stopping land clearing and deforestation for plantations; distributing food mainly through local markets instead of transnational food chains; decentralizing livestock farming and integrating it with crop production (see Box VII). While each of these measures is not necessarily specific to the agroecological paradigm, applying consistent agroecological transition processes would undoubtedly lead to their adoption. For example, as we have seen, agroecology privileges local markets that shorten the circuits of food production and consumption, hence avoiding the high energy needs of ‘long-distance food’ (Altieri and Toledo, 2011). As another example, scaling-up agroecological approaches would also lead to stopping land clearing and deforestation for plantation, notably because of the significant yields / land productivity increases the adoption of agroecological farming implies (thus avoiding the need to clear new land for agriculture purposes). As shown in Box VII, according to GRAIN stopping land clearing and deforestation for agriculture alone would allow a total GHG emissions reduction by 15 to 18 % (GRAIN, 2009b). Historically, 75 % of deforestation worldwide has been associated with agricultural expansion (CTA, 2012), including for industrial animal feed and agrofuels.

Box VII. Complementary measures for reducing GHG emissions and increasing carbon sequestration

According to GRAIN:

- by using agro-ecological practices to rebuild the organic matter in soils lost from industrial agriculture, sequestration equivalent to 20–35% of current GHG emissions can be achieved;
- by stopping land clearing and deforestation for plantations, total GHG emissions can be reduced by 15–18%.
- by distributing food mainly through local markets instead of transnational food chains, total GHG emissions can be reduced by 10–12%;
- by decentralizing livestock farming and integrating it with crop production, total GHG emissions can be reduced by 5–9%.

Brought together, these measures would lead to reduction and sequestration of one-half to three-fourths of current global GHG emissions.

Source: GRAIN (2009b).

At last, scaling-up agroecological approaches is not only important for reducing and sequestering current GHG emissions of the agricultural and food system. The challenge is even more pertinent for avoiding further increases of emissions that would inevitably result from a further expansion of the industrial model. Emphasizing this challenge is particularly relevant in light of current trends in agricultural investments which further promote the industrial agricultural development model despite evidence of its social and ecological impasses.

Box VIII. 'Climate-Smart Agriculture' and agroecology: same thing?

The concept of 'Climate-Smart Agriculture' (CSA) has gained increasing attention in recent years in debates around sustainable agriculture. It is being promoted by various actors including the World Bank, the FAO, the CGIAR and its Climate Change Agriculture and Food Security program (CCAFS), the UK Department for International Development (DFID), the International Food Policy Research Institute (IFPRI) or the Rockfeller Foundation. FAO defines it as "*agriculture that sustainably increases productivity, resilience (adaptation), reduces/removes greenhouse gases (mitigation), and enhances the achievement of national food security and development goals*" (FAO, 2013a). The concept is broad, since it potentially encompasses very diverse options for achieving sustainability and calls for developing context-specific solutions: "*CSA is not a single specific agricultural technology or practice that can be universally applied. It is an approach that requires site-specific assessments to identify suitable agricultural production technologies and practices*" (FAO, 2013a). Given such description, CSA sounds analogous to agroecology, especially since it can virtually encompass all practices developed through agroecology. Conversely, can agroecological farming not be said 'climate-smart'?

There is more to the discourse than meets the eye. The CSA agenda is far from being limited to the promotion of context-specific practices and approaches for achieving sustainability. More importantly, actors investing significant resources to promote CSA mainly use the term for referring to practices that sequester carbon in soils and above all, they seek to link it to developing soil carbon markets. Especially for the World Bank, which has been by far the entity spending the most resources for supporting the agenda, CSA is first and foremost about mitigation and the financing link with carbon markets. As pointed out by the Institute for Agriculture and Trade Policy (IATP), "*the basic idea of a soil carbon offset is that if the carbon that can be sequestered in soils can be measured and valued, it can then be traded. Soil carbon offset credits are created based on the increase in carbon sequestered through a change in farming practices. Farmers would adapt their agricultural practices to maximize the amount of carbon stored, such as incorporating compost and manures into their fields or reducing tillage; technical experts would then calculate how much carbon they were storing per ha, and sell that credit on the carbon market*" (Stabinsky, 2012).

When considering implications of CSA's linkage to carbon markets, as well as a closer look at some of the agricultural practices promoted under that agenda, CSA is in reality far from being consistent (even incompatible) with the agroecological development paradigm, mainly for the following reasons:

- CSA goes hand in hand with sustainable intensification (Diamond Collins and Chandrasekaran, 2012) and as such, it is perfectly compatible with farming systems that are far from being holistically sustainable. For example, conventional (industrial) no-till systems are heavily promoted in the framework of CSA. As we have seen, such no-till systems often comes 'in a package' with monocultures, GMOs and extensive herbicide use (Gattinger et al., 2011);
- By putting a strong emphasis on carbon sequestration, CSA diverts attention from the real challenge of mitigating climate change: preventing or reducing emissions in the very first place. It is no accident if the bulk of the credits on both voluntary and compliance carbon markets result from emissions reduction or prevention, rather than sequestration: emission reduction or prevention have significantly more environmental integrity than sequestration, and therefore more monetary value. Sequestered carbon is one that has already been emitted. Besides, the sequestration is temporary (Stabinsky, 2012). On top of that, measuring carbon sequestration is at best difficult and uncertain (Stabinsky, 2012), at worst simply unreliable (Sivakumaran, 2012). As an example, the quantifications of carbon sequestration under no-till are highly doubtful and existing protocols are not adequate for capturing no-till projects for the carbon markets (Gattinger et al., 2011);
- CSA reduces pressure on Northern governments and agribusinesses for taking strong action to put into question the industrial model that is responsible of the huge majority of GHG emissions from the agrifood system. Indeed, realizing such an agenda would allow proponents of the industrial agro-food system to escape their own responsibilities by offsetting their emissions (Stabinsky, 2012). In that sense, the CSA agenda could be understood as a reformist attempt, by the corporate food regime, to ensure its reproduction despite evidence of its huge contribution to climate change.

Such an agenda is anything but agroecological;

- The World Bank and other proponents of CSA strongly encourage developing country governments to invest their (limited) resources to mitigate their agricultural emissions and to develop frameworks for monitoring, reporting and verifying those emission reductions. How? By convincing them that later this will provide them with revenues which will help adapting their agriculture to climate change (Stabinsky, 2012). By doing so, CSA discourages developing countries' public authorities to privilege the scaling-up of agroecological approaches, even though this strategy would be far more efficient in adapting agriculture to climate change and simultaneously addressing the mitigation challenge;
- If successful, the CSA agenda would aggravate land and other natural grabbing practices by increasing the value of arable land (Sivakumaran, 2012; Delvaux et al., 2013).

E. Increasing peasants' control over agricultural and food systems

Agroecology as a movement does not only aim a change of agricultural practices. As afore mentioned, agroecology also, and crucially, aims to enhance the autonomy and control of peasants over their production systems, thus contributing to Food Sovereignty, understood as the right of peoples to healthy and culturally appropriate food produced through ecologically sound and sustainable methods, and their right to define their own food and agriculture systems.

Evidence shows that agroecological transitions lead effectively to increasing farmers' autonomy and control over their production systems, first by reducing to an absolute minimum their dependence on off-farm inputs, state subsidies to agrochemicals, local retailers and moneylenders. Increased control of peasants also builds on the bottom-up and farmer-led methods privileged for designing and managing agroecological transition processes, as illustrated by the CaC methodology. Such approaches allow peasants to take responsibility and control over transition processes, enabling them to share, discuss and decide on their own what they want to do. Ownership of processes by farmers depends importantly on the inherent flexibility available to them for trying out the practices on their own farms, adapting and innovating for addressing their specific problems with available resources (Sen, 2010). But agroecological transitions can also strengthen peasants' control over food systems more broadly, through the development of AAFNs, and a growing influence on public policy.

As we have seen (Part 1 section D.3), AAFNs such as producer-consumer networks, collective producer shops, farmers' markets, box schemes or school provisioning schemes, are frequently supportive of and rooted in agroecological farming, and seek to decrease reliance on industrialized agri-food systems. The very practice of the alternative model they represent increases not only farmers', but also consumers' and often other civil society actors' control at various levels. For example, Lamine et al. (2012) have studied the modes of coordination and decision-making, and the roles of the different actors involved in the cases of the Ecovida Network in Southern Brazil and of AMAP (*Associations pour le Maintien d'une Agriculture Paysanne*) in France[39]. They have shown that in both cases,

[39] The Ecovida Network is composed of 23 regional 'nucleos', counting 300 farmers' groups (nearly 3,500 families), 170 municipalities, 145 local markets, 30 NGOs, 10 consumer organizations and 24 rural institutions. The network functions with defined principles and aims notably to generally strengthen agro-ecology. Quite similar to the US community-supported agriculture model, by 2012 AMAP comprised about 1,600 local consumer groups (roughly 270 000 consumers) entering into medium-term contracts (often 6 months) with one or more producers who undertake to supply them with a weekly box of fresh organic farm produce. The

producers and consumers, as well as few possible intermediaries, participate in shaping the system together. They share the decision-making power, gain more autonomy and are less dependent on distant actors. They have developed their own, participatory certification systems in which all stakeholders participate in and are jointly responsible for ensuring the quality of the final product and the integration of the production, distribution and consumption stages into the certification process. They enjoy a relative freedom from classical market quality criteria (aspect, size, etc.), while promoting other criteria (localness, freshness, seasonality). Both the Ecovida Network and AMAP include a strong focus on the civic and social dimensions of food production and distribution. This focus translates into requirements such as fair prices, sustainable livelihood for producers and financial affordability for consumers, and economic solidarity (Lamine et al., 2012). As a matter of fact, agroecology as a movement often has close links with the 'solidarity economy' that has developed particularly in Latin America in the 1990s in the context of the economic crisis (Nobrega, 2013), while also growing in other parts of the world, including in developed countries[40]. In Brazil, which has emerged as a leader of this new movement (Nobrega, 2013), organizations of the solidarity economy have been particularly supportive of agroecological farmers, improving the conditions under which they evolve in the market (Fernandez and Gotuzzo, 2012).

At last, agroecology as a movement develops a growing capacity to foster key public policy changes that are needed for scaling-up agroecological approaches at a higher stage, although challenges to be met in this regard are huge and meeting them require long term struggles. This can in turn increase peasants' control over agricultural and food systems. As we have seen (Part I section D.3), public policy changes are needed both to provide specific support to agroecological farming and food systems, and for addressing the obstacles resulting from a range of policies and practices that have historically disadvantaged peasant agricultures in many national, regional and international contexts. Addressing these obstacles on the long term is crucial to unleash the tremendous sustainability potential that peasant agricultures traditionally hold, and can strongly increase through an agroecological modernization combining traditional knowledge and know-how with modern agroecological science. These public policy changes include for example addressing food prices volatility, the huge imbalances of power relations along the value chains, the lack of adequate and secured access to land or seeds, the growing pressure on peasants to fully integrate global value chains, or export-oriented agri-business policies (see Part III).

One good illustration of such growing influence capacity at the local and national levels is provided by AAFNs such as the Ecovida Network. At the local level, the work of those networks has contributed to a change in the level of consumption spurred by students' acceptance of healthier and more appropriate food, a revitalization with new market prospects for family farming, and the fostering of production practices considered less harmful to the environment. At the national level, AAFNs have played a role in the establishment of the Food Acquisition Programme (PAA) in 2003 (Lamine et al., 2012). The Programme

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aim of this reciprocal commitment is to ensure the viability of the farms concerned, and to establish an equitable relationship between producers and consumers (Lamine et al., 2012).

[40] Solidarity economy is based on self-management with more egalitarian working relationships, a way of creating job opportunities for poor people. It relies on small production groups with no employers and employees. Everyone works together, the decisions are taken jointly and the profits are shared equally between members. The model of production also shrinks environmental footprint and promote responsible consumption, taking into account the whole supply chain under fair trade basis, and is financed by microcredit and small loans (Nobrega, 2013).

ensures the public purchase of family farming products to meet the needs of populations facing food and nutrition insecurity. Under the PAA, family farmers receive a fair price from the federal government based on a regional market value average. Then, products are donated to people facing food insecurity through schools, day care centers, shelters, hospitals, nursing homes, hostels and NGOs. Between 2003 and 2009, 764,000 family farms have participated in this program, benefiting to 7.5 million people per year. Beyond providing support to family farming in general, the PAA also incentivizes agroecological-based production, by offering a 30 per cent price increase above the market average to agroecological producers (McKay, 2012). Still in Brazil, alternative food networks have also strongly influenced the elaboration of organic law oriented towards the recognition of both agro-ecology and participatory certification, legally recognized as an alternative to third-party certification systems (Lamine et al., 2012).

Another example of developing the capacity to influence national public policy is the elaboration of a new Constitution in Ecuador in 2008, to which LVC has participated (Patel, 2009), and the adoption of the Food Sovereignty Framework Law that followed in 2009. The new Constitution is among the first ones in the world to recognize the right to food (De Schutter, 2010b), and under its article 281 explicitly recognizes Food Sovereignty defined as "*a strategic objective and an obligation of the State in order to ensure that persons, communities, peoples and nations achieve self-sufficiency with respect to healthy and culturally appropriate food on a permanent basis*" (CLAS, 2011). The same article then specifies the State's responsibilities to this end, the vast majority of which are very important from an agroecological perspective, notably with regard to: the conservation and recovery of agricultural biodiversity; the use, conservation and free exchange of seeds; redistributive land, water and other production resources policies; or the development of appropriate research and technological innovation to guarantee Food Sovereignty (CLAS, 2011). As to the Food Sovereignty Framework Law, it contains several remarkable provisions putting the emphasis on small-scale farmers, including the promotion of access to capital and investment for agricultural production for small-scale and medium enterprises. The law also calls for the largest possible participation in the development of Food Sovereignty laws (De Schutter, 2010b), which is key for democratizing decision-making processes and scaling-up agroecological approaches at a higher level (see Part III section E.2).

At the international level as well, civil society actors striving for scaling-up agroecological approaches have achieved some progress. This is notably the case within the Committee on World Food Security (CFS), intergovernmental body in FAO established as a result of the food crisis of the 1970s upon recommendation from the 1974 World Food Conference. At its 35th Session in October 2009, members of the CFS agreed on an ambitious reform with the aim of making the CFS the foremost inclusive international and intergovernmental platform dealing with food security and nutrition (CFS, 2009). The reform constitutes a significant democratization of decisions-making processes at global level in terms of food security initiatives. Through the Civil Society Mechanism (CSM), representatives of smallholder farmers, fisherfolks, pastoralists, landless people, urban poor, agricultural and food workers, women organizations, youth organizations, indigenous peoples, consumers and NGOs from all continents coordinate themselves to participate actively to various negotiations within the CFS, aiming to formulate important recommendations for eradicating hunger in various matters including for example responsible governance of tenure of land, agricultural investments or food prices volatility[41]. Through the CSM, CSOs representatives

[41] For more information on CFS and CSM, consult the CSM website: http://www.csm4cfs.org .

can directly negotiate with governments and other members of the CFS, such as private sector associations, UN agencies, international and regional organizations and others, with equal rights to intervene than governments' representatives[42]. Within the CFS, CSOs have succeeded in gaining recognition of agroecological approaches or practices. This has been made possible after hard negotiations, since a few influential governments express systematically their strong opposition to the concept.

Agroecological approaches are notably referred to within the Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security (VGGT), the first global framework setting out principles and internationally accepted standards for responsible governance of land, fisheries and forests tenure, officially adopted in May 2012. These guidelines consist in a set of recommendations for all stakeholders but more especially States, to improve tenure governance of land, fisheries and forests, with the overarching goal of achieving food security for all (with an emphasis on vulnerable and marginalized people) and to support the progressive realization of the Right to Adequate Food in the context of national food security. In terms of regulated spatial planning, the VGGT notably state (paragraph 20.5) that "*Spatial planning should take duly into account the need to promote diversified sustainable management of land, fisheries and forests, including agro-ecological approaches and sustainable intensification, and to meet the challenges of climate change and food security*" (FAO, 2012). Although the language can be considered relatively weak, this was the first time that agroecology was ever officially recognized and promoted in an international body of United Nations.

Agroecology has also been recognized in the framework of other CFS processes, including the Global Strategic Framework for Food Security and Nutrition (GSF), a key living document designed to improve coordination and guide synchronized action by a wide range of stakeholders, mainly built on decisions taken during CFS Plenary sessions on the various issues. The first version of the GSF, endorsed in October 2012, acknowledges that "*agroecological practices have proved to be important in improving agricultural sustainability as well as the incomes of food producers and their resilience in the face of climate change*", and stresses "*the importance of local knowledge in promoting food security, particularly as the latter is influenced by the capacity to manage natural assets and biodiversity and to adapt to the localized impact of climate change*" (CFS, 2012). The GSF includes others useful provisions relevant for scaling-up agroecological approaches, calling on in particular CFS Member States and other stakeholders, including international and regional organizations, to elaborate programs, policies and laws in line with an ecosystem approach at local and national level, in order to increase agricultural productivity and production in a socially, economically and environmentally sustainable manner (as outlined in paragraphs 53 l, m and p of the first version of the GSF) (Boincean et al., 2013).

Although CFS decisions are soft law, they could be very useful for achieving progresses on the ground at local and national level. Governments and other stakeholders have the responsibility to implement them. As agreed by the CFS reform in October 2009, the CFS will "*promote accountability and share best practices at all levels*". In this regard, "*the CFS should help countries and regions, as appropriate, address the questions of whether objectives are being achieved and how food insecurity and malnutrition can be reduced more quickly and*

[42] Except when consensus is reached among Member-States as the final decisions lie in their responsibility. As long as consensus is not reached among governments, CSOs can take the floor.

effectively. This will entail developing an innovative mechanism, including the definition of common indicators, to monitor progress towards these agreed upon objectives and actions taking into account lessons learned from previous CFS and other monitoring attempts" (CFS, 2009). The elaboration of this innovative mechanism is the subject of a specific process, to which CSOs are actively participating through the CSM.

F. Empowering women

In theory, agroecology can benefit women most, since it is they who often work in the most degraded farming areas, have lower incomes for buying expensive inputs with lower access to credits, thus encountering more difficulties in accessing external inputs and subsidies (De Schutter, 2010a; Curtis, 2012). Considering the crucial role played by women as transmitters of traditional knowledge to the new generations, key source of knowledge about on-farm seed conservation and biodiversity management, as well as the strong reliance of agroecology on local resources and knowledge and its natural vocation to preserve biodiversity, one could expect agroecological transition processes to lead automatically to women's empowerment by making them the innovation leaders for achieving sustainability (Tripathi at al., 2012). In fact, one could expect agroecology to make a spontaneous difference with regard to gender inequalities, which as we have seen are prevalent in both traditional and modern agricultural value chains (Tripathi et al., 2012).

However, experience shows that this does not automatically happen. In Brazil for example, in the early 2000s several women questioned the National Network of Agroecology (ANA) for not including them as a constituent part in the agroecological construction process. At the end of the first national agroecology meeting in 2001, concerned about securing a space for increasing their visibility (starting by getting recognized as participants to the meeting), they drafted The Women's Letter which criticized the invisibility of women within agroecology: "*Agroecology, while taking into consideration all the production system's elements, should contribute in acknowledging and giving visibility to women's work, which is essential for the sustainability of the agricultural system, as well as the reproduction of the family system*". After the meeting, a proposal was made to establish a specific working group to address such gaps, today named Women's Working Group (Lopes and Jomalinis, 2011). Adding to that exemple, relatively few studies within the agroecological literature specifically focus on women's empowerment, and major overall reports and articles published in this field tend to at best scarcely mention that dimension. This might be interpreted as a very symptom of an obvious lack of attention on gender issues within the agroecological community.

Yet, existing evidence also reveals that agroecological transition processes have an enormous, inherent potential to empower women, demonstrating that when they are properly conceived and managed, they lead effectively to women's empowerment. The experience of the Women and Agroecology Project initiated by ActionAid in Brazil in 2007 illustrates aptly that potential. The project was born following the consideration of the leading role of women in agroecology, and in maintaining and disseminating agroecological knowledge, in the framework of another agroecological project ActionAid launched in 2005 with local partners, entitled "Agricultural Knowledge Dissemination: Exchanging experiences and strengthening the agroecological movement" (which did not initially include a specific focus on gender empowerment). Developed with the participation of ANA, the Women and Agroecology Project effectively led to empowering women. An analysis of the methodology used for achieving that objective allows understanding how concretely empowering women through agroecology can happen. In synthesis, the first challenge consisted in women becoming better aware of the challenges and difficulties they were facing, including with regard to men's dominance, and realizing what they were capable of. This awareness built in women who shared and systemized experiences with agroecology. This dynamic mitigated their isolation, led them to progressively value themselves, thus increasing their self-esteem, and at the same time encouraging their self-perception as change-agents. Through the systematization of sharing of experiences, women challenged each other to follow new paths, break barriers, and were encouraged to leave many of their fears behind. The Women and Agroecology Project thus revealed that systematizing women's experiences is an important tool for empowerment, as well as an efficient strategy for deconstructing and denaturalizing men's dominance over women (Lopes and Jomalinis, 2011).

This experience shows that when agroecological transition processes are consistent with what they are supposed to be, and therefore give women the right place they deserve, women are effectively empowered. Again, from a truly agroecological perspective, women must be put at the front seat of transition processes. The same experience also emphasizes how important collective action is. As in the case of the Women and Agroecology Project, collective action can take place through women-only groups. Such groups provide 'enabling spaces' where women, especially marginalized ones, can gain self-esteem, confidence and skills. They can be very efficient in allowing them to identify their needs, understand their rights and begin to formulate their demands. Depending on the context, women's involvement in mixed groups can also be empowering, although work is required to raise equity within the groups (Tripathi et al., 2012)[43].

But women's empowerment does not only happen as just one of the positive consequences of a coherent agroecological transition process, as if women were essentially reduced to the role of 'passive beneficiaries' of such processes. Agroecology as a movement is also an opportunity for women to actively empower themselves by playing a key role as advocates for change, just as any other vulnerable and marginalized group can. As an example, in India, thousands of women have been advocating for the inclusion of millets in the definition of food grains in the National Food Security Bill and the decentralized public distribution system, in the framework of a campaign developed by the Deccan Development Society (DDS) and the Millet Network of India. They have advocated for these changes on the basis of their experience and knowledge, having demonstrated over many years the potential of millets to contribute to food security, nutrition and productivity in drought-prone and poor soil areas (Tripathi et al., 2012).

As another example, the National Association of Rural and Indigenous Women (ANAMURI), an organisation that brings together some 10,000 peasant and indigenous women from Chile and which has been training thousands of people through LVC, announced in January 2014 the launch of the Agroecology Institute for Rural Women (IALA) in the town of Auquinco, the first agroecology institute in Latin America to only target women. The political core of the project is 'food production to resolve the problem of hunger', with a focus on defending peasant family agriculture. As explained by Alicia Muñoz, director of ANAMURI, "*our dream is having an institute for the conservation of the kind of agriculture that women*

[43] As emphasized during an Oxfam International workshop on agroecology held in January 2014 in Phnom Penh, Cambodia, women's empowerment can generate more conflicting relationships with men (Oxfam International, 2014). As illustrated in many contexts, the effective defense of human rights is far from being an easy path.

know how to do, that is trustworthy from the point of view of health and nutrients". For the anthropologist Juan Carlos Skewes, director of the School of Anthropology at the Alberta Hurtado University, while women in Chilean agriculture have been "*relegated to the domestic sphere, to the processing of food, keeping house and raising the small livestock,* (…) *their contribution* (…) *to agricultural work and to the alternative development project that is the vegetable garden, has been forgotten.* (…) *Every vegetable patch, every Campesino family farming practice, involves biodiversity, conservation of genetic material, the possibility of reproducing seeds and making better use of local resources.* (…) *There is also the question of better coordination of resources, self-sufficiency and strengthening local economies.* (…) *So, summing up, there are autonomous projects, a capacity of self-management, autonomous sustainable production, and management of non-genetically-modified material, and there is a chance to counteract, resist or challenge industrial processes in agribusiness, as well as the food processing industry*" (Jarroud, 2014).

PART III: CHALLENGES FOR SCALING-UP AGROECOLOGICAL APPROACHES

Contrary to what its detractors often claim, agroecology is scalable. As a matter of fact, it has already been spread and applied by many farming communities worldwide, reaching millions of farmers and millions of ha in Africa, Asia and the Americas (Altieri et al., 2012b), as documented by several major global assessments (see Part II section A.1). Yet, it could be far more diffused, and given the great potential it offers for meeting sustainability challenges (see Part II), it should. Disseminating agroecological farming means first promoting its adoption by more farmers through farmer-to-farmer networks ('horizontal scaling-up', also referred to as 'scaling-out'). But ensuring its adoption to a significantly higher stage will also and crucially require institutionalizing supportive policies ('vertical scaling-up') (De Schutter, 2010a; Rosset and Martinez-Torrez, 2013), breaking with cycles of policies which all too often have disadvantaged peasant agricultures and agroecology, such as mainstream trade and agricultural policies including the structural adjustments programs of the International Monetary Fund (IMF) and the World Bank, and the Agreement on Agriculture of the World Trade Organization (WTO) (De Schutter and Vanloqueren, 2011), and with the current trends in agricultural reinvestments which tends to consolidate industrial agriculture through the reformist agenda of sustainable intensification. Experience shows that with adequate support and investment from the State, agroecology can be efficiently scaled-up at a higher level[44]. This requires political will and, ultimately, a real democratization of agricultural and food governance.

A. Unlocking ideological barriers to political recognition

Generally speaking, there is a need to enhance the recognition among key decision makers of agroecology and its benefits in achieving sustainable agricultural and food systems (Altieri et al., 2012b). As long as they are not convinced of these benefits, it is unlikely that they will create the enabling institutional environment that is needed for prioritizing its scaling-up in agricultural development. But such political recognition is impeded by persisting misconceptions about agroecology and peasant agricultures.

For example, when discussing and negotiating with governments' representatives within the CFS, one easily notes that the majority still perceive agroecology as one particular set of predetermined practices only adaptable to very few, limited contexts[45]. Another example is the persisting belief that monocultures and industrially managed systems, or large farms are at all levels more productive than diversified small-size agricultural systems (De Schutter and Vanloqueren, 2011; Lin, 2011). Furthermore, agroecology is often mischaracterized as a 'return to the past' or a model incompatible with a (gradual)

[44] Experiences in Brazil and Cuba provide enlightening examples of how supportive public policies and investments are determinant for scaling-up at a higher level agroecology. See for example McKay (2012). Also see Chan and Roach (2012) on the Cuban experience. This very well documented publication underlines that "*while Cuba's agricultural policies are grounded in a unique social, political and organizational history, that experience offers a number of principles perfectly adaptable to countries facing the adverse consequences of neoliberal globalization*" (Chan and Roach, 2012).

[45] Based on the author's own experience in the CSM and CFS.

mechanization of agriculture (De Schutter and Vanloqueren, 2011), as if the only choice we had for developing agriculture was between ‘modern’ (industrialized) farming and traditional (archaic) peasant agricultures and that optimizing sustainability performances of these traditional forms of agriculture through agroecology could not be regarded as modernizing them. These cultural perceptions are sometimes so prevalent that even for many smallholders themselves, the use of industrial technologies such as synthetic fertilizers, pesticides, transgenic and hybrid plant varieties, or mono-cropping may be a lever of social integration if farmers can openly demonstrate their capacity to afford them, as illustrated in the Indian context in which traditional farming systems are often stigmatized as an anachronism (Bargout, 2012). Furthermore, performance criteria used to monitor agricultural projects are most often still narrowly limited to classical agronomical criteria and measures such as yield and productivity per unit of labor, instead of complementing them by comprehensive indicators better able to measure sustainability, including for example the productivity of land or water, the impacts of agricultural projects or technologies on incomes, resource efficiency, hunger and malnutrition, empowerment of women and other beneficiaries, ecosystem health, public health and nutritional adequacy (De Schutter and Vanloqueren, 2011). Such narrow a priori forms of perception constitute a major obstacle for building markets and economies that take into account social and environment costs.

Reversing these misconceptions are a not sufficient but necessary condition for enhancing the political will to prioritize the scaling-up of agroecological approaches in agricultural development. This will require first and foremost efforts in awareness raising and dissemination among relevant key decision makers, extension agents and farmers organizations. Among other objectives, those efforts should seek to stress the economic viability of agroecological farming. Indeed, in order to engage in an agroecological transition process, farmers need to be sure this represents an economically viable option. But many of them lack enough information about profitability and tend to fear, on the contrary, economic losses (Altieri et al., 2012b).

B. Supporting farmer-to-farmer networks

Given the bottom-up approaches that agroecology implies, using and building upon the resources already available (local people, their knowledge and their domestic natural resources), its scaling-up requires inclusive, community-oriented methods for networking and sharing techniques. Localized farmer-to-farmer networks are crucial in the dissemination of information between farmers in similar agroecological zones (Altieri et al., 2012b; McKay, 2012). Successful scaling-up relies heavily on enhancing human capital and empowering communities through training and participatory methods that seriously take into account the peasants’ needs, aspirations and circumstances (Altieri et al., 2012b). Highly organized peasant organizations are extremely important in this regard (McKay, 2012). Farmer-to-farmer networks and organized social rural movements such as LVC, compromising around 150 local and national organizations in about 70 countries, the one million families MST in Brazil, or ANAP in Cuba must therefore be actively encouraged and supported (Altieri et al., 2012b; McKay, 2012). Farmers’ organizations and networks have accumulated experience on the dissemination of agroecological practices in the last decade, with proven results. They are functioning as learning organizations and must be supported in this role (De Schutter, 2010a). In Cuba, in just ten years time, ANAP has been able to build a grassroots movement for agroecology leading to spread to more than one third of all peasant families the transformation of productions systems into agroecological and diversified farming systems (Rosset and Martinez-Torres, 2013).

Training farmers and disseminating best approaches for transitioning agricultural systems towards agroecological farming happens through a great variety of participatory methods such as field days, on-farm demonstrations, trainings of trainers or farmers' cross-visits (Altieri et al., 2012b). FFS have been very efficient in empowering peasants by helping them to organize themselves better, and stimulating continuous learning. The successful dissemination of the push-pull strategy (PPS) in East Africa by the International Centre for Insect Physiology and Ecology (ICIPE) provides a good example[46]. It is largely due to the demonstration of fields managed by model farmers, receiving visits by other farmers during field days, as well as to partnerships with national research systems in Tanzania, Uganda, Ethiopia and other countries (De Schutter, 2010a).

But peasants' organizations and farmer-to-farmer networks are not only important for disseminating agroecological farming. They also enhance farmers' skills to advocate for their rights and Food Sovereignty. LVC has created political leadership training academies in many countries and regions for preparing peasant leaders to pressure public authorities at the local, provincial, national and international level to obtain more alternative, more agroecology-, climate-, farmer- and consumer-friendly public policies, including by organizing massive mobilizations when confronted with less friendly policy makers. As we have seen (Part I section D.3), LVC has also been struggling for scaling-up agroecology by denouncing agrofuels, GMOs, carbon markets, REDD and REDD+ as 'false solutions' to climate change, and by stressing publicly the risk of cooptation of agroecology through the paradigm of sustainable intensification.

Despite successes achieved so far, the lack of appropriate social networks for allowing collective experimentation and exchange of information by peasants over agroecology remains an important constraint that limits its dissemination and adoption by farmers at a higher stage (Altieri et al., 2012b). The establishing and functioning of such networks needs adequate support. Moreover, increased collaboration and coordination is needed among the various actors (farmers' organizations, public authorities, NGOs, academic institutions and research centers) for boosting scaling-up efforts (Altieri et al., 2012b).

C. Providing an enabling public policy environment

Unlocking ideological barriers to its political recognition and supporting localized farmer-to-farmer networks will not be sufficient for scaling-up agroecological approaches at a higher level. On the longer term, it will also be crucial that public authorities ensure a favourable environment to promote it. Since agroecological systems are deeply rooted in the ecological rationale of traditional small-scale agriculture, such an environment will primarily consist in implementing supportive policies to peasants in general (progressively dismantling the policies that have historically hindered their development) and adopting specific incentives to modernize agroecologically both the most traditional peasant agricultures and those partially industrialized. However, specific action will also be needed for addressing as much as possible the non-sustainability of large-scale industrial farms. In synthesis, action will be required at the following four levels:

[46] This strategy to control parasitic weeds and insects that damage crops consists in 'pushing' away pests from corn by inter-planting corn with insect-repellent crops like *Desmodium*, while 'pulling' them towards plots of Napier grass, a plant that excretes a sticky gum which both attracts and traps pests (De Schutter, 2010a).

- (1) Designing agricultural and trade policies in support of peasants and agroecological approaches;
- (2) securing peasant's access to natural and other productive resources;
- (3) supplying public goods;
- (4) prioritizing agroecology in agricultural research and extension services;

1. Designing agricultural and trade policies in support of peasants and agroecological approaches

Most often, the dynamic of today's agricultural and markets policies, both at the domestic and international levels, seriously undermines peasant agricultures and are a great constraint for scaling-up agroecology (Altieri et al., 2012b). Peasants are fully part of different markets but their position in these markets is weak (HLPE, 2013). Some of the main unfavourable conditions include: low commodity prices and food prices volatility, further reducing net incomes in a context of high costs of inputs and/or increased food prices (peasants suffering from such increases as consumers while being badly affected as producers by low commodity prices) (De Schutter, 2010a; Altieri et al., 2012b); lack of power and negotiation capacity of most small-scale farmers within the agrifood value chains (HLPE, 2013); cheap imports reducing domestic peasants' outlets on local markets (De Schutter, 2010a; Altieri et al., 2012b); non internalization of environmental and social costs in agricultural and food prices (De Schutter and Vanloqueren, 2011; Wibbelmann, 2011; Ishii-Eiteman, 2013)[47]; downsizing of public services and disinvestment in agricultural systems (De Schutter and Vanloqueren, 2011); increased fierce international competition of peasant agricultures characterized by huge competitiveness gaps (Parmentier, 2009).

Such unfavourable conditions result from various adverse policy and economic factors such as: the liberalization of agricultural trade, including through the structural adjustment programs of the IMF and World Bank in the 1980s and 1990s and the Agreement on Agriculture of the WTO (Altieri et al., 2012b; De Schutter and Vanloqueren, 2011) which have among other things significantly contributed to import surges in developing countries (Parmentier, 2007; Parmentier, 2009); the high concentration in agrifood value chains which tend to be increasingly dominated by a few large corporations controlling the distribution channels between farmers and consumers, and which among other things reduces to the smallest proportion the gains received by peasants of the final prices of food products (Murphy, 2006; De Schutter, 2010c; ETC Group, 2011; Altieri et al., 2012; McKay, 2012; ETC Group, 2013); the internationalization of value chains and the rise of supermarket and buyer-driven chains whose impacts notably include increasing difficulties for small-scale producers to meet volumes and standards requirements of global buyers and retailers (Biénabe et al., 2007; De Schutter and Vanloqueren, 2011); agroexports and export dumping policies (Altieri et al., 2012b) primarily based on a lack of adequate supply management policies in export countries as illustrated by the US Farm Bill (Parmentier, 2006b) and the European Common Agricultural Policy (CAP) (Parmentier, 2010); or agricultural subsidies

[47] As stated by De Schutter and Vanloqueren (2011), "*the absence of full inclusion of externalities in agrifood price systems has enabled the development of industrial farming despite important social and environmental costs, and has hindered a comprehensive valuation of the benefits of agroecology. The success of large plantations is, in part, attributable to the fact that the price of food does not reflect the real costs to society resulting from their operations, particularly from the impacts of their modes of production on the soil and climate and on public health*" (De Schutter and Vanloqueren, 2011).

policies advantaging monocropping and corollary discouraging biodiverse farming systems (Lin, 2011).

On the contrary, public authorities should use all available policy tools to make markets better work for peasants and agroecological approaches. The challenge is both to regulate differently and better the existing markets, as well as developing new ones (HLPE, 2013). Consumers could contribute to this shift by pressuring governments and economic actors to take action.

2. Securing peasants' access to natural and other productive resources

Ensuring the rights of farmers to access, breed, produce, conserve, purchase, exchange and use the seeds they need is of utmost importance from an agroecological perspective. When peasants' access to and control over seeds are threatened, their flexibility to design sustainable farming systems that are adapted to their particular needs and to the specificities of each local context, is undermined. It is therefore not surprising that for LVC, access and control over seeds is the very basis of Food Sovereignty (LVC, 2013b).

Peasants' adequate access to and control over land, water and other natural resources is also essential, firstly because peasants need to be able to mobilize resources to manage agroecological strategies and practices. In that sense, scaling-up agroecological approaches at a higher stage implies ensuring a responsible governance of tenure of land, water and other natural resources. Among other things, such responsible governance includes tackling land concentration and ensuring a fair share of land, water and other natural resources, for allowing every household to mobilize these resources on a relatively small-scale that is typical of peasant agricultures. Improved security of tenure is also important for encouraging farmers to invest in the long-term sustainability of the environment (e.g. through the planting of trees, the more responsible use of soils and other practices with long-term payoffs), since they will be more motivated to take care of the land and other natural resources their livelihoods depend on if they can be ensured they won't lose them to industrial or urban developers of large scale agricultural business (De Schutter and Vanloqueren, 2011; Altieri et al., 2012b). At last, as we have seen (Part I section D.2), responsible governance of land, water and other natural resources allows (re)conciliating in a sustainable way various actors' (potentially conflicting) expectations as to the use of these resources, which is important for successful agroecological transitions.

Yet, a large-fraction of peasants and many urban poor are persistently suffering from a lack of adequate and secure access and tenure over land and other natural resources, which is one of the main causes of hunger and poverty in the world (De Schutter and Vanloqueren, 2011; Monsalve Suárez and Seufert, 2012). Furthermore, this trend has recently increased with the phenomenal acceleration of large-scale land acquisitions following the agriculture and food prices spike in 2008 (De Schutter and Vanloqueren, 2011; Cotula, 2012; ILC, 2012). Land, water and other natural resources are being grabbed to serve various commercial interests and purposes, such as the massive production of biofuels[48]. Access to seeds and in particular traditional varieties is increasingly threatened by the extension of 'modern' varieties, mainly hybrids, and the expansion of IP Rights regimes in agriculture, which tend to create a market for seeds dominated by few large companies and do not provide any incentives for *in situ* conservation by

[48] See for example Dahlbeck (2012).

farmers since they do not reward their role in conserving and improving landraces for breeding (Swiderska et al., 2011).

This must change. Peasants' rights to seeds, as well as to land, water and other natural resources should be respected and protected. Moreover, although agroecological farming reduces the need for credits (since its adoption typically leads to a higher economic viability of the farm –see Part II section A.3), peasants must also benefit from an improved access to them when needed for investing in their own development.

3. Supplying public goods

Scaling-up agroecological approaches requires the supply of public goods such as rural infrastructure (roads, electricity, information – including up-to-date information on commodity prices – and communication technologies, irrigation systems) and therefore access to local and regional markets, access to credits (see previous section) and insurance against weather-related risks, agricultural research and extension services (see section C.4 below), storage and handling facilities to reduce postharvest losses in rural areas, education and sanitation (De Schutter, 2010a; De Schutter and Vanloqueren, 2011; Altieri et al., 2012b; McKay, 2012; HLPE, 2013).

Reaffecting part of public spending on private goods (such as fertilizers or pesticides that farmers can only afford as long as they are subsidized) to public goods can bring significant sustainability benefits. This can be illustrated through a research based on the study of 15 Latin American countries over the period 1985-2001, which has shown that within a fixed national budget, a reallocation of 10 % of spending on private goods to supplying public goods increases per capita agricultural income by 5 %, while a 10 % increase in public spending on agriculture, keeping the spending composition constant, increases per capita agricultural income by only 2 % (De Schutter, 2010a). A World Bank Policy Research Working Paper concluded that "*even without changing overall expenditures, governments can improve the economic performance of their agricultural sectors by devoting a greater share of those expenditures to social services and public goods instead of non-social subsidies*" (Allcott et al., 2006).

The primary responsibility of States in ensuring the supply of public goods is particularly obvious given the general lack of natural incentives for private companies to invest in these domains, and transaction costs that are too high for local communities to create these goods themselves (De Schutter and Vanloqueren, 2011).

4. Prioritizing agroecology in agricultural research and extension services

As previously underlined, reinvestment efforts in agriculture since 2008 have essentially lead to the further expansion of a 'somewhat-less-polluting' industrial agriculture, while agroecological approaches have been poorly supported (see introduction and Part I section E). This trend notably applies to agricultural research and extension services. Public agricultural research and extension agents are increasingly being influenced by private interests to promote conventional approaches rather than agroecology (Altieri et al., 2012b). ActionAid's fieldwork in Guanzi region in China, for example, found that extension services are poorly encouraging sustainable agriculture and instead are vigorously promoting hybrid seeds, pesticides and fertilisers (Curtis, 2012). The recognition of the growing challenges that agriculture will have to face as a consequence of climate change has brought about a major effort to adapt agriculture through technical means, primarily the research and development of drought-resistant biotech crops (Lin, 2011). Clearly, much of today's publically funded research does not meet the needs or priorities of peasants in low- and middle-income countries. In West Africa, the agricultural research system, which relies heavily on external funding, has developed genetically improved varieties of sorghum, millet or groundnuts which tend to be hybrids and therefore cannot be resown year after year, while often also requiring additions of chemical fertilisers and pesticides, thus increasing farmers' dependence on purchasing and their risk of debt (Pimbert, 2012).

The "Democratising the Governance of Food Systems. Citizens Rethinking Food and Agricultural Research for the Public Good" international action-research initiative provides a prime example of the yawning gap between peasants' priorities and the mainstream further expansion of the agro-industrial model in agricultural research and extension services. Started in 2007 on the initiative of IIED and local partners, the project uses participatory methods and institutional innovations to create inclusive, democratic and safe spaces for citizens to get involved in research policymaking and agenda setting in four regions, with one country acting as host for each region: West Africa (Mali), South Asia (India), West Asia (Iran) and the Andean region in Latin America (Bolivia). In Mali, as a first step in 2009, African partners, *Biodiversité: Échanges et Diffusion d'Expériences* (BEDE) and IIED organised and facilitated an independent farmer-led assessment of the work of Malian national agricultural research programmes on plant breeding and seed management, and of an international centre for agricultural research member of CGIAR (ICRISAT) (Pimbert et al., 2010; Pimbert, 2012). As shown in Box IX hereafter, recommendations expressed by farmers –both men and women– in agricultural research and extension services contrast very much with the mainstream practices of influential actors promoting the sustainable intensification of agriculture such as USAID, FAO, CGIAR, the Gates Foundations and others (see Part I section E).

Box IX. Comparison between recommendations by West African small farmers' citizen juries and the practices of organizations promoting sustainable intensification

Citizen juries composed of West African small farmers and processors	**Organizations promoting sustainable intensification and allied concepts**
Involve farmers in every stage of creating and selecting crop varieties.	Strategic direction for creating crop varieties set by scientists, industry and funders.
Involve producers, users and consumers (both women and men) in controlling, designing, conducting and monitoring research activities.	Mainly involve scientists, experts and funders in controlling, designing and monitoring research.
Focus on improving the productivity of local varieties, e.g. through growing practices, land use and soil fertility management.	Focus on developing new crop varieties.
Promote the use, exchange, and storage of local seeds. Avoid hybrid seeds and genetically modified organisms.	Promote improved varieties, hybrid seeds and genetically modified organisms.
Use natural mineral resources and compost; integrated pest management; and mixed cropping.	Some agencies are promoting this approach (FAO, some CGIAR projects). Others are encouraging use of artificial fertilisers and pesticides (e.g. Feed the Future, New Vision for Agriculture, some conservation agriculture projects).
Develop mechanisms to help protect the local market and local produce from unfair competition from imported products.	Increase involvement of small farmers in global supply chains and markets (New Vision for Agriculture; USAID; Gates Foundation).
Build on and disseminate farmers' agro-ecological knowledge and innovations.	Promote and disseminate agency or funder's preferred agricultural system or technology.

	(FAO; some CGIAR projects; New Vision for Agriculture; USAID). Some projects do use participatory approaches to build on farmer knowledge.

Source: Reproduced from Diamond Collins and Chandrasekaran (2012); based on Pimbert et al. (2010) and Diamond Collins and Chandrasekaran (2012).

Current trends to shape mainstream agricultural research and extension services in favor of industrial farming result from a movement consisting in their ‘privatization’, understood as their reconfiguration or redeployment in the service of actors who benefit the most from the agro-industrial model, such as the pesticides and transgenic industries. This movement builds on the disproportionate lobby power enjoyed by those actors for influencing key policy makers in comparison to the much weaker influencing capacity of supporters of agroecology (Vanloqueren and Baret, 2009). As illustrated by a recent analysis by the Alliance for Democratising Agricultural Research in South Asia (ADARSA) and IIED in the context of South Asia, it proceeds from different levers including the rise of the private sector Research and Development (R&D), the general decline in public research funds for agriculture, the pressure for public institutions to generate income, the advent of the IP system, or the commodification of genetic resources. Foreign as well as domestic corporate players in the private sector have become important actors in R&D both through their own research, and by penetrating the public agricultural R&D sector in various ways (Bhutani, 2013). The ‘privatization’ of agricultural research and extension services can take the form of Private Public Partnerships (PPPs) (Bhutani, 2013), whose existing examples in the realm of biological and agricultural sciences include the alliance between Novartis and the University of California to support basic agricultural genomic research (Vanloqueren and Baret, 2009) or a partnership between Monsanto Inc. and the Indian government for developing hybrid basmati rice (Bhutani, 2013).

Corporate private actors benefitting from industrial agriculture focus on a limited range of (standardized) technologies that are profitable to them; clearly, agroecological approaches are not included since they are knowledge-intensive and need to be adapted to local conditions (HLPE, 2013). Those actors cannot have any objective interest in contributing to scale-up agricultural approaches whose further expansion would necessarily reduce significantly their economic profitability. It is hard indeed to imagine how companies selling synthetic pesticides or transgenic crops, for example, could find any economic benefit in a substantial reduction of their use worldwide. This explains why genetic engineering has benefitted much more from PPPs in the agricultural sector than agroecology, since PPPs have been launched on technological trajectories in which private firms had an interest (Vanloqueren and Baret, 2009).

Current tendencies towards the ‘privatization’ of agricultural research and extension services must be reversed. As the guardian of the general public interest, it is time for public authorities to reinvest and prioritize research and extension services in agroecological approaches, first and foremost because of the considerable and largely untapped potential they offer (De Schutter, 2010a).

D. Taking specific actions for empowering women

Rural women face numerous obstacles and gender inequities affecting their daily life, including their lack of recognition as productive farmers, unequal access to land, water, credit and other productive resources, poor access to training, extension services, or benefits from new agricultural research and technologies all of which underestimate the range of farming tasks for which they are responsible and are often incompatible with their specific needs (Tripathi et al., 2012). As noted by the Rapporteur Special on the right to food, Olivier De Schutter, gender issues are incorporated in less than 10 % of development assistance in agriculture, and women farmers receive only 5 % of extension services worldwide (De Schutter, 2010a).

As previously underlined, from an agroecological perspective, given their crucial role in seeds and biodiversity management, and as custodians of traditional knowledge, women's contribution is essential for successfully preserving natural resources and adapting agriculture to climate change, and they should be recognized as the innovation leaders for achieving sustainability (see part II sections B, C.2 and F). We have also seen that agroecology has a great potential for empowering women, but that realizing this potential is not automatic (see Part II section D). This will require targeted actions specifically designed for tackling all the various gender abuses they are facing.

E. Improving agricultural and food governance

Beyond all the measures described above, scaling-up agroecology also implies addressing the crucial challenge of agriculture and food governance. The challenge is essentially two-fold: (1) improving policy coherence and, above all, (2) democratizing agricultural decision-making processes.

1. Improving policy coherence

In its report entitled *Investing in smallholder agriculture for food security*, prepared to inform the adoption of recommendations by the CFS on investing in smallholder agriculture at its 40th Session in October 2013, the HLPE stressed the need to increase coherence among policies and ministries in charge of various matters impacting peasants. Increased coherence means essentially that the different policies concerned should support rather than hinder each other. For example, "*investments in appropriate research and extension will not necessarily lead to improvements unless investments are also made in accessing and creating new appropriate markets. Similarly, investments in infrastructure work better if they support the models of production and markets that are appropriate to smallholders and, further, these investments would not reach their aim unless investments are also made in securing tenure rights*" (HLPE, 2013). Furthermore, increased policy coherence is needed for taking better into account and support the multifunctionality of peasant agricultures, since "*traditional ministries of agriculture are typically insufficient in fulfilling this function. Experience shows that the efficiency of specific sectoral or ministerial policies is mutually enhanced by their coordination. This often calls for specific national level governance and coordination mechanisms between different ministries, public administration and concerned stakeholders*" (HLPE, 2013).

In order to enhance policy coherence in supportive policies for smallholders, the HLPE recommended that governments develop national Smallholder Investment Strategies: "*Governments should design and implement medium- and long-term strategies, with the accompanying set of policies and budgets, to increase the capacity of the smallholder sector to fulfil its multifunctional roles in national development. These roles include contributing to growth, maintaining employment, reducing poverty, enhancing the sustainable management of natural resources and achieving food security. These National Smallholder Investment Strategies should be solidly grounded in participatory processes involving first and foremost the smallholder organizations and all concerned stakeholders*" (HLPE, 2013). In October 2013, CFS Member States and other participants globally followed the recommendation[49]. The challenge is now to implement it.

Implementing it would mean putting relevant policies and regulations in line with creating an environment that allows smallholders to fulfill their multifunctional roles and develop themselves as sustainably as possible. This would imply reviewing and revising accordingly a range of various policies which negatively impact them directly or indirectly. Those policies include for example biofuels mandates and subsidies, national and regional agricultural policies, as well as bilateral and regional trade and investments agreements. Greater consistency with the requirements of smallholders' strengthening and sustainable development is an integral part of the CFS vision and roles to become "*the foremost inclusive international and intergovernmental platform for a broad range of committed stakeholders to work together in a coordinated manner and in support of country-led processes towards the elimination of hunger and ensuring food security and nutrition for all human beings*", as redefined in its 35th session of October 2009 (CFS, 2009).

2. Democratizing decision-making processes

In the long term, all the above mentioned recommendations are essential for successfully scaling-up agroecological approaches at a higher stage. There is yet another even more important challenge: democratizing relevant decision making processes in all areas that contribute to shape the dynamics of agricultural and food systems. And for good reason: ultimately, the majority of obstacles to the diffusion of agroecological approaches are a result of a democratic deficit in relevant decisions making bodies. Throughout the world, to various degrees depending on the scale and region considered, decisions that shape agricultural and food systems are indeed disproportionately influenced by vested interests of a minority of actors to the detriment of the general public interest, of sustainable development and of the fundamental rights of a majority of populations. These actors are the proponents as well as the beneficiaries of the current corporate agro-industrial food system. They include 'traditional' actors of the agri-food value chains such as global food retailers, food processors, commodity traders, the pesticide or transgenic industries. They also include other actors, not active or traditionally active in food and agriculture, such as pension funds, companies in the automotive industry, or oil companies, who can exert a strong, indirect influence on various policies that directly or indirectly shape the dynamic of the agri-food system, be they agricultural, energy, trade, or financial policies. These actors invest considerable means to protect their particular interests against any decision that may threaten them. Their influence over decision-making processes seriously harms the global sustainability of the food and agricultural system: its capacity to feed the world, preserve biodiversity, tackle climate change, eradicate poverty and address other sustainability challenges (Parmentier, 2012). Box X below provides a few examples of the corporate influence over the food and agricultural system.

The large influence of transnational companies (TNCs) that make-up the world seed, agrochemical and biotechnology markets, which have a vested interest in maintaining a monoculture-focused, carbon-intensive industrial approach to agriculture dependent on external inputs, is obvious (Li Ching, 2011). Powerful commercial interests of agribusinesses especially hamper the scaling-up of agroecological transitions to meet sustainability challenges (Ishii-Eiteman, 2013).

[49] For more information, see section IV.B of the final report of the 40th CFS (CFS, 2013), available on the CFS website at the following page: http://www.fao.org/cfs/cfs-home/cfs40/en [Accessed 22 November].

In South Asia, a second Green Revolution, along with a 'Gene Revolution', is being rolled out jointly by government and the large corporate sector. In 2012, the national Indian Ministry of Agriculture, for example, has made clear its intention "*to fully extend green revolution to all the low productivity areas of eastern region where there is good potential to harness ample natural resources in order to achieve food security and agricultural sustainability*" (Bhutani, 2013). By contrast, small-scale farmers, who are both the primary practitioners of agroecology and the first beneficiaries of its expanded use, are most often systematically marginalized in policy decisions (De Schutter and Vanloqueren, 2011).

Box X. Examples of the corporate influence over the food and agricultural system

Corporate actors strongly influence the directions of various national and international policies that contribute to shape the dynamic of the agricultural and food system. Examples include:

- A former corporate counsel for the pesticides and biotechnology company, Dupont, was appointed in January 2011 to serve as general counsel for the USDA. Soon after, the USDA proposed a dramatic reduction in agency responsibility for regulating genetic engineered (GE) crops (Ishii-Eiteman, 2013);
- For all of 2007, agribusiness giants Syngenta and Monsanto spent $1.2 million and $4.5 million respectively on lobbying the US federal government on pesticide legislation, biofuels, patent laws and other issues, according to regulatory filings (The Business Journal, 2008);
- Monsanto and its affiliates lobbied Indonesian legislators in the 1990s to support GE crops. In 2005, the firm was fined $1,5 million by the United States Department of Justice for violating the Foreign Corrupt Practices Act by bribing a senior Indonesian Environment Ministry official (Ishii-Eiteman, 2013);
- The first version of the Agreement on Agriculture of the WTO was drafted by Dan Amstutz, then a director of Cargill and president of the North-American association of grain exporters, before becoming under-secretary of the US Department of Agriculture charged with market support programs, then chief agricultural negotiator during the Uruguay Round, then president of Amstutz & Company, a consultancy firm specialized in agri-business and international trade and finally president of the board of a common enterprise of ADM, Cargill, Cenex Harvest States, DuPont and Louis Dreyfuss (Berthelot, 2006);
- The world's largest investment banks, trading companies active in the agrifood sector, and other companies speculating on derivative markets invested enormous efforts, first to prevent, then to water down the reform of the U.S. financial regulatory system (*Dodd-Frank Wall Street Reform and Consumer Protection Act)* signed by President Barack Obama on the 21st of July 2010 . For the period prior to the adoption of the *Dodd-Frank Act*, Wall Street employed 2,000 lobbyists in Washington with a 600 $million budget. Since its adoption, they have successfully weakened its implementation (Parmentier, 2012);
- The European biofuels industry has achieved a major victory with the adoption in 2009 of the European Directive on renewable energy, which includes a mandatory target of 10% renewable energy in the EU transport sector for 2020 (in practice essentially reached through biofuels). This policy offers bright prospects for growth for concerned companies, including companies active in the agrifood, biochemical, oil and automotive sectors (Munting, 2008);
- Following controversy over its close ties with industry, the European Food Safety Authority (EFSA), which is "committed to ensuring that Europe's food is safe", has implemented in 2013 a new policy designed to ensure the independence of its scientific panels. Experts involved in these panels play a crucial role in decisions key to the health and safety of Europe's food supply chain. Yet, according to a recent study of the Corporate Europe Observatory (CEO), serious conflicts of interest remain: over half of the 209 scientists sitting on the agency's panels have direct or indirect ties with the industries they are meant to regulate (CEO and Horel, 2013);
- In Bangladesh, the state has been unable at times to supply seeds to farmers because of unpaid dues to contracted seed growers. Yet, the state still does not encourage farm-saved seeds (FSS). On the contrary, influenced by interests of the industry, new laws and policies are creating an environment for the private seed companies to sell their seeds, while there is no regulatory framework for developing and expanding local seed systems for crops or varieties important to small-scale farmers (Bhutani, 2013).

The disproportionate capacity of a minority of actors to shape agricultural and food systems relies on their huge 'market power'. Applied to food and agriculture, the 'market power' of a given actor could be broadly defined as its capacity to impose its practices and requirements on others, in particular in the framework of agrifood commercial transactions along the value chains (in terms of buying or selling prices, delivery times, production standards…), and/or to influence to its advantage the policies and laws that potentially impact its objective interests and contribute to shape directly or indirectly the agricultural and food system[50]. Market power of a given actor depends mainly on its size, the concentration (horizontal and vertical) of its sector of activity, its financial capital, and its social capital (extent to which the actor nurtures close social/cultural ties with policy makers) (Murphy, 2006; Parmentier, 2012)[51].

Democratizing decision-making processes and in particular increasing the active participation of peasants in decisions that affect them and shape agricultural and food systems should be an absolute priority for scaling-up agroecological approaches at a higher stage. This is a key stepping-stone for truly overcoming obstacles for more sustainable agricultural and food systems. Active participation of peasants, and especially women, must be ensured at local, regional (subnational), national and international levels. Real participation is crucial to ensure that all relevant policies are truly responsive of the needs of vulnerable groups and for empowering them (De Schutter and Vanloqueren, 2011). Public authorities have the obligation to take strong actions for dismantling the disproportionate market power of those using their influence to highjack and format agricultural and food systems to serve their own private interests.

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[50] This broad definition is freely inspired by the one, more restrictive, originally developed by Sophia Murphy from the IATP: "*Market power is the ability to affect price (setting buyer prices above and/or supplier prices below open market levels), to reduce competition (for example, by keeping out new entrants) and to set standards for a sector of economic activity*" (Murphy, 2006).

[51] Given factors on which market power depends, one can easily understand why agribusinesses and other actors benefitting most from the current agro-industrial model impose their requirements to peasants and exert significant influence over key decision-making processes. Box X above illustrates well the roles played by their financial and social capitals in influencing policy makers. Their size and the concentration of their sectors of activities also contribute significantly to their market power. As an example, in 2009 it was estimated that the top 10 companies accounted for 73% of the global market (up to 67% in 2007) and just 3 companies controled more than half (53%) of the global commercial market for seeds. In that year, the top 10 grocery retailers accounted for 41% of the revenues earned by the top 100 grocery retail firms (ETC Group, 2011).

CONCLUSION AND RECOMMENDATIONS

As demonstrated by an extensive body of evidence, scaling-up agroecological approaches would significantly contribute to achieving sustainable agricultural and food systems: ensuring food security and the realization of the Right to Adequate Food, eradicating extreme poverty, preserving biodiversity and natural resources, and addressing the climate change crisis among other objectives. This is not only a moral, but also a human rights imperative. Meeting sustainability objectives indeed falls under states' and non-state actors' existing obligations and responsibilities as included in relevant international human rights instruments, conventions and other commitments such as the UDHR, the ICESCR, the United Nations Framework Convention on Climate Change (UNFCCC), the CBD, or the United Nations Convention to Combat Desertification in those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa (UNCCD).

The shift from the current industrial agrifood system to agroecology will not happen fortuitously. It will require positive actions for overcoming obstacles that for too long have prevented a real change to happen at a global scale. Such positive actions should primarily aim to modernize agroecologically peasant agricultures (whether more traditional or partially industrialized), both recognizing the huge added-value of traditional agricultures to sustainable development and the need to make existing peasant farms more productive, sustainable and resilient.

But efforts to scale-up agroecology will also imply increasing the agroecological integration of industrial farms to the extent possible, whether large or small scale, to make them more sustainable. As we have seen, transition paths to allow such agricultural 'des-industrialization' are expected to be more challenging than those required for further applying agroecological principles to peasant agricultures. This remains nonetheless more than ever necessary, notably in the perspective of mitigating climate change.

In a non exhaustive manner, this paper addresses a set of recommendations for scaling-up agroecological approaches to an advanced stage. Some are achievable in the short or medium term. Others, more politically sensitive, are more challenging and will only be feasible in the long term. Although each of these measures are crucial, significant progresses could be made by achieving a portion of them.

A. For unlocking ideological barriers to political recognition

All civil society organizations should:

- Devote efforts to raising awareness and disseminating key messages amongst relevant key policy makers and extension agents, to de-stigmatize the image of the peasant and de-construct the persisting misconceptions about peasant agricultures and agroecology which impede political recognition and support. Efforts should stress the economic viability of agroecological farming, and its contribution to rural livelihoods, ecological sustainability, climate adaptation and resilient food systems;

- Collaborate with researchers and practitioners to enhance the knowledge base for agroecological approaches and collect more evidence on their impacts, including in terms of economic viability, and constraints;
- Demand that governments, national, regional and international agricultural research institutions replace current economic growth measures with those that take into account external costs of production such as pollution, as well as rural development, ecosystem functions, health and well-being (Wibbelmann et al., 2013);

NGOs should:

- Support efforts of agroecological farmers, farmers' networks and organizations, through collaboration with researchers and practitioners, to disseminate relevant information among the non-convinced farmers on the benefits of agroecological farming and its increased resilience, including its economic profitability.

B. For supporting farmer-to farmer networks

Governments should:

- Provide better institutional and political recognition, at the local, regional (sub-national), national and international level, to farmer-to-farmer networks and peasant organizations for their participation and contribution in an inclusive and informed transition process towards sustainable, equitable and resilient food systems;
- Provide financial support to such networks and organizations, while respecting their autonomy, to facilitate their functioning, and strengthen their capacity to engage in farmer-led research and horizontal spread of agroecological innovations in rural and urban settings (Wibbelmann et al., 2013).

NGOs should:

- Avoid reducing agroecology to its technical ecological content, and instead take into account its broader social and political dimensions (agroecology as a movement). At the national and/or international level, NGOs should develop policy work for overcoming the key obstacles that hinder a real shift towards agroecological approaches;
- Create political space for autonomous peasants' movements and other social movements (indigenous peoples, pastoralists, women organizations and others) to advocate for the key policy changes that are needed for scaling-up agroecology to an advanced stage. In that respect, NGOs should develop, where necessary, closer collaborations with farmers' umbrella organisations like ESAFF, LVC or ROPPA;
- Provide long term support to farmer-to-farmer networks and peasants' organisations to support their horizontal and vertical scaling-up initiatives;

- Provide ad hoc technical expertise support for translating social movements' policy visions into concrete proposals of measures, including for strengthening social movements efforts to advocate for agroecology[52].

C. For ensuring an enabling public policy environment

Governments should:

- Design agricultural and trade policies and agreements in support of peasants and agroecological approaches, including by:
  - Integrating the positive and negative externalities of different agricultural practices in their policies by providing public incentives to upscale agroecological practices for their benefits, e.g. through programmes of credits, technical assistance or insurance (McKay, 2012), and imposing the required disincentives for those practices that have negative externalities, e.g. through taxation (Delvaux, 2013);
  - Promoting diversification of agricultural production and prioritizing the use of local resources to meet the requirements of an agroecological farming sector (Wibbelmann et al., 2013);
  - Incentivizing reduction of grey and blue water footprint of agricultural and food systems, not only in crop selection and farming methods but more broadly in the whole supply chain, e.g. in food processing and packaging (Varghese and Hansen-Kuhn, 2013);
  - Prioritizing support to domestic food systems over international markets and protecting peasants from cheap food imports undermining their outlets on domestic markets (De Schutter, 2010a; Altieri et al., 2012b), including through variable import tariffs (Parmentier, 2007);
  - Supporting the development of 'short circuits' (HLPE, 2013) that reduce the distance between consumers and producers, such as producer–consumer networks, collective producer shops, farmers' markets, box schemes and other alternative agri-food networks;
  - Using public food procurement schemes (e.g. for schools, hospitals or public catering) to support peasants (HLPE, 2013) and agroecological farming;
  - Better adapting sanitary and phytosanitary, and quality standards to the specific constraints of small-scale producers and agroecological production;
  - Better regulating private and public-private agricultural investments for ensuring they are consistent with human rights and support the scaling-up of agroecological approaches, notably by promoting agricultural approaches that increase sustainably land productivity, support the diversification of agricultural production and are highly labor-intensive in countries where agriculture is the main source of employment and/or income (CIDSE, 2013)[53];

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[52] A successful example of such complementarity between social movements and NGOs is provided by the CSOs joint participation to the CFS negotiations through the CSM. Most often, social movements take the floor to address political statements, and then NGOs intervene as technical advisors for translating into concrete alternative wording proposals social movements' political concerns.

[53] CIDSE report on agribusiness responsibilities with regard to human rights is available in English, French and Spanish at www.cidse.org/resources

  - Taking positive action to significantly reduce food prices volatility (De Schutter; HLPE, 2013), especially through supply management (Parmentier, 2007);
  - Rebalancing power relations along the value chains by tackling the high concentration and centralized control of global corporate players over key agricultural functions (De Schutter and Vanloqueren, 2011), and by increasing the negotiation capacity of peasants (notably through supply management schemes and collective marketing regulations) (Parmentier, 2007);
  - Better regulating procurement practices of supermarkets and other corporate private actors for ensuring to peasants a fairer share of food prices paid by consumers;
  - Allowing peasants to keep more value-added at the holding and territorial level (HLPE, 2013), by allowing and encouraging them to assume increased roles at other stages of the value chains such as packaging, processing, and products marketing (De Schutter, 2010a)

- Secure peasants' access and control over natural and other productive resources, notably by:

  - Taking positive actions to ensure that peasants' rights to seeds, as well as to land, water and other natural resources are fully respected and protected, including through the consistent application of the CFS VGGT, and the implementation of redistributive land reforms in contexts of highly unequal access to land and natural resources (Monsalve Suárez, 2009);
  - Assisting developing countries in developing national action plans to review and adjust relevant laws for allowing farmers to save, use, exchange and sell their own seeds, and enhancing community rights over innovations in seeds, plants and biodiversity (Varghese and Hansen-Kuhn, 2013);
  - Protecting the commons[54] by better recognizing them through national laws and legislations, and by opposing 'biodiversity offsetting' initiatives[55];
  - Improving peasants' access to fair credit for facilitating investments in the development of agroecological approaches, as well as the financing of possible costs necessary for the required transition. States could for example provide ad hoc regulatory frameworks and public guarantees to encourage responsible support from financial institutions

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[54] As defined in the CSOs' autonomous vision of the Guidelines on Responsible Governance of Land and Natural Resources Tenure prepared prior to the CFS Land Tenure Guidelines negotiation, the 'common' "*refer to resources that peoples, communities and societies recognize as being accessible to everyone, and that are preserved and managed collectively for use by present and future generations. Commons can be natural, social and institutional, political and intellectual, cultural and spiritual*". The 'natural common' "*comprise lands and water bodies, including for example, farm/crop lands, wetlands, forests, wood-lots, open pasture, grazing and range-lands, hill and mountain slopes, streams and rivers, ponds, lakes and other fresh water bodies, fishing grounds, seas and oceans, coastlines, minerals, terrestrial and aquatic biodiversity*" (FIAN International, 2011).

[55] 'Biodiversity offsetting' is a planning mechanism through which developers would be able to compensate for habitats they destroy by creating or improving other landscapes. See the "No to Biodiversity Offsetting!" statement, released by 140 organisations from all over the world on November 21st 2013: http://corporateeurope.org/climate-and-energy/2013/11/no-biodiversity-offsetting

for facilitating smallholders' collective investments through cooperatives (HLPE, 2013).

- Increase public investments for ensuring the supply of public goods such as rural infrastructure (roads, electricity, information and communications technologies, sustainable irrigation systems), insurance against weather-related risks, agricultural research and extension services, storage and handling facilities to reduce postharvest losses in rural areas, education and sanitation. Additional public budgetary margin of manoeuver for public investments could be found through various ways, e.g. ad hoc tax measures and the partial reallocation of public spending on private goods (such as fertilizers or pesticides) to public goods;
- Prioritize agroecology in agricultural research, extension services and education, notably by:
    - Focusing public agricultural research on agroecological innovations, such as improving the productivity of local varieties through growing practices, land use and soil fertility management and building on farmers' agroecological knowledge, know-how and innovations;
    - Closely associating representatives from peasants' organisations and farmer-to-farmer networks, and consumers in defining public research and extension services priorities, as well as in controlling, designing, conducting and monitoring research activities;
    - Supporting the development of farmer-led and community-driven participatory research and extension services for the co-construction and dissemination of agroecological knowledge, e.g. through funding support;
    - Paying specific attention, not only to optimizing agroecologically peasant agricultures, but also to identifying the best transition paths for increasing the agroecological integration of industrial farms, whether at large or small scale;
    - Mainstreaming agroecology in agricultural education.

D. For empowering women through agroecological approaches

All actors should:

- Develop targeted actions specifically designed for tackling all the various gender abuses faced by women. Among other measures, the following actions are required:
    - Establishing specific, targeted schemes, both through women-only groups and mixed-groups, to ensure that within farmer-led, bottom-up participatory processes leading to the co-construction of agroecological knowledge and its dissemination: (1) women's experiences, knowledge and know-how is given a central place, (2) women are given a leading role, (3) gender inequities and discriminations they are facing are systematically identified, (4) as well as appropriate ways to address them in order to deconstruct and denaturalize men's dominance over women;
    - Systematically involving women in all relevant decision making processes for scaling-up agroecological approaches. For example, women should be consistently involved in the identification of

agricultural research and technology priorities, in order to ensure the development of gender-sensitive technologies (Tripathi et al., 2012);
- Recognizing indigenous knowledge as a 'gendered science' which would help legitimize and strengthen rural women's and men's separate, shared and interlocking knowledge as tools to shape their own futures (Barpujari, 2005).

E. For improving agricultural and food governance

Governments should:

- Enhance policy coherence in supportive policies for agroecological approaches, notably by:
  - adopting ad hoc governance mechanisms at national level to make sure that all policies having direct or indirect impacts on agricultural and food systems (e.g. energy, trade, agricultural research, land-use planning policies…) do not hinder but instead support a radical shift of the current industrial food regime towards agroecological approaches. The policy coherence of those policies could notably be evaluated on the basis of the GSF of the CFS (Delvaux, 2013);
  - Prioritizing food production as the primary purpose of agriculture (e.g. in the context of energy policies), while recognizing the multifunctionality and non-monetary exchanges of products and services values in agriculture;
  - Ensuring coordinated environmental and agricultural policies on biodiversity that guarantee heterogeneity and diversity at the landscape and farm level (Varghese and Hansen-Kuhn, 2013);
- Democratizing agricultural and food governance at the local, regional (sub-national), national, regional (supra-national) and international level, with a particular focus on increasing the active participation of small scale producers in decisions that affect them and shape agricultural and food systems. Possible public measures for achieving that goal could include:
  - Establishing clear rules and mechanisms for preventing conflicts of interest in partnerships, investments and policy-making (Ishii-Eiteman, 2013);
  - Duplicating the inclusive, participatory policy-making process of the CFS at the local, regional (subnational) and national levels for enhancing the real participation of the most affected, vulnerable and marginalized groups to decision making in all relevant areas. More precisely, States should seek to enhance their participation by privileging truly inclusive multi-stakeholders platforms and processes;
  - Increasing transparency for enhancing political accountability as to relevant decisions-making processes. As an example, with regard to biosafety, States could request the proponent of a technology to disclose all test results before getting clearance to move to the next level (Bhutani, 2013);
  - Ensuring the participation of peasant organizations and other civil society organizations in governance structures of multilateral and bilateral agricultural development programmes that might affect agroecological approaches.

NGOs should:

- In collaboration with citizens and consumers' movements and mobilizations, support small scale producers' organisations and social movements in increasing pressure on policy makers to support the democratization of agricultural and food governance. Among other actions, NGOs should support the following initiatives:
  - Farmer-led, community oriented local initiatives that use participatory methods and institutional innovations to create inclusive, democratic and safe spaces for citizens to get involved in policymaking and agenda setting, such as the "Democratising the Governance of Food Systems. Citizens Rethinking Food and Agricultural Research for the Public Good" international action-research project facilitated since 2007 by IIED and its local partners in the area of agricultural research in West Africa, South Asia, West Asia and the Andean region in Latin America (see Part III section C.4);
  - Civil society capacity building initiatives aiming to strengthen farmers and other communities' skills to advocate for their rights and Food Sovereignty, such as LVC political leadership training academies;
  - Local struggles of peasants movements, indigenous peoples, small-scale fisherfolks, resettled communities, older women, widowed women and orphaned girls, nomadic pastoralists and landless people and other communities, civil society groups and movements, to get adequate and secure access to and control over land, water and other natural resources they depend on for their livelihoods, as well as to protect their rights to seeds. NGOs have the responsibility to support these autonomous struggles in ways that can truly support their voices within all relevant arenas.

ANNEXES

ANNEX 1:

SYNTHESIS: WHAT IS 'AGROECOLOGY'?

Agroecology cannot be exclusively defined as a scientific discipline, or exclusively as a social movement nor an agricultural approach. It is a federative concept of actions, intermediate between the three dimensions (Wezel et al., 2009). Agroecology first emerged in the 1930s as a science. It is since the 1970s that agroecology no longer refers solely to a scientific discipline but also to an agricultural approach and a number of collective mobilizations, mainly in response to the Green Revolution (Schaller, 2013).

(1) As a science

- As a first step, agroecology as a science developed through an attempt to integrate the principles of ecology in the redefinition of agronomy (Stassart et al., 2012). Today's most frequent benchmark definition of agroecology as a **science combining ecology and agronomy** has been established by Altieri, as "***the application of ecological science to the study, design, and management of sustainable agriculture***" (Altieri, 1995).
- While this definition remains widely used, the scope and nature of agroecology as a science has **broadened considerably over time**, moving beyond the level of agroecosystems towards a larger focus on the **whole food system**, and developing a **transdisciplinary approach**, no more exclusively based on biotechnical sciences but also applying social sciences (Wezel et al., 2009).
- Agroecology as a science is first and foremost based on **the rediscovery and study of traditional small-scale farming** (Pérez-Vitoria, 2011; Altieri et al., 2012b; Holt-Giménez and Altieri, 2013).
- The practice of agroecology as a science has allowed for the **identification of key principles** that form the **foundation of agricultural sustainability**. Literature on agroecology most often refers to the following 5 core principles (Altieri, 1995; Altieri, 2002; Rosset et al., 2011):
  - (1) Increasing the recycling of biomass and achieving a balance in nutrients flow;
  - (2) Assuring favourable soil conditions, keeping the soil covered with mulch or cover crops, guaranteeing a high level of soil organic matter and an active soil biology:
  - (3) Minimizing nutrients losses from the system, through relatively closed rather than open system design;
  - (4) Promoting the functional biodiversity of the system, including within – and between- species diversity, above –and below- ground and landscape level biodiversity;
  - (5) Promoting increased biological interactions and synergisms among the system components that can sponsor system services like regenerating soil fertility and providing pest management without resorting to external inputs.
- These 'historical' principles are widely accepted as core pillars of agroecology. However, further identification of **key principles** remains a **topic of debate and is subject to further theorization**, especially when integrating broader social or political aspects of agroecology (Stassart et al., 2012).

(2) As an agricultural approach

- As an agricultural approach, agroecology can be defined as a **holistic transition process** aiming to make agriculture economically, ecologically and socially more sustainable by realizing to further agroecological principles, through multiple context-specific combinations of strategies and practices that are designed, applied and managed primarily by farmers themselves.
- Realizing agroecological principles consists primarily in **mimicking natural processes**, thus creating beneficial biological interactions and synergies among the components of the agroecosystem (De Schutter, 2010a). It must notably lead to minimize the use of non-renewable inputs that cause harm to the environment or to the health of farmers and consumers (Pretty, 2008). However, agroecological farming **does not exclude the use of chemical inputs. It rather seeks to reduce the use of all off-farm inputs (chemical or biological) to an absolute minimum** (Rosset et al., 2011).
- As a process of transition towards more sustainable agricultural systems, agroecology means essentially **designing and applying an adequate strategy for managing the transition**. As a starting point for designing such strategy, agroecology implies proceeding to a comprehensive **diagnosis of sustainability** challenges and conditions specific to the given context (Berton et al., 2012). This diagnosis requires a **holistic approach**. This notably means the following:
    - All relevant aspects of sustainability, whether linked to food security, environmental protection and/or to community well-being, must be taken into account, recognizing the multi-functionality of agriculture (Curtis, 2012);
    - All human and environmental constraints, and the ways through which those elements interact with each other, as well as all assets (natural, social, human, physical and financial) locally available, must be identified (Altieri, 2002);
    - Expected benefits in the short, medium and long term must be defined (Berton et al., 2012);
    - The need to go beyond the level of the plot or the farming system, as well as to thinking in terms of collective actions, thus requiring coordination between different actors (Schaller, 2013).
- Agroecological transition requires **bottom-up processes in which farmers take the front seat**. Agroecological farming is knowledge-intensive and based on techniques that are not delivered top-down but developed on the basis on farmer's knowledge, experimentation and innovation, combined with modern agroecological science (De Schutter, 2010a; Altieri and Toledo, 2011; Rosset and Martinez-Torres, 2013), thus leading to a co-construction of knowledge.

(3) As a movement

- Agroecology as a movement essentially seeks to **increase small-scale farmers autonomy and control over agricultural and food systems, for realizing 'Food Sovereignty'**, understood as "*the right of peoples to healthy and culturally appropriate food produced through ecological sound and sustainable methods, and their right to define their own food and agricultural systems*" (Nyeleny Declaration, 2007) (Rosset and Martinez-Torres, 2013). Increasing small-scale farmers' autonomy vis-à-vis industrial agri-food system can notably be considered as a necessary condition for ensuring a real shift towards more sustainable agricultural and food systems.
- Agroecology as a movement includes **two main categories of civil society actors** (Holt-Giménez et al., 2010):

  - The **'practitioners'**: farmer organizations and NGOs which first and foremost seek to further spread agroecological farming to a growing number of farmers, relying on farmer-to-farmer networks and highly organized farmer' organizations ('horizontal scaling-up', also called 'scaling-out' –Rosset and Martinez-Torres, 2013-);
  - The **'advocates'**: farmers' organizations, NGOs and other civil society actors who make specific efforts for creating an enabling institutional, economic or political environment for scaling up agroecology to a much higher stage, in order to induce a radical shift towards agricultural and food systems ('vertical scaling-up' or simply 'scaling-up' –Rosset and Martinez-Torres, 2013-).
- The agroecological movement is **very diverse** and is characterized by **historical tensions** between practitioners and advocates, the advocates considering that practitioners have historically tended to reduce agroecology to technical and apolitical approaches to agricultural development (Holt-Giménez and Altieri, 2013). **But convergence is progressively growing** between these actors (Holt-Giménez et al., 2010).
- The achievement of an increased autonomy and control over agricultural and food systems notably relies on the **search for a reduced dependence on off-farm inputs** (Rosset and Martinez-Torres, 2013), states subsidies to agrochemicals, and moneylenders (De Schutter, 2010a), as well as on **farmers-led bottom-up** experimentation, innovation and dissemination **processes** (Sen, 2010), but can include other strategies, including:
  - **Direct advocacy or support to advocacy work targeting key decision makers** for creating an enabling public policy environment, for the adoption of key policy changes aiming specifically at promoting agroecology and dismantling or reforming policies that have historically all too often disadvantaged small-scale farmers (Rosset and Martinez-Torres, 2013);
  - Developing strategic alliances for **developing alternative agri-food networks** for reducing the 'distance' between consumers and producers and promoting agroecological production (Lamine et al., 2012; Kremen et al., 2012).

ANNEX 2:

BASIC ATTRIBUTES OF SUSTAINABLE AGRICULTURAL SYSTEMS

1. Use of local and improved crop varieties and livestock breeds so as to enhance genetic diversity and enhance adaptation to changing biotic and environmental conditions;
2. Avoid the unnecessary use of agrochemical and other technologies that adversely impact on the environment and on human health (e.g. heavy machineries, transgenic crops, etc.);
3. Efficient use of resources (nutrients, water, energy, etc.), reduced use of non-renewable energy and reduced farmer dependence on external inputs;
4. Harness agroecological principals and processes such as nutrient cycling, biological nitrogen fixation, allelopathy, biological control via promotion of diversified farming systems and harnessing functional biodiversity;
5. Making productive use of human capital in the form of traditional and modern scientific knowledge and skills to innovate and the use of social capital through recognition of cultural identity, participatory methods and farmer networks to enhance solidarity and exchange of innovations and technologies to resolve problems;
6. Reduce the ecological footprint of production, distribution and consumption practices, thereby minimizing GHG emissions and soil and water pollution;
7. Promoting practices that enhance clean water availability, carbon sequestration, conservation of biodiversity, soil and water conservation, etc.;
8. Enhanced adaptive capacity based on the premise that the key to coping with rapid and unforeseeable change is to strengthen the ability to adequately respond to change to sustain a balance between long-term adaptability and short-term efficiency;
9. Strengthen adaptive capacity and resilience of the farming system by maintaining agroecosystem diversity, which not only allows various responses to change, but also ensures key functions on the farm;
10. Recognition and dynamic conservation of agricultural heritage systems that allows social cohesion and a sense of pride and promote a sense of belonging and reduce migration

Source: Reproduced from Koohafkan et al. (2011).

References indicated in Koohafkan et al. (2011) are: Gliessman S.R., 1998. 'Agroecology: Ecological Process in Sustainable Agriculture', Ann Arbor Press, Michigan; Altieri M.A, 2002. 'Agroecology: the science of natural resource management for poor farmers in marginal environments', Agriculture, Ecosystems and Environment 93, 1-24; UK Food Group, 2010. Securing Future Food: Toward Ecological Food Provision, UK Food Group Briefing, London

ANNEX 3:

FURTHER THEORIZATION OF AGROECOLOGICAL PRINCIPLES BY GIRAF

On the basis of INRA and its own work, the GIRAF (Interdisciplinary Group of Research on 'Agroecology' of the Belgian Fonds de la Recherche Scientifique –Fnrs) proposes a conceptual framework encompassing a total of 13 agroecological principles, adding 8 principles to the 5 historical principles primarily theorized by Altieri: 1 historical principle, 4 methodological ones and 3 socio-economic ones. These 8 additional principles are the following:

***INRA**, Department sciences and Action. Tichit M., Bellon S., et al., 2010. 'L'agroécologie en action'. AG 2010. Department SAD INRA, Cap Esterel, January 27-29*:

Historical principle:

- (6) promote agro-biodiversity, as the point of entry for the re-design of systems ensuring the autonomy of farmers and Food Sovereignty;

Methodological principles:

- (7) foster and equip the multi-criteria steering of agroecosystems in a perspective of long term transition, including arbitrations between short time and long time and attaching significance to resilience and adaptability properties;
- (8) promote the spatio-temporal variability (diversity and complementarity) of resources, i.e. take advantage of local resources and characteristics and work with diversity and variety rather than seek to overcome it;
- (9) Stimulate the exploration of situations far removed from optima already known, e.g. "extreme" systems at very low levels of inputs and/or organic in livestock as well as in vegetable production;

***GIRAF**:*

- (10) promote the construction of arrangements for participatory research that allow the development of "finalized" research while guaranteeing the scientificity of approaches. The design of sustainable systems indeed is complex and implies the acknowledgment of interdependence of actors, of their ambiguities, as well as of the uncertainty of socio-economic impacts of technological innovations;

Socio-economic principles:

- (11) create knowledge and collective capacity of adaptation through networks including producers, citizens-consumers, researchers and technical advisers of public authorities, which promote deliberative forums, public debate and knowledge dissemination;
- (12) promote possibilities of choices of autonomy compared with global markets by the creation of a public goods-friendly environment and the development of socio-economic practices and models which strengthen democratic governance of food systems, notably via systems co-managed by producers and citizens-consumers and via systems (re)territorialized highly labour intensive;
- (13) promote the diversity of knowledge to be taken into account: local or traditional knowledge and practices, ordinary knowledge in the construction of problems and the construction of publics concerned by these problems, than in the search of solutions.

Source: Stassart et al. (2012). Translated from French. See Stassart et al. (2012) for the full list of references.

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