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THE SUSTAINABLE INTENSIFICATION OF EUROPEAN AGRICULTURE:

A REVIEW SPONSORED BY THE RISE FOUNDATION

EXECUTIVE SUMMARY

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Institute for European Environmental Policy

Preface

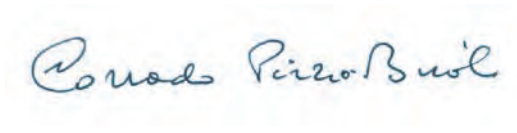
This report has been undertaken on the initiative of the Public Utility Foundation for Rural Investment Support for Europe (RISE).

At its creation in 2007, RISE launched a debate on the interconnected world challenges of food and environmental security, contributing to the annual Forum for the Future of Agriculture (FFA), which has become the key annual conference for farming and environment in Brussels. More recently, RISE has devoted particular attention to the sustainable intensification (SI) of agricultural production in a world in which the population is growing quickly and food availability is challenged by climate change and rapid urbanization, and also by a realization that intensive agriculture has been damaging biodiversity. This puts pressure on farmers to improve their productivity yet at the same time to significantly improve their environmental performance.

Aware that we are not alone in working on this critical subject, it was important to review our first findings with academics and practitioners and get their feedback. Therefore, a consultation process was launched through two workshops. The first workshop was held at the European Parliament in January where the initial findings were presented to a group of invited experts under the leadership of MEP Paolo De Castro, Chairman of the Agriculture and Rural Development Committee (COMAGRI). RISE had already contributed to a report on tools to produce public goods in agriculture that COMAGRI had launched in preparation for the deliberations on CAP Reform in 2011. In the spring of 2014, RISE held a second workshop at the FFA on indicators to assess how to measure farm environmental performance in order to manage it. This was followed by three FFA breakout sessions on SI, respectively on practical approaches and policy approaches in Europe, and perspectives from beyond Europe. This report builds on those debates. It deepens the reflections on SI undertaken by RISE, in particular as regards the meaning of SI, the actions to progress it, and the lessons that can be drawn from the report's three case studies. It reaches a number of conclusions as to the changes that are required in the CAP if it is to become more productive as well as more sustainable, suggesting issues that require further research.

The report has been led by Professor Allan Buckwell with contributions by Professors Winfried Blum and Alois Heissenhuber and their teams, who dealt in particular with the report's case studies on the land quality, nutrient management and biodiversity aspects of agricultural production. The study reflects a general consensus without implying total agreement on each sentence of the report. The same holds a fortiori for the expert advice received through the consultation process. Whilst the report clarifies the meaning and aims of SI and addresses the most relevant queries, it brings out new questions and avenues that need to be explored. RISE is planning to continue the vital research in this area and welcomes any offers of support and knowledge exchange.

Franz Fischler
Chairman, RISE Foundation



Corrado Pirzio-Biroli
CEO, RISE Foundation

Executive summary

Context and purpose

The concept of sustainable intensification has come to the fore in recent years as a response to the challenges confronting ***global*** food security. These challenges are principally continuing population and economic growth in the face of scarcities of agricultural land and water and the dangers posed by climate change, agricultural pollution and biodiversity loss.

This project was initiated by the RISE Foundation to explore the relevance and meaning of the concept for the European Union and for its future agricultural policy. Two important features of the project have been consultations with experts, officials and practitioners at two workshops in Brussels, and three case studies utilizing on-going research into soils, nutrient recovery and biodiversity protection to explore specific dimensions of the concept. A clear consensus which emerged from these consultations and research is that sustainable intensification *is* a useful, globally based, concept which aims to steer farmers to land management which has a better balance between food production and the environment.

The prime logic behind the phrase is the assertion that it would be unacceptably damaging to climate and biodiversity if the necessary future expansion of global agricultural production were based on further conversion of forest, grasslands and wetlands. There has been large-scale destruction of these ecosystems over the last 150 years and much evidence to show the biodiversity loss, pollution, and climate impacts of this land use change.

This leads to the conclusion that further increments in global food output must come very largely from higher yields on existing agricultural land. This was the main route through which agricultural production expanded in the 20th Century. The difference in future must be a step reduction in the negative environmental impacts of agriculture. These are the arguments which lead ineluctably towards the concept of sustainable intensification of existing agricultural land. No assumptions are made in the report about targets for production growth globally or in Europe, however it is an underlying assumption that some production increase is required.

It is constantly asserted that tackling the issue of global food security must deal with policies and efforts to contain growth in food consumption, e.g. through reduced waste, as well as expanding supplies. There is no disagreement at all with this assertion yet this report confines itself to issues of agricultural production. The reasons are that sustainable intensification refers to production not consumption, and the expertise and interest of the organisations and researchers involved concerns agriculture. In addition, the

demand side issues (food waste, food consumption and dietary patterns), and the policies to steer society towards more sustainable consumption involve subjects, policy instruments, approaches and institutions utterly different than those directed towards agricultural production and environmental land management by farmers which are the subject of this report.

What is sustainable intensification?

The definition suggested by this report is as follows. *Sustainable Intensification means simultaneously improving the productivity and environmental management of agricultural land.*

The phrase is used throughout this report in the sense of being an aspiration. Two general conclusions about sustainable intensification are:

- *Sustainable intensification does not point to a single development path for all agricultural systems or farms. The direction of the path and the actions required to meet it will depend partly on the conditions, particularly the current agricultural productivity and environmental performance of a farm or system.*
- *A sustainable intensification path could mean an increase in the output per hectare of environmental services of the farm or an increase in agricultural products per hectare, it does not only mean the latter.*

The application of the concept to the European Union

Five considerations led to the conclusion that the globally motivated concept of sustainable intensification when applied to the EU must place most emphasis on the first word of the couplet. The first is that most of the new pressure for additional food production will arise outside the EU. Added to this, EU agricultural production is already amongst the most intensive in the world, and the resulting steady productivity growth in Europe has meant that the area of EU agricultural land has slowly been falling. Agricultural encroachment onto new lands is not the problem in the EU; indeed the reverse process of agricultural abandonment is more often of concern for environmental and social reasons. The critical EU issue is that the past intensification of agriculture is associated with pervasive undesirable environmental impacts in Europe. An additional concern is that agricultural imports into the EU are associated with environmental damage in the exporting countries. Therefore it is argued that the role of European sustainable intensification is to show how high intensity, productive agriculture, can be combined with much higher standards of environmental performance. The emphasis has to be to find ways to continue the process of technical change in food production to radically improve the resource efficiency of European agriculture and in the process to meet European citizens' ambitions for high standards of biodiversity, climate, soil, water and cultural landscape protection. In short, in the EU interpretation of sustainable intensification must place most emphasis on improving sustainability.

Deconstructing sustainable intensification

The component words of this phrase and their combination are subject to a range of interpretations. The report therefore devotes much space in trying to clarify them. This partly amounts to destigmatising intensification and showing the wide range of interpretations of the word sustainable. In the context of agriculture, **intensity** is well defined as a ratio of inputs or output per hectare. It is relatively easily measured but it is generally denigrated! In contrast, **sustainability** is not well defined, or measured; yet it is universally supported!

When reference is made to "intensive agriculture" this invariably refers to a ratio of a restricted range of inputs per hectare of land especially fertilisers, pesticides, water and machinery for crop production and high density housing systems for animals. There are understandable reasons for focusing on these specific inputs particularly because if they are used inappropriately they contribute to pollution of water and atmosphere and destroy habitats and biodiversity.

The prime objective of sustainable intensification is not intensification *per se*, and certainly not an increase in intensity of use of environmentally harmful agricultural inputs. Rather the prime objective is to improve the resource efficiency of agriculture. A great deal of intensification can and must, in future, take the form of added knowledge which will affect how physical inputs are combined and managed. A suggested shorthand to describe what sustainable intensification means is ***more knowledge per hectare***! Similarly, increasing levels of knowledge are needed to manage the ecosystem services on which agriculture relies. Intensification of agriculture, especially in Europe is therefore not primarily about the use of more fertilisers, pesticides and machinery applied per hectare, but the development of much more knowledge intensive management of scarce resources to produce food outputs with minimal disturbance to the natural environment, and more environmental outputs too.

The environmental outputs of land management should be on an equal footing with the food and energy outputs. Unfortunately the word 'production' has been deeply embedded to refer only to planned outputs which are marketed and sold. A virtue of the relatively new language of ecosystems is that it seeks to place the provisioning services of nature, e.g. food and energy which are produced and

sold through market-based processes, on the same basis as the supporting, regulating and cultural services, which are non-marketed. A correct interpretation of sustainable intensification should embrace examples where the production to be intensified per hectare can equally refer to the conservation outputs, e.g. pollinators or fledged lapwings per hectare, as to agricultural products.

Sustainability and sustainable development

The 1987 Brundtland Report defined sustainability as "*meeting the needs of the present generation without compromising the ability of future generations to meet their own needs*"

Whilst there is universal agreement on the desirability of the concept, there are quite strongly held differences on how it is interpreted and what it means for policy and practical action. Some of these differences are philosophical or ideological and do not readily lend themselves to resolution by appeal to empirical evidence.

There is general agreement that sustainability must be considered under the three pillars: economic, environmental and social. Yet despite the lip service paid to three equally important pillars of sustainability, it is common to observe that analysis is often focused mostly on the environmental dimension. Disagreements about weak versus strong sustainability are not resolved. A recent summary of this debate suggested that weak sustainability is associated with growth optimists who see natural capital as a production factor and a source for human welfare. Whereas strong sustainability supporters stress limits to economic growth and see natural capital as a basis for human survival (Kaphengst (2014). This issue is closely related to the debate on whether sustainability implies the existence of limits, thresholds or tipping points beyond which a system cannot recover, going into irreversible decline. There are strong beliefs that some such limits exist, and that the effects of human activity have taken us, or are about to take us, beyond these thresholds. However outside of climate change there has been little progress in identifying and robustly quantifying these limits as they may apply to European agriculture.

Given these difficult conceptual and unresolved aspects of sustainability it is perhaps not surprising to find that the empirical literature which sets out to measure the sustainability of specific agricultural systems is inconclusive. A review of 49 academic and other investigations into the sustainability of farming systems conducted in this project turned up 500 different indicators of sustainability. Of these 202 could be characterised as social, 95 as economic, 198 as environmental, and the final five as 'other'. There is little convergence on a core set of sustainability indicators which should always be included. It was also disappointing to find that the considerable efforts devoted by the European Institutions to define indicator sets, for example the IRENA indicators for the agri-environment, have not found their way to be used as the basis for empirical analyses of agricultural sustainability in academic literature or by governments.

Conclusions drawn from this review of the concepts behind sustainable intensification are:

- Input intensification *per se* is ***not*** the goal, but may well be a consequence of achieving these goals. Although, an input which should be intensified everywhere is knowledge per hectare.
- The prime goals of sustainable intensification are a resource efficient agriculture with significantly higher environmental performance. Ecosystem degradation is itself reducing agricultural productivity.
- Sustainable intensification means improving productivity of crops and animals whilst reducing: the leakages of nutrients, crop protection chemicals and greenhouse gases; soil erosion and biodiversity, habitat and species loss; and expanding conservation outputs of agriculture.
- Because intensity and sustainability of agricultural systems vary enormously and from site to site, sustainable intensification development paths will differ widely between locations, farming systems and individual farms.
- Sustainable intensification will mean increasing agricultural outputs in some cases and conservation outputs in others, and in some situations both.
- It would be helpful if academic and commercial attempts to measure sustainability in agricultural systems were to build on the basis of the official indicator sets.
- More effort should be expended to examine the evidence on environmental thresholds relevant to EU agriculture, particularly those related to climate change.
- In the absence of sufficiently comprehensive or specific evidence on thresholds, then it would be more scientifically defensible to talk about environmental, economic and social *performance* rather than *sustainability*. This would better match the use of legislative standards as proxies for thresholds, as performance below such standards is unacceptable.
- The phrase sustainable intensification can be seen as the latest manifestation of many attempts to demonstrate to farmers that they have a twin role of producing food and environmental services.

Actions to progress sustainable intensification

It has been emphasised that a sustainable intensification path, can only be defined with respect to particular farm systems in specific locations and with respect specific concerns. There is no single and simple formula to indicate the

path of sustainable intensification for any farm or group of farms. Achieving it will be a process over time and the actions required could involve participants and stakeholders in agriculture, up and down-stream of agriculture and from other interests in rural communities. The actions are discussed under two headings, collective actions which will have to be taken by public authorities and actions which will primarily be the responsibility of private sector land managers and the other businesses in the food chain.

A key common action required of both public and private sectors is research and development. There is clear evidence that agricultural productivity growth responds to research and development effort. Since the food price spikes of the period 2007-2011 the importance of strengthening the public sector research for agricultural development has been well recognized. It is also now well acknowledged that the target of agricultural R&D has to embrace the twin goals of agricultural productivity and the environmental performance which accompanies agricultural production. This is particularly so for public sector research but it is visible in the private sector too.

Actions for the public sector

The two broad areas where collective societal actions are required are to assemble and publicise the evidence on the economic, environmental and social performance of agriculture, and to put in place, and appropriately resource, the mix of policy measures required.

> As far as ***assembling indicators*** is concerned, the Member States and European Union have invested considerable resources over many years to define indicators of economic and environmental performance and to devise methods for collecting and collating the data on a common basis for the EU. Two deficiencies in farm-level data collection identified are the recording of non-agricultural incomes of farming households, and environmental performance at farm level. Wider rural development and agri-environmental policy have become a steadily larger part of European policy yet there has not been a parallel development of the farm-level evidence base to support these policies. This is proving to be a handicap in providing the evidence for policy change.

There are two other areas where further efforts are required on indicators to guide policy. The first is the development of methodologies and metrics for international comparisons of agricultural sustainability. Without these, for example, it is very difficult to assess the relative environmental impacts of displacing imported protein with EU production. The second is to understand better the relationships between land management practices, the factors which drive them, and the impacts on environmental variables. Monitoring developments is a key part of this process which is all too frequently given low priority by governments.

Policy actions are required for improving both the productivity and the environmental management of agricultural land. Policies are reviewed in the report under the four headings: R&D, education, advice and innovation; environmental policy; agricultural policy; and brief mention of other collective actions to stimulate provision of environmental services. Given the policy decisions and actions already underway, it was concluded that the most important policy development to help EU agriculture onto a path of sustainable intensification must be the further evolution of its agricultural policy.

The phrase sustainable intensification has not been adopted as an explicit target or slogan for the Common Agricultural Policy (CAP). However at the strategic level there is no contradiction between this concept and the current objectives of European agricultural and environmental legislation. Environmental and social considerations have steadily grown in importance in the CAP and this is now the largest operational policy for influencing the rural environment as reflected in the number and variety of measures and in the financial resources available to those measures. What matters therefore is first, how the general objectives are expressed in measures in the regulations, second on how the measures are selected, interpreted and implemented by the Member States, and finally how they then affect farmer behaviour on the ground. It is suggested that for those parts of EU agriculture not currently on a path of sustainable intensification, the principal problems are weakness at the second and third of these stages.

This report concluded that sustainable intensification is a logically correct approach, and that for Europe the emphasis has to be further improvement of the environmental credentials of European agriculture. The 2011-14 reform debate ostensibly gave prominence to the improvement of the sustainability of EU agriculture too, but it is judged not to have advanced very far. It is suggested that at the broad policy level the questions setting an agenda for future reforms of the CAP should include:

- Was the strategy of greening pillar 1 a mistake?
- Has the dilution of greening drained it of impact? Should cross compliance and greening conditions be strengthened?
- Should environmental payments be results-based rather than prescriptive?
- Are the principles which underlie the determination of payment rates for environmental services correct?
- If environmental land management contracts with individual farmers are too costly to administer would it help to operate instead through collectives of farmers at higher, landscape or river catchment scale?
- Is a common European policy for integrating environment into agricultural practice the wrong basis through which to operate, should this be devolved to Member States?

- Are there alternative ways, outside the CAP, for achieving delivery of the environmental services from agriculture? Is more strongly enforced environmental regulation a major part of the answer?

The main controversy about the CAP remains the balance between the unclearly justified direct payments in Pillar 1 and the more purposeful measures in Pillar 2. But whatever the data and the policy instruments, ultimately, achieving a sustainably intensive EU agricultural sector requires the active participation of its farmers.

Actions for farmers and agribusiness

An individual farm, moving towards a path of sustainable intensification will generally have to adjust current practices on their farm so that agricultural productivity improves without detriment to environmental performance, or vice versa. This moves them closer to what can be termed the food-environment production possibilities frontier.

The report discusses five kinds of actions which can be initiated in the private sector.

- The first is the full adoption of one of the many farming systems which have been created specifically for their sustainability attributes: agroecology, biodynamic, organic, integrated and precision farming, and conservation agriculture.
- Second is to opt for specific farming practices which tackle particular problems of sustainability. The report indicates forty-three such practices.
- A third kind of action is to more actively engage in measuring farm-level environmental performance to stimulate and guide action.
- The fourth action is to work collectively or collaboratively in groups of farmers to improve environmental performance.
- The final action considers if significantly higher environmental performance might be brought about through private sustainability certification schemes.

Case studies

Three case studies were devised to supplement and illustrate this general analysis of sustainable intensification. They were chosen to deal with quite different issues, soils, nutrients recovery and recycling and biodiversity management. They employed quite different analytical approaches, to sustainable intensification. The soils case developed a methodology (based on six measured soil characteristics) to identify soils which could be suitable for sustainable intensification. The results showed 41% of the arable area of the EU25 was estimated to be in this category. At the other end of the scale 4% of the area was classed as unsuitable and suggested for extensification. Of the rest, 43% was deemed unsuitable for intensification as at least one indicator was beyond a threshold, and 12% could be suitable for sustainably intensification with restrictions. The nutrient recovery case study investigated options, including difficult ones of reducing scale and density of livestock production, to reduce nutrient surplus and enable better use of scarce resources. The biodiversity study helped illuminate the variability in biodiversity protection in arable farming. The importance of this observed variability is that it implies that much agricultural production in Europe may be taking place well inside the food-environment production possibilities frontier. This in turn implies that there may be corresponding scope to achieve gains from sustainable intensification which moves farm management closer to the frontier.

Final remarks

The collective actions required to define and measure the environmental performance of EU agriculture are well advanced, although not complete. Equally, the suite of policies to protect the farmed environment through environmental legislation and agricultural policy instruments is well developed. In short, in Europe, broadly we know what the problems are and where they are, and we have policy measures which could contribute to dealing with them, so why is progress to reduce these problems insufficient?

One answer is a misguided concern of the contribution of European agricultural production to global food security. The worry is that by taking measures to improve environmental performance in Europe this will reduce production potential in a world of still growing population and food demand. These fears may be overstated. Europe is a relatively high cost production area and its agricultural exports are of more processed high quality foods and highly developed plant and animal genetics. It is therefore not generally a source of low cost calories for poorest countries. Second, there is a continuing long-term trend in underlying productivity growth which also responds positively to R&D effort. In this context the potential output loss from the further withdrawal of a few percentage points of land to provide biodiversity and water protection could be replaced by a relatively few year's productivity growth. Third, such is the size of food waste in the EU, that the private and public efforts to reduce this could also 'replace' output forgone from some production areas where actions are taken to reduce negative environmental effects of intensive production.

Another answer lies perhaps with the perceptions and motivations of farmers. It is not at all clear that they appreciate the extent of the environmental degradation that has accumulated over the last century, or the potential threat this poses for continued future production. This underlines the importance of continuing the efforts to provide the evidence of this damage, and to put more effort to investigate the extent of environmental change and to improve our understanding of the timescale in which environmental thresholds may be reached.

The two most important lessons of applying the idea of sustainable intensification to European agriculture are that farmers and the public should learn to take a more holistic view of the agricultural and environmental outputs from agricultural land management, and that the key input to be intensified is knowledge.

Summary of areas meriting more research

- Internationally comparable indicators of environmental impacts of agricultural production.
- Social sustainability indicators.
- Detecting the proximity of environmental thresholds in European agriculture and thus boundaries for safe operation.
- Assessing how much of EU agriculture could be classed as currently unsustainable with respect to specified indicators.
- Inclusion in the Farm Accountancy Data Network (FADN) of a wider range of non-farming income earned by agricultural households.
- Inclusion in the FADN of farm-level environmental performance.
- Completion of the development and compilation of IRENA agri-environmental indicators.
- Reviewing the choices confronting the next reform of the CAP.
- Assessing the potential contribution to farm-based public good provision through actions beyond CAP-based and other public payments.
- The establishment of current levels of land farmed and output produced by 'sustainable farming systems' and their potential to deliver sustainable intensification.
- Finding a framework which could help farmers judge the environmental value and economic cost of adopting practices to improve environmental performance.
- Establishment and benchmarking of practicable farm-level indicators of environmental performance.
- Assessing the scope and impediments to collaborative provision of environmental management by farmers in a naturally defined area.
- Evaluating the past and prospective contribution to improved environmental land management of commercial certification and sustainability schemes.
- The approach developed in our soil case, regardless of any drawbacks, deserves to be taken into account, mutatis mutandis, to conduct an analysis of sustainability of land areas or farms in terms of water quality, GHG emissions and/or biodiversity.

To download a copy of the full report, go to
www.risefoundation.eu

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