and the lower use of energy-demanding foodstuffs for livestock (Gomiero et al., 2008). However, it is important to recognise, as Gomiero et al. (2008) conclude, that even though the energy efficiency (output/input) was found to be higher in the organic systems, conventional crop production had the highest total net energy production per unit area (higher yields). Organic grain yields are often lower than conventional yields, as for example Mader et al. (2002) show, presenting data from a long-term field experiment demonstrating that organic management had a much lower energy input compared to conventional, yet the yields were 20 per cent lower. There are a variety of different methodological approaches for comparing energy efficiency of conventional and organic farming (Kasperczyk and Knickel, 2006; Gomiero et al., 2008), thus caution should be shown when comparing systems, particularly when measuring efficiency (e.g. is the unit per unit area or per unit output).

Conclusion

Although it is a challenge to provide a unanimous point of view on which system type is most resource-efficient, it can be said that there is evidence that organic farming has favoured the development of techniques, breeds and practices that are beneficial regarding resource efficiency, since organic farmers generally have to deal with a relative poor nutrient supply. Topp et al. (2007) identify and discuss the methodological challenges of assessing the impacts of multifunctional agriculture on resources and call for the development of new tools and data for such assessments. Taking a holistic view of resource management on organic farms is very important when considering what system type best suits our needs. For example, high-yielding systems might appear more efficient when focussing on energy output alone; however, when considering potential environmental trade-offs (e.g. nutrient leaching or energy consumption), organic systems might be more beneficial.

6 I ORGANIC FARMING - AN EFFICIENT AND INTEGRATED SYSTEM APPROACH RESPONDING TO PRESSING CHALLENGES

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- **One strict and easily understandable rule in organic farming such as the ban of synthetic fertilisers often results in a number of environmental benefits.**
- **Organic farming support helps to minimise costs for farm support while increasing its environmental effects.**
- **Cost effectiveness of organic farming support can result from consistency of the policy measure, the system approach of organic farming and resulting synergetic environmental effects, as well as increased market values and lower transaction costs.**

Introduction

Agriculture is multifunctional by nature as it produces not only commodities but also many non-commodity outputs such as environmental services, landscape amenities and cultural heritage. The wealth of scientific results given in the preceding chapters of this brochure highlight that organic farming is amongst the best examples for this multi-output activity.

The IAASTD report recommended therefore in the year 2008 that new and successful existing approaches to maintain and restore soil fertility and to maintain sustainable production through practices based on **integrated management systems** and on understanding of agro-ecology and soil science (e.g. agroforestry, conservation agriculture, organic agriculture and permaculture) are paramount for coping with the challenges ahead.

The Tinbergen Rule (1956), which states that efficient policy needs at least as many independent policy instruments as there are policy targets, appears to contradict these IAASTD recommendations. Referring to the Tinbergen Rule, von Alvensleben (1998) argues that organic farming support payments are not economically-sound, as the policy objectives could be achieved more efficiently through using more flexible and targeted combinations of various agri-environmental instruments. Therefore, policy

support for sustainable farming systems is sometimes questioned against the background of limited public budgets and considerations of cost-effectiveness.

Since the beginning of the 1990s, European agri-environmental policy offers the option of providing financial support for organic farming. Area payments have turned out to be the most important financial instrument for supporting organic farming (Stolze and Lampkin, 2009). Will such payments for organic farming meet the requirements of clever targeting and tailoring of policies to achieve maximum effectiveness with a given budget (OECD, 2007)?

Organic farmers have adopted a strategy of complex management responses

Organic standards consist of strict rules, e.g. a complete ban of mineral fertilisers and synthetic pesticides. Thus, they are easy to understand for farmers and plain and simple to control. In order to cope with them, farmers have to respond with complex management measures: For instance, in weed control chemical herbicides cannot simply be replaced by mechanical weeding. Otherwise, infestation of weeds would escalate and become unmanageable a few years after transformation. In order to avoid such problems, farmers' first response is to diversify the crop rotation so that soil cover and root competition adversely affect weeds. The introduction of grass-clover leys into the crop rotation and cover crops further help suppress weeds. As a positive side-effect, soil fertility and nitrogen supply improve, and nutrient losses decrease. On top of prevention, mechanical weeding reduces weeds to residual but often diverse populations which host many (beneficial) insects. In addition, the superficial mechanical disturbance of the soils by harrows and hoes stimulates nitrogen mineralisation of the crop, closes macro-pores and reduces evaporation of water from the soil efficiently.

In a nutshell, a simple ban induces a chain reaction on farmers, resulting in more sustainable and productive farming systems. Similar examples can be given with other pesticides, slow-release fertilisers or veterinary medicaments where simple bans or restrictions unleash cascades of environmentally-sound preventive actions.

Organic farming is highly efficient at using scarce resources

Fortunately, agricultural science was interested in the performance of organic farming at an early stage already. Hence, a considerable number of statistically-designed field trials were started 20 to 30 years ago in different European countries. These empirical data from many years give a comprehensive picture of the

Table 3: **Input and output of organic and integrated farming systems of the DOK trial.** Long-term field trial DOK in Therwil (Switzerland): Data for the years 1977 to 2005.

Parameter	Unit	Organic farming	Integrated farming (IP) with farmyard manure	Organic in % of IP
Nutrient input	kg Ntotal ha^{-1} yr^{-1}	101	157	64%
	kg Nmin ha^{-1} yr^{-1}	34	112	30%
	kg P ha^{-1} yr^{-1}	25	40	62%
	kg K ha^{-1} yr^{-1}	162	254	64%
Pesticides applied (active ingredients)	kg ha^{-1} yr^{-1}	15	42	4%
Fuel use	Lha^{-1} yr^{-1}	808	924	87%
Total yield output for 28 years	%	83	100	83%
Soil microbial biomass "output"	tons ha^{-1}	40	24	167%

Explanation: Input of nutrients, organic matter, pesticides and energy as well as yields were calculated on the basis of 28 years. Crop sequence was potatoes, winter wheat followed by fodder intercrop, vegetables (soybean), winter wheat (maize), winter barley (grass-clover for fodder production, winter wheat), grass-clover for fodder production, grass-clover for fodder production. Crops in brackets are alterations in one of the four crop rotations. Integrated production (IP) is an improved conventional farming system.

ecological performance and yields of organic farming systems. Mäder et al. (2002) showed that an organic crop rotation used only 30 to 64 per cent of the nutrient input of the same conventional and integrated farming (IP) rotation, respectively (table 3). Average organic yields calculated for a period of 28 years on the other hand produced 83 per cent of the yield gained in IP farming systems and the living biomass of the organic soil topped the IP one by 167 per cent. The resource use efficiency – an important criteria for limited or non-renewable resources – is invincibly high for organic farming.

Organic farming support – an effective and efficient policy instrument

Policy instruments are evaluated against the criteria 'environmental effectiveness' and 'economic efficiency'. While effectiveness requires that the policy instrument is able to deliver effects that help to meet policy targets, efficiency ensures that these targets are met at lowest cost.

By using a mathematical optimisation model (linear programming), Schader (2009) could show that support schemes for organic farming as one part of a larger portfolio of agri-environmental measures helps to minimise costs for farm support while increasing its environmental effects. Therefore, there is no contradiction between the Tinbergen Rule and organic farming support payments. Introducing organic farming support payments in addition to independent and targeted policy instruments (e.g. payments for nature conservation, a carbon tax) may result in either lower costs for achieving the same level of policy targets or in a better target achievement with less expenditure as it tackles all three policy targets at once. In order to verify the theoretical models, Schader (2009) analysed empirical data of the Swiss agri-environmental scheme for three policy targets: 'reduction of fossil energy use', 'improvement of habitat quality (landscape and biodiversity)' and 'reduction of eutrophication (N and P)'. Area payments for organic farms were both very effective and efficient at achieving the targets, comparable to policy instruments targeted to specific environmental problems.

Cost-effectiveness of organic farming compared to specific agri-environmental measures

What could be reasons for a better cost-effectiveness of organic farming compared to specific agri-environmental measures?

Firstly, organic farming is perhaps the only way to pursue different challenges at the same time within one consistent policy instrument. For example, a basic element of organic farming is compost use which leads i) to higher yields in low-input systems, while at the same time ii) the increased soil organic matter is beneficial to biodiversity and soil structure, and iii) the abandonment of mineral nitrogen fertiliser reduces energy use and thus contributes to climate change mitigation. Organic agriculture therefore is likely to deliver cost-efficient solutions to complex global challenges of agriculture.

Secondly, organic agriculture guides farmers to solve the perceived discrepancy of integrating environmentally-friendly measures in the daily farm management business. Various authors showed organic farmers consider professional honour not only to be determined by maximum yields but also by successful implementation of nature conservation measures (Stotten, 2008). Thus, farmers' acceptance of agri-environmental policies could be considerably increased by organic agriculture (Schader et al., 2008).

Thirdly, the system approach of organic farming, e.g. the combination of many different rules, may induce synergetic environmental effects additional to the effects of each single restriction. The promotion of high nature value elements on farms, such as hedgerows, beetle banks and habitats for other beneficial insects in grass or wildflower strips along field margins becomes ecologically and agronomically much more attractive in combination with a ban on pesticides (Niggli et al., 2008).

Fourthly, organic agriculture is the only farming system which consistently succeeds in generating higher market values through premium prices. Due to consumers' trust in the organic labels and additional willingness-to-pay for organic products, payment levels do not need to cover the full costs of implementing organic farming. This makes organic farming attractive to policy-makers aiming at generating public benefits through both policy support and market mechanisms.

Fifthly, the multi-purpose character of organic agriculture could increase its cost-effectiveness due to potentially lower transaction costs compared to targeted agri-environmental measures (Dabbert et al., 2004). According to Lippert (2005), savings of transaction costs in organic agriculture include: a) lower administrative costs, because less agri-environmental measures have to be administered per farm

(economies of scope in administration); b) generally lower control costs, because the full ban of synthetic pesticides and mineral fertiliser is easier to control than thresholds; c) lower costs of control due to a combined control of several attributes (economies of scope at inspection level); d) lower fixed administrative costs due to the use of existing structures for the establishment of control systems; and e) lower intensity of control, as organic farmers risk their reputation if convicted of violation of standards.

Conclusions

Recent scientific publications showed that designing policy instruments on the grounds of the Tinbergen Rule is neither a knock-out criterion against organic farming policy support nor does it imply that multi-objective policy instruments like organic farming are per se inefficient. On the contrary, we demonstrated on the basis of most recent scientific literature that organic farming policy support and specific tailored policy instruments are complementary while focusing only on one of these approaches could bear inefficiencies.

Therefore, we suggest building future agri-environmental policies on two floors:

1. The solid basement addresses the main objectives of European agricultural policy, especially climate change, biodiversity and global food security through organic farming support. This multi-objective policy instrument is a perfect means to capture both the strong interrelations and potential trade-offs between separate food security, biodiversity and climate change policies in a consistent policy concept.
2. The second level consists of tailored policy instruments which will be built on top of this basement. These tailored policies accommodate the regional differences in the EU and are to ensure that the targets for biodiversity, climate change and food security can be fully met in all EU regions. In this respect, tailored policies need to be flexible and region-specific, making reference to geographical, natural and socio-cultural conditions.

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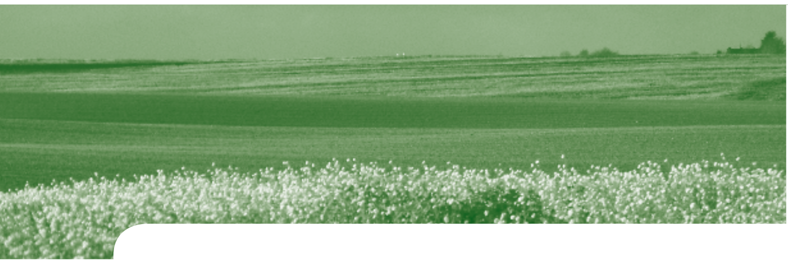

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Organic food production - a comprehensive tool box to meet the sustainability challenge

Climate change, biodiversity loss, soil degradation, water pollution and increasing pressure on natural resources, such as soil nutrients and fossil fuels are amongst the most pressing challenges for society. Agriculture and food production play an important part in both causing harm and offering solutions to meet these challenges. The EU with its Common Agricultural Policy (CAP) has a policy instrument available, of which best use must be made to shape agriculture towards best practices that allow meeting the above-named challenges.

Policy support favouring organic farming and specific tailored policy instruments are complementary, effective tools to tackle environmental challenges under the CAP. Whereas specific agro-environmental measures can help tackle problems one by one and are in particular useful to react to specific local problems, the concept of organic farming offers a holistic approach to meet several environmental challenges at once, while at the same time also supporting animal welfare and delivering high-quality food. Due to synergy effects, an efficient European-wide control system in place and organic food being a quality label with an enhanced market value, structurally supporting organic farming is not only an effective, but also a cost-efficient tool to reach sustainability objectives within agricultural policies.

The dossier "Organic food and farming – a system approach to meet the sustainability challenge" delivers scientific data that underpin the value of policy support for organic farming as effective tool to tackle sustainability challenges in the food sector.

IFOAM EU GROUP

The IFOAM EU Group is the European working level within the International Federation of Organic Agriculture Movements. It brings together more than 340 organisations, associations and enterprises from all EU-27, EFTA and candidate countries. IFOAM´s goal is the worldwide adoption of ecologically, socially and economically sound systems that are based on the principles of Organic Agriculture.

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