

Policy Paper on Agriculture and Food Security

Prisma and ICCO
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This document is the result of a process of study, reflection and dialogue of staff of ICCO, Prisma, Prismamembers and Kerkinactie, produced in view of common programmes in agriculture and food and nutrition security. The process started during the functioning of the Cooperation members. Because of the different way of cooperation that was established in 2016, this document speaks of 'Cooperation members' where formerly ICCO Cooperation was mentioned.

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Introduction

The UN expects world population to grow to 9.15 billion in 2050. Combined with changing diets among growing middle classes in wealthier developing countries, this is expected to result in a significant increase in demand not only for cereals but also dairy and meat products. FAO projections suggest that, in the absence of changing food consumption habits in the West and effective action to deal with food waste and loss, overall food production will have to increase by 70% between 2005/07 and 2050 to meet growing demand. Increasing demand for biofuels and the growing impacts of climate change pose further challenges to maintaining food security (FAO 2009). Few still dispute the need for new global sustainable food and consumption systems (IFAD, 2010).

Throughout its history the ICCO as well as other Cooperation members have maintained predominantly, though not exclusively, a strong presence in rural areas. Cooperation members have built a deep understanding on themes related to inclusive rural development, rural economies, food security and livelihoods, which always have been addressed from the perspective of human dignity and rights, nurtured by Cooperation members' core values: compassion, justice and good stewardship.¹ The policy document 'Towards a just and dignified world', (adopted 2013, also called MASP 2020²) reaffirms this tradition and puts it in the light of actual and future developments.

The MASP 2020 focusses on two major principles: **Securing sustainable livelihoods** and **Justice and dignity for all**. Based on ICCO's rural experience and looking at the future, the present policy paper describes the agricultural (food) system the Cooperation members envision to be in line with the two aforementioned principles. It builds on the following paragraph in the MASP, making use of the extensive experiences and knowledge of the Cooperation members and their partners.

"Our focus is on sustainable farming and agri-business value chains. Where needed, this includes mitigating and adapting to climatological impacts.

Our strength lies in making connections on the ground. We connect organizations that strengthen producers' organizations to enhance farmers' livelihoods. We also support organizations that help farmers obtain land titles, and we are also working with private sector businesses who purchase produce, set quality standards and strengthen farmers' organizations. In this way, we enable farmers to become sustainable producers for markets within value chains. We focus on chains that are vital to creating sustainable livelihoods, and those that support food security worldwide for feeding the growing world population." (MASP, p. 14)

A vision on agriculture entails a vision on land. Cooperation members' vision on land includes access to land, control over land, use of land (farming and agriculture) and development based on secured land. This vision strongly emphasizes smallholder's development, taking into account issues related to (land) governance, climate, agroecology, food and nutrition security, the socio-political environment, and financial sustainability and commercialization. Cooperation members aim at systemic change and the

¹ For a helpful step towards a theological underpinning of food security/ right to food see (Buckingham, 2000)

² The Multi Annual Strategic Plan was formulated during the time of Cooperation members; it still is a guiding document for the Cooperation members

creation of an enabling environment for activities working towards fair and sustainable economic development.

Where Cooperation members work in different local, regional and global realities, based on context and stakeholder analyses, the different pathways of change will reflect these differences. In one context the primary focus may be on local production of food in another context access to land and land governance may dominate, and still another context may urge for a concentration on production and commercialization, etc. In all cases, however, food and nutrition security for the people we work with is an underlying objective, while linkages with other themes are meant to bring about systemic change. These linkages and the systemic change may furthermore be enhanced by a shared *geographical focus*, a *landscaping approach* or a *territorial development* approach (different names for approaches with slightly different accents but with a lot of overlap).³ Emphasizing systemic change in a particular geographical area begs the question what type of change is desired. What type of agriculture is fitting, in particular for the socioeconomically vulnerable, generally small farm holders? This question is more pressing against the background of climate changes, increasing environmental pollution and soil degradation by conventional agro-industrial farming. Hence, what this policy document seeks to accomplish is to provide for an agricultural paradigm that can give guidance to the work of the Cooperation members, also with respect to the steps needed to promote this agricultural paradigm.⁴ It has to be emphasized that this agricultural paradigm concerns principles and key practices and not a fixed blueprint of practices that should be promoted everywhere and every time. How the principles and key practices will be implemented, will depend on local circumstances - physical, social, environmental, economic, political – and requires research into those local circumstances.



Figure 1. Agriculture operates within diverse complex systems and is multifunctional in its nature.

³ A territorial approach, as opposed to a strictly thematic approach, works in a specific area in an inter-thematic way, based on a context analysis that reveals the (most pressing) needs. So, it looks at a certain area from a historical, political and social perspective. It integrates physical characteristics such as land and natural resources with the ways these are managed and used. At the same time, being an integral approach, it may help to overcome narrow sector or thematic approaches.

⁴ Following Sato and Smith (1996) a paradigm is understood to: (1) provide a meta-theory, *viz.* one that serves to explain many other theories; (2) be accepted by a community of practitioners; and (3) have a body of successful practice, including exemplars that can be held up as paradigms in practice. Although the notion of paradigm arose in a philosophy of science context, it is assumed that this concept of paradigm is at least partly applicable to non-scientific contexts – such as agricultural development cooperation – as well. In doing so, the Cooperation members adhere to the jargon in use.

Cooperation members' view on agriculture

Old Paradigm

In the industrialized countries, traditionally and still the major donor countries in the context of Development cooperation, agriculture has also been industrialized, especially after World War II. This process can be summarized in several general developments (Hardeman & Jochemsen, 2012). The first is *mechanization*: the process of replacing human work forces and techniques with machines and technological procedures. The second salient development is *intensification*, in this case meaning the increase in production per hectare or per animal. The third development is *specialization*, where farms focus only on one type of crop or activity, e.g. dairying, pig-keeping, poultry or maize. The *leading role of science and technology* is the fourth development to be mentioned. Agronomic research has focused on the increase of productivity per unit of labour through the use of new technologies and capital. Hence it underlies – among others – developments in plant breeding, resistance to disease, artificial insemination and the feed conversion rate. The final development to be mentioned is the *increase in the scale of farming*, which has been vigorously stimulated by Governments. All these developments required the education of farmers. Four sub-processes can be distinguished here: re-allotment, the introduction of non-land-based farms, the growth in their size and the decrease in their number.

This industrialization of agriculture has doubtlessly led to an increase in the volumes of agrarian production, especially to an increase of production per farmer and also to the availability of enough food for those countries at a relatively low price. The industrialization of agriculture generally goes together with the commodification⁵ of food and other agricultural products. Facing the challenge to make sure that during the next decades enough nutritious food will be available for nine billion people, a major question is, whether in the global South agriculture should also follow the path of industrialization and commodification. Our answer is No –without ruling out that certain elements of that model may be introduced into a fundamentally different paradigm that we will present below. But first a few remarks why the industrialization model should not be followed. Again we summarize in a few brief statements, referring to the literature for further proof.

The predominant form of agriculture in the industrialized world, that is promoted by many research institutes and donors, is heavily based on and modelled by an agro-industrial approach. This involves a strong focus on commodities as opposed to a primary focus on a full realization of the right to food security for all; emphasis on external inputs of chemicals in the form of pesticides and herbicides and artificial fertilizer, instead of building on soil characteristics and biological relationships; a focus on a few strains of seeds and animal races that are controlled by a few companies instead of diverse systems that are controlled by farmers; and putting technical models before the aspirations of people, to name a few. This agro-industrial model has led to increased genetic erosion, degraded soils and pollution of the environment involving serious threats to ecosystem services like genetic erosion, a strong dependency on irreplaceable natural resources and, hence, is far from sustainable in many ways. And we have not mentioned yet the animal ethical problems related to this model. It is clear we need an agricultural transformation.

⁵ Commodification is the transformation of goods and services, as well as ideas or other entities that normally may not be considered goods,[1] into a commodity, i.e. something that is assigned just economic value (Wikipedia).

Towards a new paradigm

Within the Cooperation members, in the course of two series of conversations in the Netherlands, experts and programme officers working on agriculture from different members of the cooperation have listed a number of ‘asks’ or ‘demands’ for the type of agriculture that should be promoted both in the global North and South, especially for the small holders (see Annex 1). Taking into account these demands, we will describe below the type of agriculture that Cooperation members, have promoted and want to promote, noting that ICCO has the longest and most extensive track record in this field.

We start with the observation that agriculture finds itself and develops at the crossroads of diverse complex systems (see Figure 1). This means that agriculture is a dynamic activity that, to be sustainable, permanently changes, adapts and is resilient towards the multiple forces it interacts with. In this dynamic context, the creative interaction between the farmer and its environment, i.e. the systems of which the farmer is part, is essential. Important systems that must be taken into account:

- the economic system (finance, incentives, commerce and trade opportunities),
- the ecological system (land, natural resources including genetic resources),
- the social system (food and nutrition, well-being), and
- the political system (governance, public policies, institutions).

In the agricultural system a good balance needs to be sought between establishing sustainable food systems at the various levels, and production for trade beyond the locality. Agriculture is a contributor to climate change and in turn climate change threatens the food production across the globe. Hence, economic development should be pursued within the boundaries set by the ecological system: agriculture should contribute to carbon sequestration to mitigate climate change, contribute to local soil and forest restoration, prevent environmental pollution from pesticides and fertilizers and contribute to biodiversity in the local agro-ecological system. Furthermore, it should be acknowledged that agriculture for many family farmers and smallholders is a way of living, apart from an economic activity. This means that people, especially (smallholder) farmers and farm workers, both male and female, should be central and be allowed self-steering and self-governance, also in negotiation with consumers.

A multi-functional approach to agricultural knowledge, science and technology will enhance its impact on hunger and poverty, improving human nutrition and livelihoods in an equitable, environmentally, socially and economically sustainable manner. IAASTD key finding #6, IAASTD 2008a

In view of these requirements for agriculture, Cooperation members believe that the *agro-ecological paradigm* (agroecology for short) best fits their agricultural vision for the South. The agro-ecological paradigm fully recognizes the importance of the socio-political and economic environment (human ecology) in which (female and male) farmers operate, their access to land and other natural resources, and their access to public policies that affect their lives. Agroecology is more labour-intensive than industrial agriculture; but the population growth in Southern countries will lead to a sufficient labour force to sustain agro-ecological development, even foreseeing that a gradually decreasing percentage of the population will work in agriculture. Important for the development and implementation of agroecology is that this sector will be attractive for at least part of the young people entering the labour

market. In this paper we will not be able to further develop this point, that in the broader strategy of developmental work will require attention.

Characteristics agroecology

Agroecology is a science, a practice and a movement. As a science, agroecology involves the holistic study of agro-ecosystems. As a practice, agroecology enhances the resilience and ecological, socio-economic and cultural sustainability of farming systems. As a movement, it seeks a new way to link agriculture with society.⁶ Here we will concentrate on agroecology as a practice, realizing that the three perspectives are very much intertwined.

As a practice agroecology entails a farming system based on a sustainable and dynamic cooperation between man/women and nature, supported by sound relations between farmers and society. This farming system combines agro- and human ecologic principles to create sustainable livelihoods. Agroecology functions by making smart use of the ecological interactions among crops, soil biota and livestock – including dairy cattle, pigs, poultry and insects. In this way it minimizes the need for external inputs such as fertilizer and herbicides. For results and debate on production yields of agroecology see Excurse.

Excuse: The yields of Agroecology

In the scientific literature there is an ongoing debate about the productivity of organic (and agro-ecological) compared with conventional or industrial agriculture or with mixed practices. Considering the focus on multi-functionality in agroecology, total agricultural productivity is harder to estimate than under an agro-industrial regime. In a relatively recently publication Altieri, an important initiator of today's agroecology, renders the following data (Altieri et al. 2012).

- In Cuba, a group of about 100.000 family farmers practicing agroecology, produce over 65% of the country's food on only 25% of the land.
- Further, in a study 208 agro-ecologically based projects and/or initiatives throughout the developing world clear increases were documented in food production over some 29 million ha, with nearly nine million households benefiting from increased food diversity and security. Promoted sustainable agriculture practices led to 50–100% increases in per hectare food production (about 1.7 Mg/year/household) in rain-fed areas typical of small farmers living in marginal environments; that is an area of about 3.58 million ha, cultivated by some 4.42 million farmers (Altieri et al, 2012, 6,7).
- A study of farming in the Philippines compared findings from 280 full organic farmers, 280 in conversion to organic agriculture, and 280 conventional farmers to act as a reference group. The analysis focused on food security, income and livelihood, yields and productivity, environmental outcomes, and farmer knowledge and empowerment (Altieri et al, 2012, 9,10). The results demonstrate:
Food security: 88% of organic farmers find their food security better or much better than in 2000 compared to only 44% of conventional farmers. Of conventional farmers, 18% are worse off. Only 2% of full organic farmers are worse off.
Diversity of diet: Organic farmers eat 68% more vegetables, 56% more fruit, 55% more protein rich staples and 40% more meat than in 2000. This is an increase between 2 and 3.7 times higher than for

⁶ Vision 2030: Making current approaches work for sustainable agriculture. Briefing note for expert meeting Agri-profocus September 2014. <http://agriprofocus.com/upload/Briefing-Note-Expert-Meeting-Sustainable-Agriculture-Agri-ProFocus1417623173.pdf>

conventional farmers.

Diversity of crop range: Organic farmers on average grow 50% more crop types than conventional farmers.

Experience of health outcomes: In the full organic group 85% rate their health today better or much better than in 2000. In the reference group, only 32% rate it positively, while 56% see no change and 13% report worse health.

In 2007, a meta-analysis of global yield data showed that, globally, Ecological Farming can, on average, produce about 30% more food per hectare than conventional agriculture. In developing countries, it can produce about 80% more food per hectare than conventional agriculture (Badgley et al., 2007).

Other studies have shown yields of organic farms to be, on average, about 20% lower than those of conventional farms (De Ponti et al., 2012; Jansen, 2015). The 20% difference in yields also reflects a difference in investments between organic and industrial agriculture. Investments in agriculture have been estimated to be around 90-95% (or higher) in favour of industrial agriculture since the onset of the Green Revolution. This is a small estimated difference in yields given this extremely uneven playing field (Greenpeace 2015, 30). Furthermore, on other factors like soil fertility, climate resilience and biodiversity, organic and eco-agriculture score better than conventional agriculture. It seems to depend on the contextual baseline situation whether agricultural productivity will increase.

Again other authors argue that in, what is called conservation agriculture, some elements of conventional agriculture have a positive effect on the farmers' situation regarding food security and poverty (Vanlauwe et al, 2014). These results should be read with caution since it should be realized that situations differ enormously and in different situations different approaches may be most appropriate. However, there is a broad consensus that main stream conventional agriculture with its high input of artificial fertilizer and chemical pest control is not sustainable, less climate resilient and less smallholder-friendly, and that other, more sustainable forms of agriculture can potentially produce sufficient food (Tittonell, 2014, Liebman & Schulte, 2015; Wegner & Zwart, 2011). Furthermore, that in terms of productivity per unit of land and per unit of energy, small and diversified farming systems perform better than large, intensive farming systems (Chappell and LaValle 2009; McIntyre et al. 2009). And concerning the profitability of agroecology, there are indications that its economic performance can be comparable to or even better than with conventional, agro-industrial farming (Chappell and LaValle 2009).

In the literature a number of authors have summarized the characteristics of agroecology in a number of principles (see Table 1). The first five principles in the table constitute the key principles of agroecology that have been formulated by Altieri very early in the conception of agroecology as a science. The other eight principles are later additions. Of these added principles, principle 6, like the first five principles, is an agronomic principle. The other additional principles are methodological and socio-economic principles.

The agronomic implications of agroecology, encompassing both environmental and economic aspects) is elaborated in Annex 2, for those interested. The social aspects come back in the paragraph about the role of Cooperation members.

Table 1. The thirteen principles of agroecology as identified by GIRAF (Stassart et al. 2012). Table adopted from Stassart et al. with translation by Stineke Oenema and Corné Rademaker.

<p>Altieri (2002), Reijntjes et al. (1992)</p>	<p>A. 'HISTORICAL' AGRO-ECOLOGICAL PRINCIPLES</p> <ol style="list-style-type: none"> 1. Recycling of biomass and balancing nutrient flow and availability 2. Securing favourable soil conditions for plant growth, through enhanced organic matter and soil biotic activity 3. Minimizing losses of solar radiation, air, water and nutrients by way of microclimate management, water harvesting and soil cover 4. Enhancing species and genetic diversification of the agroecosystem in time and space 5. Enhancing beneficial biological interactions and synergisms among agrobiodiversity components resulting in the promotion of key ecological processes and services 6. Valorising agro-biodiversity as the point of entry for the re-design of agricultural systems that ensure the autonomy of farmers and food sovereignty
<p>Département Sciences et Action, INRA (Tichit et al. 2010)</p>	<p>B. METHODOLOGICAL PRINCIPLES</p> <ol style="list-style-type: none"> 7. Promoting and equipping the multi-criteria steering of agro-ecosystems in a long-term transition perspective, including arbitrations between the short- and the long-term and in accordance with the importance of resilience and adaptability properties 8. Valorising 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 on an organic approach in animal husbandry as well as in crop production 10. Promoting 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 innovative techniques
<p>Groupe Interdisciplinaire de Recherche en Agroécologie FNRS GIRAF</p>	<p>C. SOCIO-ECONOMIC PRINCIPLES</p> <ol style="list-style-type: none"> 11. Creating collective knowledges (connaissances) and capacities of adaptation through networks involving producers, citizens-consumers, researchers and technical advisers of public authorities, which promote deliberative forums, public debate and knowledge dissemination 12. Promoting possibilities of choices of autonomy relative to global markets through the creation of an environment favourable for public goods 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 with high labour intensity 13. Valorising the diversity of knowledges (savoirs) by taking into account: local or traditional knowledges and practices (indigenous technology knowledge; ITK), ordinary knowledges both in the framing of problems and the framing of the public concerned by these problems, and in the search for solutions

Transforming agriculture – the contribution of Cooperation members

We already indicated that agro-ecological systems first of all start from the position of the (female and male) farmers, their community, their own knowledge of local conditions and their relation to their natural environment. Starting from this position, agro-ecological systems aim to maintain the ecological functions that natural systems provide while developing a robust, productive, resilient and fair food system. This means integrating rather than segregating, increasing diversity instead of restricting it and regeneration of natural capacities, not degradation. It also means thinking of inputs and wastes in terms of cycles rather than as linear processes in which fossil fuel-derived inputs are practically considered to be endless, nutrients are lost, chemical residues are ignored and animal feed is transported halfway round the world (CONCORD 2014).

Agriculture landscapes are often a result of agriculture management and ecological structure. ICCO understands that agriculture sector is not only for producing provisioning services like agriculture products and raw material, it also provides environmental and habitat regulation services and recreational and supporting services. ICCO supports agriculture management aiming at the maintenance of broader ecosystem services.

The agro-ecological paradigm as described above, exists in many countries and is promoted in much of the projects and programs of Cooperation members' partners. Yet, it is still scattered and most of it relatively small-scale. These examples established so far within the networks of ICCO and other Cooperation members and sometimes outside, deserve up-scaling and support from the Cooperation members. This type of farming system needs to be strengthened and promoted where possible. Cooperation members will support its partners and members to work towards and according to this agro-ecological paradigm. In what types of activities and programmes this is to be done, is presented below.

We order the activities according to the two major principles of the MASP, securing 'sustainable livelihoods' and 'justice and dignity for all' and according to the major strategies of the cooperation, civil society and institution building (including land tenure, financial services, market development), education (including technical assistance), sound investments and lobby&advocacy (for the observance of human rights, at all levels).

Justice and dignity for all

Worldwide access to land and other natural resources, including access to public policies and governance decisions and practices on these resources, is often based on unequal power relations leading to poverty, exclusion and created scarcity that negatively affect rural people and their communities. Sustainable livelihoods based on the agro-ecologic paradigm for the vast majority of rural people can only be strengthened by empowering both their participation (*voice in*) in public policies and governance, and their responsibility (them having *voice over*) their own farms, land and natural resources. In light of the currents trends in international agribusiness, as presented below, this is very important!

Context of Agribusiness market development.

The overall problem in linking small holders to fair markets is that in agriculture and food imperfect markets predominate. Some authors see the behaviour of Transnational corporations in agribusiness as the main problem. They briefly summarize the situation with respect to agricultural production as follows (Clapp, 2014; Agropoly, 2013)!

First of all there has been a strong concentration of Transnational corporations (TNCs) in agribusiness and food production. In 1996, the ten biggest seed companies had a market share of less than 30 %. Today, the three largest control more than 50 % of the market. Often seeds become more expensive with fewer varieties available. The three market leaders in seeds are also major pesticide producers. By genetic modification the TNCs can get patents on seeds. Of the global soy production just over 50% is gmo and of corn this is about 30 % (World watch Institute, 2013).

Secondly, the powerful control the chain. Farmers are pressurized by corporations. The TNCs pay low prices for the farmers' produce such as soya, wheat, and maize, and they pay high prices for seeds, pesticides, energy, fertilizers and animal feed. The record food prices of 2008 resulted in higher profits for corporations, and not for farmers who have to bear all the risks. Just an example. Vietnamese aquaculture farmers produce Pangasius fish, for which Northern consumers pay around US\$ 10 per kilo. The farmer gets US\$ 1. After deduction of production costs their income is 10 cents per kilo. And the farmers bear all the risks of aquaculture such as fish diseases and weather problems; many also have debts to the aquaculture companies.

Thirdly, the TNCs also increasingly control the chain. In addition to horizontal integration, where one company controls a large share of the market, corporate strategies aim at vertical integration by processing the product and producing inputs. This is not about distributing business risks across several sectors but about controlling the value chain and access to cheap raw materials.

Furthermore, world trade dominates prices. Although 85 % of all food is consumed close to where it is produced, global trade actually has a disproportionate influence on prices. On the stock market, batches of the same soya and maize may be traded speculatively several times over, thus increasing price volatility.

Finally, the TNCs in agribusiness display enormous lobby efforts. Thousands of lobbyists promote corporate interests, among others in government institutions. They often successfully lobby for corporate interests on food standards, approval of pesticides, GM seeds, trade agreements, or the public research agenda. Although the TNCs officially promote competition in an open market, in fact they try to achieve favourable positions.

One study of the neoliberal food policy summarizes the situation as follows. "Neoliberalism has produced an unsustainable food system, which might prove inadequate to nourish future generations. Notwithstanding the steady food price increases, natural resources deterioration, loss of resilience of agricultural systems and climate change disturbances, international bodies and national governments continue to propose neoliberal policies. Privatization and deregulation are passed off as bulwarks of liberty and efficiency, while they are consigning the system to corporate power and transnational financial elites. All this is made possible not only through the power of organizations with vested interests, but also through the adamant trust of the majority of academics and bureaucrats in the mainstream economics" (Sodano, 2012).

To this analysis that clearly outlines the problematic role of TNCs we would like to make two additional remarks. First, though the role of TNCs is powerful and problematic, they do not dictate everything. Farmers and farmer organisations, sometimes together with NGO's, succeed in setting up of fair markets for certain products independent of TNCs, in all parts of the world. Second, criticising the behaviour of (many) TNCs does not at all mean a rejection of private sector involvement in agribusiness. Private initiatives and investments are crucial in agriculture. Developing fair markets for agricultural products is an essential part of policies that pursue the enhancement of production and access to nutritious food for all people. In an agricultural and food system in which the power is distributed more justly through the chain and that works sustainably, at least according to triple P, also TNCs can play a useful role.

Working towards market development

It will be clear that this situation puts an enormous challenge to the Cooperation members to promote the development of markets for small holder farmers in the global South. Change should take place at all levels, from the local situation and capacities of the farmers to the global food system and financial markets.

Cooperation members want to take a market systems approach which means that market development will be facilitated in such a way that they include the poor and make them strong actors in their value chains rather than beneficiaries of temporary access to land and use of land and services received. This approach is more systemic than conventional approaches that often strengthen target groups to access markets without changing market systems. Both should be done. This means that smallholder farmers require different forms of support to optimize their engagement with markets. Evidence suggests many of the opportunities and benefits relating to new markets and increased agricultural investment currently observed, reach only the wealthier and better-connected smallholder farmers, representing a small minority of the overall smallholder population. Cooperation members have extensive experience of successfully supporting smallholder farmers in becoming more entrepreneurial, particularly those poorer farmers who were previously excluded from markets, including women farmers. Case studies confirm that, given the right support, these farmers are able to increase their productivity and competitiveness and participate in traditional, restructured or new markets. The challenge is to facilitate this process on a larger scale.

It should be realized that domestic markets hold greater promise for many smallholders than international markets due to fierce competition in export markets and the high cost of certification and meeting standards. As a consequence, the majority of farmers will not benefit from being integrated into corporate supply chains such as contract farming, without concerted action to protect their interests and ensure fair value sharing, and support for farmer groups. Local governments should work towards such an enabling environment for (small) farmers, by establishing an institutional context of, among others, land rights and register, financial services, knowledge infrastructure and should support small farmers by taking steps to boost local demand and provide incentives to buyers, both in the public and private sectors, to source from smaller producers.

To support an increased inclusion of small producers and workers, in particular of marginalized groups, women, indigenous people and youth, the capacity development in Lobby and advocacy of farmers' organisations and CSOs representing these groups should be supported. Access to land, productive

resources, financial services, skills, and access to markets are main issues for L&A. Pathway #3⁷ of the strategic partnership of the ICCO Consortium (in which all the Cooperation members participate) with the Dutch Ministry of Foreign affairs on 'Convening and convincing', in the first place aims at those who own or have user rights to land, even a small area. Many of the interventions and policies developed under the programme are less likely to be relevant to subsistence farmers with very little or no land and other assets. The poorest of the rural poor are more the focus of pathway #2.⁸ Although at international L&A-levels the differentiation between categories 2 and 3 is not so obvious, at national levels the third category rural poor does require a separate set of measures to be advocated for. These should be aimed at protecting their interests, including incentivizing off-farm job creation, in agribusiness and elsewhere; vocational skills, fair labour practices and protection of workers' rights; social protection and productive safety nets; and voice and representation in policy decisions.

Strengthening the enabling environment requires influencing policies, rules, and regulations for a good business environment for inclusive value chains and decent working conditions. Promoting and developing inclusive value chain governance, thus influencing decision-making in value chains, is key to making a sustainable impact. Furthermore, rules and regulations that promote fair and inclusive trade and investment policies are part of the enabling environment.

Also governments have a crucial responsibility here. When they cooperate internationally they should be able to resist unjust and improper influences of TNCs. They should promote an enabling environment for small holders to apply agro-ecological approaches and to develop local and regional markets. NGOs should lobby governments to put such policies in place and if possible together with governments form a countervailing power to the TNCs.

Securing sustainable livelihoods

Sustainable livelihoods are based on the dynamic and balanced relationship between man/women and nature, and between man/women and society. The agro-ecologic approach of Cooperation members fully recognizes the complexity of the different forces at work and thus has a preference for multi-stakeholder processes in order to create resilient farming systems. Agroecology is an indispensable approach not only for creating sustainable livelihoods for the (small) producers, but also in relation to obtaining food and nutrition security for all. Its value chains not necessarily nor preferentially develop via the world market but primarily aim for direct relations at shorter distances between consumers and producers. It aims for indigenous development (see former section and ICCO economic charter). We emphasize that our focus is on the small holders; this does not rule out that in a broader view it may be desirable that larger farms will be established that (also) produce for the world market, as long as it is in agreement with social and ecological responsible entrepreneurship.

Where poverty and lack of food security increasingly become a rural phenomenon, these direct relations must and can be improved. Direct links between rural and neighbouring urban areas show interesting opportunities. A territorial approach of rural development will empower the still underdeveloped but already multifaceted potentials that exist between cities and surrounding rural areas. This approach implies working with a double focus: the empowerment of both rural and urban actors.

⁷ Small producer empowerment and inclusive markets

⁸ Realizing the right to adequate food.

The recent crises in food prices highlighted the vulnerability of poor people to volatile food prices, and vaulted the issue of food security to the top of the global agenda. As smallholders produce up to 80% of the food consumed in Africa, Asia and Latin America, a lot of emphasis is being placed on finding ways to help them increase their output to meet growing demand. But smallholders are central to the question of food security not only as producers but also as consumers of food: the majority of smallholders are net buyers of food, and volatile food prices greatly increase their vulnerability and threaten their own food security (IFAD 2010). Maintaining adequate food production and developing resistance against price shocks should be a founding principle of all agricultural market access interventions. A recent study into the impact of the food price crises on smallholder farmers and small businesses finds that risk and vulnerability are long-standing, overriding concerns guiding their economic activities, and makes a strong recommendation for a policy response that prioritizes reducing risk and vulnerability. The report emphasizes the need for macro-economic stability, including reducing inflation, price and currency volatility (respondents in workshops confirmed that price stability mattered more than absolute price levels), and recommends support for G20 action on reforming the international monetary system and commodity market speculation. However 'food security' also encompasses the issue of persistent hunger which today still affects almost one billion, according to latest FAO estimates, and malnutrition. It is therefore that the Consortium makes an extra effort to ensure that agricultural programs include improved nutrition and health outcomes for women and children as a key objective. Growing more nutritious varieties of staple crops that have higher levels of micronutrients like vitamin A, iron, and zinc can potentially reduce death and disease, especially of women and children. Producing more diverse crops, especially fruits and vegetables, can also help to combat malnutrition, and selling more nutritious food could increase incomes and provide additional employment (IFPRI 2011).

Cooperation members will develop agro-ecological programmes that promote indigenous development and sustainable (local) food systems, facilitating direct relations between producers and consumers, taking into account market-led approaches among which food production attuned to the demands of the Bottom-of-the-pyramid (BoP) deserves specific attention. Emphasis on ICCO's focus on Women and children.

Civil society and institution building

Independent civil society organizations (CSOs) play an indispensable role in development cooperation⁹, and –related to this agroecology policy paper- in the promotion of agro-ecological practices. Strong CSOs more and more are working with a multi-stakeholder approach (also called: programmatic approach), inviting different actors to participate in programmes with shared objectives. At the same time we see the political and operational space for CSOs change worldwide. New opportunities arise, but at the same time spaces shrink. CSOs working on land governance often face restrictions and counteraction.

Being part of civil society themselves the Cooperation members will continue to empower CSOs that work in rural areas and on agro-ecological development. More specifically they will

- Help local CSOs improve their capacities to cooperate with other stakeholders. This strategy can be linked to the Convening & Convincing pathway 'enhancing political and operational space for CSOs).
- Support in institution building, thus creating an enabling environment for agro-ecological practices.
- Help to develop land and natural resource governance policies, financial institutions, and inclusive markets.
- Enhance specific institution development activities that favour agro-ecological development.

At the same time we realize that in the development of some of these institutions, viz. market systems and support systems that also work for the poor, the role of CSO is relative small. The promotion and establishment of such systems should be realized by market actors in such a way that agro-ecological practices are mainstreamed. This underlines once again the importance of a multi stakeholder approach!

Education and technical assistance

Agro-ecological agriculture is scientific knowledge-intensive, builds on local knowledge and requires sound agricultural education and vocational training, which is important for innovations and processes to transform current agricultural practices into the desired one.

In agroecology bottom-up processes are promoted, with farmers (food producers) in the driving seat. It builds on the positive creative interaction between a farmer and her environment. Farmers, especially female and small scale, need to be in the centre and deserve our support.

For Cooperation members this leads to the following activities in the area of Education and Research¹⁰:

- support smallholder development both in the technical and organizational capacities of the smallholders themselves.
- as well as in their interactions with markets, large-scale farming, the agri-business and investors (see principles 11-13 of Table 1).
- In this way Cooperation members aims at locally sustainable agriculture, an increase of income, food and nutrition security, and local economic development, including increased employment opportunities.

By the identification of best practices Cooperation members, together with the partners, seek to learn constantly and attempts to implement new knowledge and experience in the programmes.

Lobby

A transformation to an agro-ecological paradigm requires lobby activities to bend economic and political structures non-conducive to agro-ecological innovation. In its lobby work at the local and national level

¹⁰ Evidence confirms that investments in agricultural research for development have a significant effect on growth in the agricultural sector. Investment levels are far below what is needed to help farmers effectively respond to the challenges of increasing production sustainably and building resilience in the face of climate change. Funding for such research would need to come primarily from public funding. Farmers need to have a greater say in setting research agendas. A strong extension system is critical to moving research between the laboratory and the field, but extension coverage is generally very low, requiring renewed investment from the state, including in providing incentives for private providers. Extension services can no longer have a simply technical agenda. In the service provision model the focus is shifting to pluralistic and demand-led approaches. Appropriate research and extension can also help narrow the gender gap in agriculture.

in the South, ICCO will plead for more support for agroecology and will use positive examples in order to demonstrate the potential of agroecology to improve food and nutrition security, to mitigate climate change and to protect and promote biodiversity.

One of the preconditions to make this happen is to guarantee stable, reliable and just access of small producers and other rural people to, and control over, productive resources such as water, land and genetic material such as seeds and tubers. This means that we will support and also realize lobby for the realization of land registration and of land rights of (female) farmers, and we will realize lobby and advocacy to enhance their inclusion in public policy debates, land governance etc.

Related to this Cooperation members will also lobby on Human Rights and business. This lobby builds primarily on the inclusion of Economic, Social and Cultural (ESC) Rights in sustainable business. In this lobby ICCO will have to identify those businesses that are willing to incorporate agro-ecological principles in their agribusinesses.

The ICCO cooperative acknowledges the interrelatedness between the agricultural and food systems in the global North and South and acknowledges that this interlinkages need to be challenged in order to be able to sustainably feed the world.

So, at international level (Europe and beyond) Cooperation members will support:

- those lobby trajectories that promote self-determination and governance of small scale farmers.
- policies that provide farmers to take decision over their own lives/livelihoods. In this context the CSF&CSM can fulfil an important role.¹¹
- an enabling environment : markets, trade, rural infrastructure, agro-education etc. to allow small scale farmers to sustainable invest in their businesses.

In Europe and Netherlands the Cooperation members will support the following two lobby trajectories. First, lobby that focusses in particular on the promotion of food system that joins sustainable consumption in the North, with sustainable production in the South. Second lobby that concentrates on global value chains. International trade policies and practices can damage smallholder farmers' scope for accessing markets through distorting local prices for agricultural produce and limiting local producers' capacity to compete. These include EU export subsidies; tariffs on processed foods; and production incentives that lead to over-supply. Farmers' interests would be well served by efficient implementation and monitoring of international measures aimed at addressing these issues, including trade defence measures such as anti-dumping measures.

Partners in the lobby

Cooperation members perform lobby-activities themselves, especially in the Netherland. In the lobby at international levels they closely cooperate with partners. Below the main partners are mentioned.

¹¹ CSF: The committee on world Food Security is an intergovernmental body that allows CSOs political space to raise their voice and have a direct say in policy making. Farmers organizations and other small scale food producers, as well as other constituencies who represent people that suffer from food insecurity and malnutrition are represented in the CFS (CSM refers to the NGO's that work together in the context of the CSF). ICCO will provide support in lobby these groups need and deserve. This fits smoothly into more political space for CSO's.

NGOs, social movements and networks

- Ecumenical Initiative facilitated by the World Council of Churches (WCC-EAA); lobbies at international level for Food security and supports participants in lobbying; developed position paper about agroecology and its potential to support realization of the right to food.¹²
- ACT/Aprodev: Network of diaconal and development agencies of major protestant/ecumenical churches
- CFS and CSM: civil society related to CFS collectively asks for agro ecological approaches to support food security and nutrition. Several organizations have examples of how agro ecology promotes better diets through diverse production patterns
- EFSG: recently developed policy document: diversity for food security in which agroecology plays an important role
- APF: several members jointly prepared a seminar about agroecology
- ACT-EU: FNS working group, looking at the EPAs (i.e. Inclusive import standards, less disruptive export standards, negotiating capacity building LDCs)
- Concord: FNS/EE agenda, focussing on pro-poor and coherent policy agenda
 - Integrating environmental sustainability
 - Promoting participatory governance, transparency and accountability
 - Financial institutions reform
- IFOAM, Organics International <https://www.ifoam.bio/en>

Knowledge institutes

The most obvious for ICCO in this field are:

- ISS, International Institute of Social Studies, <http://www.iss.nl/>
- Wageningen University and research centres, www.wur.nl
- Food and business Knowledge platform, <http://knowledge4food.net/GFRAS>, Global Forum for Rural Advisory Services (GFRAS) <http://www.g-fras.org/en/>
- CGAP, The Consultative Group to Assist the Poor, <http://www.cgap.org/>
- M4Phub Sharing knowledge on making markets work for the poor, <http://m4phub.org/about-m4p-hub.aspx>

Private sector

We are convinced that the fight against poverty and injustice, including hunger, can only be won if private companies, governments and NGOs team up. ICCO is cooperating with private companies to improve the social and ecological conditions of the (agro-)business, e.g. with the Dutch companies Albert Heijn and Heineken.¹³ Another example is EOSTA, a Dutch based international importer and distributor of fresh organic fruits and vegetables, which developed a unique trace and tell system and is

¹² For the view of WCC-EAA on Agroecology, see http://www.e-alliance.ch/typo3conf/ext/naw_secured/secure1e4e.pdf?u=0&file=fileadmin/user_upload/docs/All_Food/2012/AgroEcology/2012_10_ScalingUpAgroecology_WEB_.pdf&t=1433845242&hash=ead956a12135b570a11b2b6c6fe600bb

¹³ See: ICCOnomics. The right way to do business. Utrecht: ICCO, 2015; <http://www.icco-international.com/int/news/news/download-new-version-of-icconomics/>

involved in the RVO funded Buen Apetito program of ICCO South America. See also ‘Sound investments’. ICCO is also NGO representative member of the Steering Committee of the Fresh & Ingredients Program of IDH.

Sound investments

Two Cooperation members have investments programmes, ICCO and Woord en Daad. ICCO investments¹⁴ (Capital for development, C4D) and Incluvest¹⁵ in a variety of ways make investments that are explicitly supportive to the empowerment of small producers, the first link in value chains. By enhancing their economic power, not only through increased incomes, but also by them having access to economic policy decision making processes higher up in the value chains, small producers can improve their access to land and other natural resources. (For further information on policies and processes we refer to the websites).

Cooperation members, together with financial institutions, considers to create a credit fund for land acquisition for small farmers. Where land ownership is imperative for farmers to invest in improvements, agroecology is strongly served by farmers with secured access to their land. The proposed credit fund may also include the investments in said improvements.

Characteristics of investments

- Grants of the Cooperation members should be used strategically to support agro-ecological innovation, improve outreach , efficiency etc.
- ICCO investments and Incluvest should also attempt to reach the ‘bottom’ of the ‘missing middle’, in order to promote people-centred and local agricultural development.
- Possibly investments should take into account a transition period to allow for an intermediate period with lower yields for soils to restore soil fertility.
- Investments, both grants and loans, should promote a progressively decline in the unnecessary use of agro-chemicals (where this is still the case), by using agro-ecological methods.
- Investments should allow for development of knowledge to support agro-ecological transformations. (Example DRC (year report 2013): local soil research indicates that allowing for precise and specific soil treatment and use, resulted in higher yields and less external inputs, leading to higher income for farmers.

Closing remarks

The programmes related to Food and Nutrition security and (agricultural) economic development, are at the heart of Cooperation members’ activities. These include programmes aiming to promote inclusive agribusinesses and agro value chains, both by grants and by investments, and at the promotion of land tenure and land rights for small holder farmers. These programmes are all related to agriculture. A vision on agriculture informs those programmes and provides a link between them. This underlines the

¹⁴ <http://icco-investments.org/>

¹⁵ www.incluvest.com/

relevance of this document in which the vision of Cooperation members on agriculture is presented. The elaboration of the vision concerns only the conceptual framework since the actual strategies, interventions and activities need to be defined based on local contexts and in view of more precise objectives. Hopefully this vision paper will support the elaboration of such plans and provide a basis for coherence in the activities of Cooperation members that relate to agriculture.

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Annex 1:

Requirements for the agricultural policy and the agricultural system (systemic change) we strive for¹⁶:

Requirements	Triple P categorization
<ul style="list-style-type: none"> • Agriculture should primarily provide sufficient, safe and adequate food • Agriculture should provide employment and income (decent living and dignity) • Agriculture should be financially and environmentally viable • Agriculture should not contribute to further negative climate change, should contribute to carbon sequestration 	<p><i>people</i> <i>people, profit</i> <i>profit</i> <i>planet</i></p>
<ul style="list-style-type: none"> • Agriculture should contribute to environmental recovery (including the soil and forests) • Agriculture should not lead to environmental degradation and pollution (use of pesticides and fertilizers beyond the inevitable) 	<p><i>climate/planet</i> <i>planet</i></p>
<ul style="list-style-type: none"> • Agriculture only should supply energy when not competing with food and feed: it could make use of new, “circular techniques’ that allows local reuse of rest material for energy and compost 	<p><i>planet</i></p>
<ul style="list-style-type: none"> • Agriculture should contribute to local area development • Agricultural system should be diverse and contribute to bio diversity, or not contribute to loss of bio diversity 	<p><i>people,</i> <i>planet, profit</i> <i>planet</i></p>
<ul style="list-style-type: none"> • Agricultural system should make more sustainable links from agriculture to value chains and markets 	<p><i>people, profit</i></p>
<ul style="list-style-type: none"> • The agricultural system should allow for sustainable (local) linkages between towns and rural areas (and contribute to local area development) and could facilitate eco-tourism 	<p><i>people planet</i> <i>profit</i></p>
<ul style="list-style-type: none"> • Agricultural system should allow to add local value (lower in the chain, nearer to the farmer (in country) 	<p><i>people, profit</i></p>
<ul style="list-style-type: none"> • Agricultural system should not contribute to a food system in which obesity and waste are pandemic problems 	<p><i>people, planet</i></p>
<ul style="list-style-type: none"> • Agricultural system should allow for a financial system that incorporates other values, such as nature, good food etc., apart from purely financial value (no externalization of ecological or social costs) 	<p><i>people,</i> <i>planet, profit</i></p>
<ul style="list-style-type: none"> • Agricultural system should allow for disaster risk management and other risks management (also income related) 	<p><i>people</i></p>
<ul style="list-style-type: none"> • The agricultural system should acknowledge the existence, living and dignity of 1 B people that depend on subsistence agriculture (not just focus on value chains) 	<p><i>people</i></p>
<ul style="list-style-type: none"> • The agricultural system acknowledges the productive capacity of God’s Creation as a gift to all humankind (and not just to corporations), calling for an attitude of modesty because of the limited <i>positive</i> influence we can have on it, and of respect for its ‘wholeness’ the limited influence we as cooperative we can have on God’s Creation and its “wholeness”. 	<p><i>people, planet</i></p>
<ul style="list-style-type: none"> • Agricultural system should allow freedom of organization 	<p><i>people</i></p>
<ul style="list-style-type: none"> • Agricultural system should strengthen gender balance in work load, income, decision power, etc. 	<p><i>people</i></p>
<ul style="list-style-type: none"> • The agricultural system the ICCO Coop is looking for, should lead to empowerment of people and take into account the demographic development 	<p><i>people, planet</i></p>
<ul style="list-style-type: none"> • In the agricultural system of the ICCO Coop consumers appreciate agriculture and its products 	<p><i>people</i></p>
<ul style="list-style-type: none"> • The Agricultural system of the ICCO Coop puts people at its centre and is modest in its nature 	<p><i>people</i></p>

¹⁶ Requirements based on input from staff of Cooperation members and program officers.

Annex 2: The agronomy of Agroecology

In this section we briefly describe the key agronomic practices and mechanisms that should get attention to obtain the desired transformation from agro-industrial to agro-ecological farming.

Crop choice, crop spatial distribution, and crop temporal succession

Crop resistance to nitrogen (N) and water deficiency, pathogens, and diseases can be enhanced by choosing the appropriate cultivars. Furthermore, in combination with intercropping (enhancing spatial distribution) and crop rotation (enhancing temporal crop diversity), this can be an effective strategy to lower the risk of crop losses due to disease incidence. Although as yet not much is known about it, the selection of crops that favor the development of beneficial soil organisms, notably arbuscular mycorrhizal fungi (AMF) and plant-growth promoting rhizobacteria (PGPR), deserves attention.

The use of cover crops can lower artificial fertilizer input, reduce the risk of water contamination due to leaching, and reduce soil erosion. Soil biological activity is typically enhanced, and, if leguminous plants are used as cover crop, due to atmospheric N fixation in the roots of the leguminous plants, additional N is added to the soil that benefits the subsequent crop. It should be kept in mind that cover crop practice increases labour demand and the risk of pest development in subsequent crops. Some crops can function as cover and trap crop, but also as biocontrol, biofumigant, and biocidal agent against pests.

Crop rotation can be used to optimize nutrient availability and to reduce the reliance on artificial fertilizer. An example is the use of leguminous crops, just mentioned. Certain crop rotations prevent soil erosion by providing soil cover, but they also improve carbon content and soil fertility. Other benefits are the prevention of successive host crops for diseases and the reduction of weed infestation. A typical crop rotation scheme is maize/maize/grain legume, which means that a third of the total harvest of one crop cycle consists of grain legumes. This can be a drawback in (sub)tropical conditions because grain legume demand of households is typically less than maize demand (cf. Giller et al. 2009). If crop rotation is to take hold, alternative markets have to be found for the grain legumes (which currently may be achievable for e.g. soybean).

Intercropping is the coexistence of two or more crops in the same field at the same time. Its advantage is that the complementarity of certain crops is used to improve land productivity. This has positive impacts on resource use efficiency. Mechanisms through which this obtains differs as to the crops used, but include improved soil phosphorus availability, improving organic fertilization, weed infestation mitigation, soil physical structure and fertility improvement, and the prevention of soil crusting and erosion.

A specific interesting example of intercropping is agroforestry. In this practice, multifunctional trees are incorporated into agricultural systems. This reduces nutrient leaching, conserves soils, increases diversity of the production system, and produces wood for various uses. A specific example is the use of *Faidherbia albida*, a N-fixing acacia species indigenous to Africa, that can be grown together with maize. During the growing season of the maize, the acacia doesn't compete significantly with the maize for light, nutrients, and water, because it has shed its foliage. On the other hand, the fallen foliage fertilizes the maize field, leading to significant increases in maize yield, especially on poor soils (De Schutter 2012).

Challenges for the adoption of intercropping in general and agroforestry in particular are higher management needs, loss of cropped land for the main crop, and often a higher labour demand (although according to Olivier De Schutter the latter may be seen as an advantage in poor rural areas because of the generally high unemployment rate there (De Schutter 2012).

Crop fertilization

Crop fertilization can be split in time and space. If split in time, several N fertilizer applications are performed over time so that N use efficiency of the crop is enhanced. The drawback of this technique is, however, that it requires tools to measure actual N uptake of the crop and the increased labour demand. Fertilizer application can also be split in space (although not mentioned by Wezel et al. (2013)), which means that fertilizer is applied in microdoses to individual crops.

Another way to reduce fertilizer inputs while improving nutrient availability is to use biofertilizers. Biofertilizers are “substances which contain living microorganisms which, when applied to seed, plant surfaces, or soil, colonise the rhizosphere of the interior of the plant, and promote growth by increasing the supply or availability of primary nutrients to the host plant” (Vessey 2003). Well-known are the N-fixing rhizobia that live in symbiosis with legumes. Other micro-organisms such as AMF and PGPR are assumed to promote plant growth. There is a commercial *Azospirillum* inoculant available for a variety of crops in Africa. However, drawback of AMF and PGPR is that there is still much unknown about them and effects seem to vary across crop varieties and field sites.

Organic fertilization enhances soil biological activity and potentially increases soil mineralization. However, potential constraints include higher labour demand and difficulty in optimizing N availability in soils. Moreover, obtaining organic fertilizers may be difficult because many crop residues are used for animal feed in Africa (Giller et al. 2009). On the other hand, animal manure is a valuable organic fertilizer as well. Yet, this requires the introduction of livestock on the farm. This may be a challenge in the African context because livestock are often also left roaming around (communal grazing).

Weed, pest, and disease management

As Isman (2008) argues, the use of natural pesticides is an opportunity for resource-poor farmers in sub-tropical and tropical developing countries, because many natural pesticides are derived from plant species from the subtropics and tropics, while there often is longstanding indigenous knowledge of using plants and plant extracts for mitigating pests in those areas as well. The use of natural pesticides promises benefits both in economic and human health terms. The use of locally available plants species to produce natural pesticides can potentially diminish farmer’s reliance on expensive pesticides (e.g. Coulibaly et al. 2002), while it can also stimulate local specialized natural pesticide production. Considering the fact that harm to human health from pesticides mainly occurs in developing countries due to a lack of knowledge of the harmful effects of pesticides, the use of natural pesticides may diminish harm to human health because usually crude plant preparations (containing between 1 and 5% of the working substance) are used and not the pure working substance (Isman 2008).

Allelopathic plants release active biomolecules, ‘allelochemicals’, into the environment that negatively impact the growth and development of weeds, pests or diseases. For instance, crops such as rye, sorghum and sunflower release root exudates that directly inhibit weed germination and/or development (Albuquerque et al. 2010). Inclusion of allelopathic plants into crop rotations as cover crop

or intercrop therefore provides a means of reducing the need for expensive pesticides. Challenges for the use of the allelopathic properties of plants are, however, the lack of understanding of biological processes, the high dependence on local circumstances, and the fact that allelopathic plants can also function as hosts for pests.

Another way in which pesticide use can be diminished is by making use of natural enemies of the pests involved (e.g. Herren and Neuenschwander 1991), also known as biological pest control. Challenges for the use of biological pest control are, however, the increased management and costs and the high knowledge requirement. As to the latter, it is good to know the possible effects of the introduction of non-native species on local biodiversity.

Tillage management

Although not completely uncontested, reduced or no tillage is generally taken to reduce energy inputs, decrease soil erosion, reduce soil compaction, increase soil biota activity, and increase soil organic matter and hence carbon sequestration. The lowered demand for energy inputs is often beneficial in resource-poor environments because the need for expensive tractors and equipment is eliminated or reduced and/or labour requirements are decreased. With reduced tillage the soil is only worked to a depth of 5-15 cm.

The most important challenge for reduced or no tillage is weed control, as tillage normally reduces the germination and development of weeds. This may result in increased demand for herbicides and/or increased labour requirements for hand weeding. In some cultures the increased labour requirement disproportionately falls on women (Giller et al. 2009).

Management of landscape elements

The inclusion of landscape elements such as hedges and vegetation strips have potential to provide habitats as well as additional resources for beneficial insects or other pest predators. As they also attract pollinators, this may result in improved crop pollination. Moreover, landscape elements protect against soil erosion. Overall, landscape elements maintain or improve biodiversity in the area.

Challenges for the promotion of the inclusion of landscape elements include: (1) landscape elements may also harbor pests; (2) the efficacy for natural pest control may vary considerably; (3) the development or maintenance of landscape elements reduce the area available for crop growth; and (4) landscape elements require maintenance by the farmers.

Farm diversification

Agroforestry was already mentioned as a way to improve (crop) diversity on the farm. However, farming systems can also be made more diverse by the inclusion of livestock (including poultry). Livestock offers opportunities in terms of the provision of manure and traction for crop production. Moreover, animals act as insurance against hard times and are a source of regular income from the production of meat, milk, eggs, and other products (Herrero et al. 2010). By combining crop and livestock farming on the farm, optimal use can be made of the ecological relationships among them.

The biggest challenge for mixed agroecosystems is the competing use of crop residues for, on the one hand, the production of mulch and, on the other hand, feeding livestock (Giller et al. 2009; Valbuena et al. 2012).

Recently, the opportunities of the production and consumption of insects by humans and animals for food security have caught attention (Van Huis et al. 2013; Van Huis 2013; Nadeau et al. 2015). The advantages of insect production and consumption include: (1) the provision of an alternative high-quality protein source in the face of rising world prices for grain, and consequently meat; (2) lower emissions of greenhouse gases than conventional livestock thus contributing to climate-smart farming; (3) the possibility to use organic waste streams to feed the insects; (4) potential to replace expensive protein ingredients from animal feed; and (5) in the case of many developing countries, the connection with an, at least in the past, traditional practice of insect consumption.

Challenges include: (1) the development of sustainable harvesting practices (from the wild); (2) the enhancement of natural populations by semi-culture; and (3) the set-up of cottage industry-like rearing facilities (Van Huis 2013). In the latter case another challenge is that the organic residues needed to feed the insects can compete with both the organic residues needed for providing mulch and/or livestock feed in (sub)tropical contexts.

