



“Diversity instead of uniformity” plays a key role in the concept of agroecology. It includes bidding farewell to large-scale mono-cropping and ...

Photo: Martin Leissl/laif

## AGROECOLOGY – THE MOST CONVINCING PROPOSAL FOR TRANSFORMING UNSUSTAINABLE AGRO-FOOD SYSTEMS

“Agroecology” is becoming increasingly important in the debate on the future of agriculture and the food industry. Is it just a new buzzword, one of so many on the long list of sustainable agriculture terms, or is it really a novel approach that calls for changing tack? Our authors explain.

By Angelika Hilbeck and Bernadette Oehen

The current industrial agro-food system, including the many aspects of production and distribution, is highly unsustainable, both for environmental and for human health reasons. Furthermore, it fails to feed the world as was promised decades ago. This was concluded in the 2008 International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD) Report and captured in the statement that “business as usual is not an option anymore” (see also article on pages 11–13). The situation was described even more dramatically in the 2013 Review by the United Nations Conference on Trade and Development (UNCTAD), titled “Wake up before it is too late to make agriculture truly sustainable for food security in a changing climate”. But hunger and starvation continue to rise despite the fact that more than enough foodstuff is available and global productivity of most staple crops is still increasing.

Moreover, for many years, scientists have been sounding the alarm that the global ecosystem is in a precarious state and possibly on the verge of an abrupt shift because of anthropogenic pressures. For example, Johan Rockström and

his colleagues write: “Further pressure on the earth system could destabilize critical biophysical systems and trigger abrupt or irreversible environmental changes that would be deleterious or even catastrophic for human well-being”, which may leave planet Earth in a “much less hospitable state” for human populations, as Will Steffen and colleagues maintain. Together with other scientists, they have identified nine key global ecosystem processes that regulate the stability and resilience of the global ecosystem. For each process, they have defined the boundaries of the safe operation space for humans. They show that for four of these nine processes, the planetary boundaries have been exceeded as a result of human activity: climate change, loss of biosphere integrity (i.e. biodiversity), land-system change, and altered biogeochemical cycles (phosphorus and nitrogen).

### CALLING INDUSTRIALISED AGRICULTURE TO ACCOUNT

One of the main drivers behind the anthropogenic pressures on these planetary processes is industrialised agriculture. This form of agri-

culture has been modelled after the extractive industries, reducing agriculture to one function only: the production of raw materials (commodities) for long industrial extraction and production chains for feed, fibre, energy and foodstuff. In this model, maize or soybeans, for example, are no different from oil or minerals mined from beneath the soil. Also in so-called less developed countries with as yet little industrialised agriculture, powerful forces are at work pressuring national governments into converting land to such industrial monocultures, at the expense of small-scale farmers, human health and the environment. The products of these long, open and linear industrial processing chains may be edible foods, although this is not what these commodity crops are mainly meant for. Many of them serve as raw materials for feed, fibre and, increasingly, fuel. Emily Cassidy and colleagues calculated that, globally, only about 59 per cent of the total produced calories are delivered to the world’s food system. However, the more than 80 per cent of crop produced calories going into human food in development countries contrasts sharply with the 34 per cent in the USA. The rest ‘feeds’ engines, industries and



... a greater variety of seeds for farmers to choose from.

Photo: Jörg Böhling

waste disposal sites. Cassidy and colleagues found that if the current mix of crops were grown exclusively for direct human consumption, in principle, it could feed an additional four billion people today – instead, more than 800 million are starving.

Just like all commodities, these commodity crops are globally traded and transported. In basically all industrial countries (as well as those striving to become such countries), policies and subsidiary systems have been installed that reward those farmers who consolidate their farms as larger units and firms to produce the highest quantities possible of primary raw materials from a handful of crops, like soy beans, maize, oilseed rape, wheat or cotton. These industrial agro-food systems rely on external inputs such as fossil fuel, synthetic pesticides and fertilisers to support the large-scale production of these few commodity crops bred primarily, if not exclusively, for yields. In the breeding programmes of the high yield varieties used in these industrial systems, little consideration was given to adaptation to local conditions and resistance against pests and diseases.

## THE CONCEPT OF AGROECOLOGY

Agroecology is inspiring more and more people as a concept for the transformation of current unsustainable agro-food systems into sustainable ones. In 1983, Miguel Altieri defined it as the application of ecological principles to agriculture, and it fundamentally includes farmers and builds on farmers' knowledge. He proposed that agroecological systems should be based on five ecological principles: 1) re-

cycling biomass and balancing nutrient flows and availability; 2) securing favourable soil conditions for plant growth by enhancing the organic matter; 3) minimising losses of solar radiation, water and nutrients by managing the microclimate and soil cover, and practising water harvesting; 4) enhancing biological and genetic diversification on cropland; and 5) enhancing beneficial biological interactions and minimising the use of pesticides.

For others, agroecology is not only a system of producing food or a scientific discipline, but also a social movement that links producers to consumers and criticises the effects of industrialisation and the economic framework of the globalised food market. Michel Pimbert states that agroecology is based on autonomy, prudent use of resources and co-operation along the entire agro-food chain. Agroecology is, thus, neither a defined production system nor a production technique. It is rather a set of principles and practices intended to enhance the sustainability of a farming system tailored to the local conditions, and as a movement, it seeks new ways of connecting food producers with consumers – an approach which is vital for food security.

Among the many different forms of agroecological production systems, only the products of organic farming are subject to world-wide regulation, with laws and private label guidelines. However, the various forms, whether codified organic or agroecological, all differ substantially from conventional, industrialised agriculture, as described in the Table.

## PROPOSED COMPETING PATHWAYS TO SUSTAINABLE AGRICULTURE – REAL ALTERNATIVES OR WINDOW DRESSING?






Competing concepts of making industrial agriculture more sustainable are also proposed, again purporting technology-oriented narratives. Proprietary techno-science packages are envisioned to be the primary key drivers of change and productivity increase, with yields of monoculture crops per area remaining the chief target and guarantee for food security. The Standing Committee on Agricultural Research to the European Commission (SCAR) contrasted two main types of proposals for change in their 3<sup>rd</sup> SCAR Foresight Exercise, published in 2011, and coined them 'productivity narrative' and 'sufficiency narrative'. Sufficiency is one element of sustainability. It stands for moderation or temperance, i.e. for production and consumption adapted to the resources available.

Under the 'productivity narrative', scientific advances should deliver high-yielding varieties (preferably patent-protected, e.g. by using genetic engineering techniques) that are amendable to automated precision technologies, taking into account resource scarcities and environmental problems. The focus of these strategies is the more efficient use of external inputs, leading perhaps to less of them being used, but certainly not to their expendability. The increase in efficiency is to come about through high-tech solutions offering the required inputs packaged with the necessary

### Differences between industrial and agroecological food production

Conventional agri-food systems	Agroecologically based agri-food systems
Domestic and export-oriented production of raw materials (feed, fibres, commodities)	Local, regional and national food production and consumption
Long supply chains	Short supply chains
Feeding the agri-food industries with cheap raw materials	Nourishing households with healthy food
Few crop and livestock species	Different varieties of crops and livestock species
Large-scale mono-cropping or short crop rotation	Small-scale diversified food systems with long crop rotations and temporary grasslands/fallow lands
High dependency on external inputs (hybrid seeds, fertiliser, energy)	Lower dependency on external inputs (farm-saved seeds and own breeding, manure and composts to feed the soil)
Top-down extension schemes	Farmer field schools, stable schools, innovation platforms
Industries lead innovations, proprietary technology packages (main act) drive change	Farmers lead innovations, technologies (support act) help them in achieving their agroecological production goals
Segregation of the producers from their social background	Integration of the social relationships (farmer to farmer, farmer to consumer)
Segregation of agriculture from landscape, biodiversity, single function	Integration of landscape and biodiversity into agriculture, multifunctional
Narrow, single-field perspective, one-size-fits-all blueprint approach	System view, holistic approach including methods and technologies based on farmers' knowledge, traditional and indigenous people's perspectives

Conceptual comparison of a range of proposed changes (paradigms and narratives) towards sustainable agricultural systems

Productivity paradigm / narrative		Agroecology paradigm / narrative	
			
			
			
<b>Exit systems: Conventional, high-input, chemical intensive, high yields</b>		<b>Traditional, low-input, low yields</b>	
Conversion – maximise efficiency through precision technologies: <ul style="list-style-type: none"> <li>- Large industrial operations</li> <li>- Linear, open extraction chains</li> <li>- Integration with high-tech robotics, remote control, IT, software</li> <li>- Biotechnologies</li> <li>- Conventional production – less chemical inputs, more efficient low-volume chemicals</li> </ul>	Conversion – maximise efficiency through precision technologies: <ul style="list-style-type: none"> <li>- Large industrial operations</li> <li>- Conform with current economic paradigm</li> <li>- Perhaps shorter extraction chains?</li> <li>- Appropriation of organic-inspired production methods and supporting technologies</li> <li>- Biotechnologies plus GE*</li> <li>- No/little chemical inputs?</li> </ul>	Transformation to agroecological systems: <ul style="list-style-type: none"> <li>- Family farm, small to mid size</li> <li>- Transform current economic paradigm, local-global agency</li> <li>- Short chains, closed cycles</li> <li>- Organic production methods and supporting technologies</li> <li>- Biotechnologies except GE*</li> <li>- No chemical inputs</li> </ul>	Conversion to more productive systems: <ul style="list-style-type: none"> <li>- Family farm, small to mid size</li> <li>- Transform and create local economies</li> <li>- Short chains, closed cycles</li> <li>- Organic or other agroecological production methods and supporting technologies</li> <li>- Biotechnologies except GE*</li> <li>- No chemical inputs</li> </ul>
<b>Modified conventional</b>	<b>Ecologically inspired conventional</b>	<b>Agroecological</b>	<b>Agroecological</b>
<b>Business-as-usual LIGHT</b> Little to medium change – still towards ruin		<b>Transformation</b> Much change – away from ruin	

\* GE = genetic engineering

Source: Hilbeck, A. and B. Oehen (eds & authors) 2015.

Feeding the People: Agroecology for Nourishing the World and transforming the Agri-Food System.

technical (ideally autonomous) machinery, e.g. GPS-directed robots or drones, and, most importantly, the quintessential knowhow in the form of proprietary software (big data). In this vision, a farmer becomes either an investor, a ‘virtual farmer’ who runs the farm remotely from his/her home or office via a computer, or a farmer-technician executing the proprietary protocols and instructions developed by industry – for fees. Such technology-driven concepts are coined as ‘climate-smart agriculture’ or ‘precision agriculture/farming’. Moderation of production tailored to local conditions or reduction in consumptions are no-go areas in this narrative.

Climate-smart agriculture or CSA is mostly embedded in a development context and emerged from the debate in international UN circles around the interlinked challenges of climate change, agriculture and food security. Significant support stems from major institutional UN actors: the UN Food and Agriculture Organization (FAO), the International Fund for Agriculture and Development (IFAD), most importantly its international agricultural research centres of the Consultative Group for International Agricultural Research (CGIAR).

‘Precision agriculture/farming’ are terms that were coined in the USA and find their biggest supporters and developers among those global agriculture input, processing and trading industries who are the primary drivers behind the current destructive industrial agro-food systems. They are supported by governments in North America and the European Union who also help promoting these ‘CSA’ or ‘pre-

cision’ agro-food systems in those parts of the world where the most industrialised agro-food systems are already established, e.g. South America or eastern European countries.

### SEEMINGLY THE SAME, BUT IN FACT DIFFERENT

Much of the rhetoric of CSA, but also ‘precision agriculture/farming’, is reminiscent of the wording used in agroecology, and builds on similar analyses. Ben Lilliston claims that such rhetoric creates ambiguity regarding the meaning of these terms and co-opts agroecology’s recent popularity while it simultaneously aims to “drown out the rising support for agroecology coming from both scientists and social movements”. Similar strategies were identified by Nicolas Lampkin and colleagues when comparing the different conceptual approaches to ‘sustainable intensification’ to genuine agroecological approaches. For instance, descriptions like “CSA is not a set of practices that can be universally applied, but rather an approach that involves different elements embedded in local contexts” borrows heavily from the language developed around agroecology. It also makes it sound like accommodating similar objectives as agroecology, such as food security, resilience, sustainable use of natural resources, reduced emissions and less deforestation. However, the main difference lies in what is not mentioned but is key to agroecology: small-scale farmers, food sovereignty, local supply, and circular and short production chains. Indigenous and traditional knowledge certainly has little to no value or role in the vision of CSA or precision agriculture.

In agroecological systems, scientific advances and technologies are also critical but assume a support role in helping to achieve the goal of developing highly productive agro-food systems that are respectful of ecosystems and resource saving through behavioural change and agroecological practices that are tailored to the local conditions. In contrast to the competing visions outlined above, agroecological approaches put food production and people at the centre, and farmers are key actors. Ideally, supporting technologies are offered at the capacity level of the farmers to master and own them. Education and training that increases the knowledge and skills of the farmers is crucial. This approach will require a fundamental change in the political, economic and institutional support structures. True agroecological transformation means ‘no business as usual’ anymore and requires a ‘system re-design’ aiming away from ruin, while all competing proposals try in one way or another to ‘conform’ to and, thus, rescue the current socio-economic and trading framework and, with it, the associated power and profit structures (see Figure). Consequently, they can at best offer approaches that we call ‘business-as-usual-light’ but that are still headed towards ruin – just a little later.

**Angelika Hilbeck** is a Senior Scientist at the Institute of Integrative Biology of the Swiss Federal Institute of Technology (ETHZ) Zurich in Switzerland.

**Bernadette Oehen** is a Senior Scientist at the Department of Socio-Economic Sciences at the Research Institute of Organic Agriculture (FiBL) in Frick, Switzerland.

Contact: angelika.hilbeck@env.ethz.ch