

Innovation and resource efficiency – the way forward is reducing chemical input dependency

PAN Europe position paper
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The key focus in the entire EU debate on innovation and resource efficiency, aiming at combining the concepts of productivity and sustainability under the official slogan 'achieve more from less' should according to PAN Europe be 1) encouraging intelligent use of nature in the agricultural sector integrating the concept of sustainability and productivity and 2) encouraging increased diversification by integrating new actors into the sector to ensure new thinking of the food chain.

While PAN Europe welcomes the good intention of bridging the gap between research and agriculture, as part of the debate on innovation, we encourage some steering aiming ensuring long-term food security, and on the importance of focusing on how agricultural practices can deliver, and highlights the need to develop some solid CAP indicators, starting with measuring dependency on external chemical inputs.

Resource efficiency and Innovation: the challenges to target

Today's agricultural practices contribute to several persistent and serious environmental problems (e.g. climate change, water contamination and shortage, soil degradation and biodiversity loss), as recognized by the sustainable use directive and the 2008 UN International Assessment of Agricultural Science & Technology for Development (ISTAAD 2009).

The main agricultural pollutants are nitrates and pesticides (Shortle and Abler, 1999), and European consumers consider pesticide residues in their food as the main food risk (Eurobarometer 238 from 2006 and Eurobarometer 354 from 2010).

The way forward to integrate the concepts of sustainability and productivity is 1) promoting integrated production, producing while taking care of the environment and public health, and implemented as holistic approach based on a solid package of agronomic techniques in combination with physical, mechanical and biological pest control practices reducing chemical dependency and 2) involving new actors in the food chain able to help encouraging the needed diversification in the production system

"Approaches that promise building blocks towards low-input high output systems, integrate historical knowledge and agroecology principles that use nature's capacity, should receive the highest priority for funding." (SCAR foresight)

2. Smart and sustainable growth – a combined approach

Danish studies on wild plant species from 1970 to 1990 has shown a reduced by 60% in the cultivated fields. (Andreasen et al., 1996.) Moreover, the pesticides also damage the natural flora and fauna on the bordering conservation areas. In addition they frequently cause contamination of groundwater. Weed that can grow in cultivated fields comprise approx. 200 wild plant species, but approx. 80% of them are so weak in the competition with the crops that they

do not affect yield substantially in any well-run farms. It is therefore mainly the remaining 20% of weed species that are so competitive that they can affect the yield significantly. The 20% of damaging weed is the reason why the combat against pests continues to increase (Andreasen et al, 1996).

The negative impact of pesticides on wild plant and animal species on European farmland has recently been documented by scientists from nine European countries, concluding: "If biodiversity is to be restored in Europe and opportunities are to be created for crop production utilizing biodiversity-based ecosystem services such as biological pest control, there must be a Europe-wide shift towards farming with minimum use of pesticides over large areas."(Geiger et al, 2009)

254 participants of the 12th Congress of the European Society for Agronomy (August 2012) compass wider effects from reduced use of fertilisers and pesticides, increased farmland biodiversity, and global benefits from more diverse production, highlighting that more diverse and resilient cropping patterns also have long-term agronomic and economic benefits (<http://www.european-agronomy.org>)

It is time for a paradigm change in European agriculture to make sure that farmers leave the approach of killing all pests to instead start managing pests, integrating practices such as:

Agricultural practices that can minimize the risk of significant yield losses due to weeds include:

- Improving the quality (health) of soil (agro-physical properties, which suppose avoiding soil compaction; high biological activity; reducing the amount of soluble nutrients, which are stimulating the growth of weeds and higher damage by pests and diseases)
- Achieving the priority of crops under weeds during the initial stages (the first 1/3) of the vegetation period.

a wide crop rotation, to prevent the weed from spreading dramatically

choice of crop varieties that grow quickly in spring and minimizes the amount of light that reaches down to the weeds

- Placement of fertilizer in the soil under the planted crop, so fertilizer is not available to the weed, which sprouts from the surface
- split fertilization, so the fertilizer allocated for several laps as the crop, therefore there is a small amount of fertilizer available to weeds.

Agronomic practices that can minimize the risk of significant yield losses due to attacks of insects and fungi include:

- A wide crop rotation, which prevents that pests can propagate themselves so much that they result in significant yield loss, such as nematodes in sugar beet (1 in 3 years rotation needed), fungi attack in crucifers (1 in 5 years rotation needed).
- Choice of crop varieties that are fully or partially resistant to pests.
- Fertilization in a way so that the content of nutrients in crop plant juice is reduced.
- Reduced crop density, so the risk of fungal attack is reduced because of lower humidity

2.2 A CAP encouraging agricultural practices, from smart growth to sustainable growth

Consumption of insecticides can be reduced drastically without leading to significant yield loss and by replacing them by agroecological techniques. Often technological solutions like precision farming are being proposed as the only tool to match the challenge of achieving more from less though, conservation can help significantly too.

Recent research has shown that informed and targeted landscape management can match the challenges of productivity and productivity when growers support ecosystem services such as pollination and pest control. The choice of the right non-crop vegetation is essential to generate these services (Olson and Wäckers, 2007; Wäckers and van Rijn, 2012; Campbell et al., 2012).

Projects with commercial growers in the UK, the Netherlands and Switzerland successfully used specific, low-maintenance flowering field margins targeted to pollinators and insects delivering natural pest control. The projects have demonstrated that these margins increase natural enemies and pollinators, reduce pest levels, and raise crop yield in several crops (www.ecostac.co.uk). This shows that informed landscape management can contribute to food security and that conservation and crop production can go hand-in-hand.

Reduced use of pesticide is a win-win situation, as it will permit auxiliary insects to develop and restore a natural equilibrium between detrimental and helpful insects. 84% of the world's crop diversity relies on insect pollination (Gallai et al, 2009). Reduced weed control will help to ensure more space, hiding places and habitats, for wildlife that eat the pests, limit erosion and enhance water and nutrient sequestration.

At the same time there are a number of empirical studies showing that farmers applying solid agricultural practice will save money over time, while also be able to upkeep productivity, but question is who will transmit these results to the farmers?

Specific on yields:

A 12 years study on conventional versus organic, in the US, found that after the transition period organic corn and soybean produced on average identical amounts of food as the conventional managed plants (<http://www.rodaleinstitute.org/files/FSTbookletFINAL.pdf>).

A 6 years study on conventional versus organic, in the UK, shows that there is a very strong correlation between fertilizer (especially N) inputs and disease, pest and weed pressure and the need for crop protection inputs and it is therefore not a good idea to push for maximum yields! (Cooper et al. 2006, 2007 and 2008).

A 50 years field experiment in the Northern zone of Moldova shows that crop rotation is increasing significantly productivity of crops relatively to permanent crops (monoculture). Permanent cropping requires more chemicals for maintaining crop productivity. It is cheaper to respect crop rotation than to compensate for its absence with extra chemicals (Boincean 2012).

A long term field experiment from Hungary shows that replacing part of the mineral with organic fertilizers gives similar or higher yields and improved N-use efficiency" (Kismanyoky et al, 2012)

A data comparison of yield in France wheat indicates that replacing leguminous with rapeseeds over time has a negative influence on yield in wheat (Brisson et al, 2010).

On soil fertility:

4 case studies at crop rotation level in Germany, France, Switzerland, and Spain show that the strength of the introduction of grain legumes into intensive crop rotations with a high proportion of cereal and intensive nitrogen-fertilisation is the reduction of energy demand, global warming potential, ozone formation and acidification as well as eco-and human toxicity per unit of cultivated area (Nemecek et al, 2008).

On income:

Rotated low chemical management **increased net returns** compared to continuous corn under high chemical management can save farmers 70 USD/ha or even more in moldboard plow and 120 USD/ha or more in chisel tillage (Katsvairo, 2000).

Appeal: this paper is meant to be dynamic, meaning if you think you have a study that we should add send us an email

Lets use the debate on innovation to establish new collaborations

An innovation system can be defined as a network of organizations, enterprises, and individuals focused on bringing new products, new processes, and new forms of organization into economic use, together with the institutions and policies that affect their behavior and performance. The innovation systems concept embraces not only the science suppliers, but also the totality of interacting actors involved in innovation. It extends beyond the creation of knowledge to encompass the factors affecting demand and use of knowledge in new and useful ways. PAN Europe encourages to use 'totality of actors' concept of innovation approach in the EIP on agricultural productivity and sustainability.

NGOs affect "knowledge" policies is explained by IAASTD as: Policy relating to the AKST model is thus understood as the attempt to systematically intervene in the process of shaping and reshaping the interrelationships between the different actors, networks and organizations involved in the processes of coproduction of knowledge for more sustainable and pro-poor agriculture and food production".

2.1 NGOs as the logical innovative partner proposing alternative solutions

The development of alternative integrated production techniques, meaning changes to longer rotations periods require changes outside and inside the farm, are shown to be difficult to apply because of the way the whole system is organized. The technical challenge requires not only the existence of an alternative technology but also changes in the whole system of which it is part, and which involves the users, the distribution networks, the infrastructures, and cultural and symbolic values (Jacquet et al., 2011).

For the alternative integrated production techniques, it is important to support small and medium business enterprises that are involved in supplying agriculture inputs; particularly those firms that offer green agriculture products and services such as organic certification auditing and reporting (http://www.unep.org/greeneconomy/Portals/88/documents/ger/ger_final_dec_2011/2.0-AGR-Agriculture.pdf). Though it is also important to integrate NGOs who are often able quick in identifying green ideas and therefore a key to disseminate new scientific knowledge, including practices that no company has a commercial interest in promoting and products as the development stage, before it becomes mainstream.

Reflection – the innovation process, when is the real innovation occurring:

2006 Andrea Lucchi, Valerio Mazzoni, Meta Virant-Doberlet e Anna Eriksson researchers at Università di Pisa, Fondazione E. Mach di S. Michele all'Adige and National Institute of Biology of Ljubljana, start investigating into disruption of mating behaviour in *Scaphoideus titanus* (sounds) encouraged by the CBC group.

- 2009 PAN Europe organise an exhibition of alternatives to pesticides in the Economic and Social Committee, presenting the sound techniques to national farmers representatives
- 2011 Researchers starts publishing research results.
- 2012 The PURE network presents the sound technique in the EIP conference as innovation.

2.2 NGOs as the logical innovative partner to encourage diversification in the food chain

The European agricultural sector is becoming more and more standardized; raw material is becoming a standard product. The importance on how the raw material is being produced is being set aside by the industry with no benefit to neither farmers nor society. PAN Europe believes that a paradigm change in the agricultural sector must again put production methods and origins at the center of the debate.

Special Eurobarometer 354, November 2010 on food risks includes a survey on **Public confidence in sources of information on food safety**. The survey shows that EU citizens are the most confident in “their physician/doctor”, “family and friends” and then “consumer organizations” (76%), “scientists” (73%) and “**environmental protection groups**” (71%), while fewer have confident about “farmers” (58%), while only very few have confidence in information from “food manufacturers” (35%) and “retailers” (36%).

To optimize the EU’s intervention in the internal market, there is a need to seriously consider **involving NGOs as equal partners able to help ensuring the needed diversification** in the food chain, and increase the chances that the farmers gets a fair price for their products, meaning a price linked to the environmental and public health services that they delivered in producing these products, for products less reliant on pesticides.

3. Let’s not forget the entire price of inputs in the debate on resource efficiency

The debate on resource efficiency, measured in life cycle assessments, need to take the full costs of pesticides into account, including:

Estimated annual economic and environmental **losses due to the application of pesticides in the USA** (Pimentel 2009):

- public health, \$1.1 billion/year
- pesticide resistance in pests, \$1.5 billion;
- crop losses caused by pesticides, \$1.1 billion;
- bird losses due to pesticides, \$2.2 billion; and
- ground water contamination, \$2.0 billion.

Estimated annual economic loss caused by pesticide in the EU:

Studies in the UK and Germany US\$257m and \$166m, respectively, paid by sufferers of pesticide-related poor health, the environment and citizens (Pretty & Waibel, 2005).

Pesticides are among the most relevant and important chemical found in European ground water samples (Loos, 2010)

UK water companies spent £189 million removing nitrates and £92 million removing pesticides from their water supplies between 2004-2005 and 2008-2009 (National Audit Service, 2010)

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Pesticide Action Network Europe (PAN Europe) was founded in 1987 and brings together consumer, public health, and environmental organisations and women's groups from across 19 European countries. PAN Europe is part of the global network PAN working to minimise the negative effects and replace the use of harmful pesticides with ecologically sound alternatives.