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TRAJECTORIES OF AGRICULTURAL MODERNIZATION AND RURAL RESILIENCE: SOME FIRST INSIGHTS DERIVED FROM CASE STUDIES IN 14 COUNTRIES

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Abstract: *In this paper, alternative trajectories of agricultural modernization and rural resilience are explored based on case studies in 14 countries. The analysis is to support discussions about the further development of agriculture at a time when the agricultural sector must respond to an increasing scarcity of natural resources, challenges like climate change, urbanization, demographic change, food security, consumer demands, distributional issues in food value chains and changing urban-rural relations. The discussion relates different trajectories of agricultural modernization to the multiple mechanisms underlying rural prosperity and resilience. The mainstream capital-intensive and technology-driven model of agricultural modernization is contrasted with more incremental, socially embedded and localised forms of development. Potential synergies between different modes of farm 'modernization', resilience and sustainable rural development are highlighted and a different future-oriented understanding of the term 'modernization' explored. The basis for the analysis are case studies in 14 countries (including Turkey and Israel). The key question asked is how actors are connecting economic, social and natural systems in the different cases and how the connections made (or not) point to different ideas about modernization. The conclusions focus on some current information needs of policy-makers: the links between different forms of farm modernization, rural development and resilience, and the implications for agricultural knowledge systems and the new European Innovation Partnerships. It is emphasized that local capacities for transdisciplinary research need to be strengthened and that more attention should be paid to addressing modernization potentials that are less mainstream. The paper seeks to foster discussions that help overcome simplistic viewpoints of what 'modernization' entails. It is based on an earlier review paper by Knickel, Zemeckis and Tisenkopfs (2014).*

Modernization, the orienting principle of our time

Countries that are seen as 'modern' are also seen as 'developed'. But what type of farm modernization can be considered sustainable in view of current and foreseeable challenges? What changes in farming contribute to prosperous rural areas, and how? Do we need to rethink, and reorient, agricultural research and development? And where do the millions of subsistence and semi-subsistence farmers in the new EU member states fit into this discussion?

In today's post-industrialist world, the daunting claims of modernization are steadily eroded. Analysts emphasize the need for a more 'reflexive' and 'reflective' approach to modernisation (Beck *et al.*, 1994; Borne, 2010; Rasborg, 2012). The argument is that technological achievements, material prosperity and consumption tend to be over-emphasized while ignoring other quality of life values, equity issues and long-term sustainability. Resilience is a new term that is central in this discussion. It has become prominent in particular through the

work of the Stockholm Environment Institute (SEI) but also the International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD). I argue that it ought to become more important in European frameworks for agricultural and rural development, and the related policies.

In more practical terms, resilience stands for the ability to embrace change with a capacity to adapt (McManus *et al.*, 2012). Resilience recognizes that people are not passive objects but capable agents (Olwig, 2012). Applied to farm (household) and rural systems, it acknowledges that natural and economic systems are continuously changing and that farm households (and rural communities) need to have the ability to absorb disturbance and retain basic functions and structures (Berkes *et al.*, 2000). Linked with that is the ability to maintain the integrity and functioning of natural systems, and to restore degraded ecosystem services. Related studies have mainly focussed on farm household, farming and rural systems and their functioning in variable environments (Rodriguez *et al.*, 2011), the stability of agroecosystems, particularly as they

are threatened by global environmental change (Olwig, 2012; IAASTD, 2009), and the multifunctionality of rural regions (Bryden *et al.*, 2011; Knickel *et al.*, 2004; Wilson, 2010).

The objective of this paper is to explore alternative trajectories of agricultural modernization and rural resilience. I contrast the capital-intensive and technology-driven model of agricultural modernization with more incremental, socially embedded and localised forms of development. A particular focus in our discussion is the level of farms and rural communities where resilience relates above all to the capacity to learn, take decisions, and adjust economic and social activity to changing market and societal conditions. Knickel *et al.* (2014) argued that the capacity to innovate and collaborate can be seen as the other side of the coin called “*smart and sustainable modernization*”.

Agricultural and rural development challenges are discussed in much detail in the assessments and foresight reports of the Standing Committee on Agricultural Research (SCAR) (2011, 2012) and the background documents on CAP reform by the European Commission (2010, 2011, 2012). Knickel (2013) summarizes the main challenges to be addressed referring to sustainable food production and the particular need to increase access to food in developing countries; environmental sustainability and resource use efficiency, including low carbon production systems; the quality of life of farmers, consumers and society at large, including high food quality and environmental integrity; and the global scale of problems which shows that resource and emission-intensive lifestyles in rich countries can neither be sustained nor transferred to the world as a whole. The big question is in how far technological progress and ‘modernization’ will be sufficient in addressing these challenges. For example, the bio-based economy has been suggested as a smart way to overcome resource constraints and to make production systems more sustainable. There is of course also the risk that the related structural changes might aggravate the concentration of power in up- and downstream industries and increase dependencies. The concepts of multiple modernities (Fourie, 2012) and resilience pathways (Wilson, 2013) can help to explore alternative futures.

The analysis and discussion presented in this paper is based on a first appraisal of the case study profiles and additional information from 14 countries (including Turkey and Israel). The analysis is grounded in social sciences, economics, political theory and geography, and it has a strong interdisciplinary perspective. The analysis and discussion are driven by concerns related to the resilience of agriculture and rural communities and a more balanced development of European regions. The paper is based on some key ideas that are investigated in the new transdisciplinary RETHINK research programme ‘Rethinking the links between farm modernization, rural development and resilience in a world of increasing demands and finite resources’. The programme is supported by the European Commission and funding bodies in 14 countries under the umbrella of FP7 and the RURAGRI ERA-NET. RETHINK is carried out at a time of potentially profound change - when the agricultural sector must finally respond to increasing resource scarcity and distributional demands,

and when economies, production systems and lifestyles must be transformed.

In the first part of the paper, I will briefly sketch out the predominant lines of thinking about agricultural modernization. I refer to the ideas of progress, modernity and modernization and will briefly examine the impact of policy signals on change. Thereafter I present the conceptual and analytical frameworks applied in this research as well as the case studies in 14 countries. In the central part of the analysis and discussion, I focus on the question in how far and where precisely the case studies represent alternative development trajectories. In each case study, I will ask how the links between social and ecological systems are conceptualized and how this expresses different ideas about modernization. Focus is on the interrelations between agricultural change (and modernization), rural development and resilience as well as the importance of adaptive management and ecological modernization concepts. In the concluding section, I pull together the main findings identifying best practices supporting a sustainable agriculture in vibrant rural areas. Throughout the paper, I emphasise that policymakers, technology developers, researchers and stakeholders need to overcome simplistic viewpoints of what ‘modernization’ entails.

Different views about agricultural modernization

The modernization of European farming in the 20th century

The idea of progress implies that advances in technology, science, and social organization inevitably produce an improvement in societal conditions. The discernible assumption is that a society can raise its quality of life and foster economic development through the application of science and technology. Progress will in this logic happen if people apply their reason and skills. The role of the ‘expert’ is to help overcome hindrances that slow progress.

Modernization is perceived to contribute to ‘progress’. The modernization of European farming in the 20th century freed up a significant proportion of the workforce and eliminated drudgery. It was also connected with major increases in productivity, leading to the satisfaction of European food demand and, at times, sizable surplus production. On the negative side of the specialisation, intensification and scale enlargement of agriculture are monotonous production landscapes, a disproportionate use of natural resources (in particular fossil fuels and minerals like potassium and phosphorus), an increase in emissions and a standardization of food qualities. At another level, we can see a concentration of farming in lowland plains and or regions with better access to (imported) feed, fertilizers or markets, and a marginalisation of other, normally less favoured areas.

The industrialization of production tends to lead to the individual and the individual business becoming more important; in agriculture replacing the machinery ring, the commons or the dairy coop. The same tendency might, at least partly, explain that public goods are under increasing pressure in ‘modern’ societies. Globalization can, against

this background, not only be defined as the integration of economic, political and social systems but also as the spreading of modernization across borders.

“A new technology does not merely add something; it changes everything”

The statement from Neil Postman (1992) emphasizes that new technology tends to lead to social change. The availability of cheap fossil fuels fostered industrial manufacturing and enterprise development. Many agricultural technologies of the past decades are fossil-fuel-based and energy-intensive, leading not only to increased dependencies from fuel imports but also to a release of labour from production and huge increases in greenhouse gas emissions, thus contributing massively to climate change.

Agriculture is characterised by close links between social and ecological systems. Technological change has therefore, probably more than in any other sector, major repercussions on the organization of production, the natural environment and, in the long term, farm and rural structures. The introduction of tractors and of mineral fertilizer has both led to far-reaching changes in production systems and agricultural structures. Mineral fertilizer led to major increases in the productivity of land while increasing greenhouse gas emissions and the dependency from fossil fuels. Both, the low cost of fossil fuels and the labour demand in other non-agricultural sectors have decreased a lot in the past years – maybe changing the game again.

This all happens in a context of climatic change and declining resources of critical input factors for contemporary industrialized agriculture. ‘Peak oil’ is already influencing the costs of nitrogen fertilizer, and other crucial nutrients for crop production like phosphorous might follow. Deteriorating soil fertility, dropping groundwater tables and degradation of biological diversity in intensive arable farming areas reduce the resilience of high input agriculture.

What seems clear is that ‘business as usual’ is no longer an option. The summary statement in OECD’s Environmental Outlook to 2050 speaks for itself (OECD, 2012): *“Humanity has witnessed unprecedented growth and prosperity in the past decades, with the size of the world economy more than tripling and population increasing by over 3 billion people since 1970. This growth, however, has been accompanied by environmental pollution and natural resource depletion. The current growth model and the mismanagement of natural assets could ultimately undermine human development.”*

The next transition that until now is only starting in very few countries is the move towards low carbon resource-efficient production systems, mobility and lifestyles (Fan and Ramirez, 2012; Norse, 2012). The productivity of the use of natural resources and the ecological and carbon footprints are becoming key parameters in any system change. Related to that is the question: will the ‘knowledge-based bioeconomy’ just become a logical continuation of the industrialisation of agriculture?

Conceptual framework for the analysis and data basis

The conceptual and analytical frameworks applied in the 14 case studies and analysis build on the results obtained in a large number of EU-funded research projects: MULTAGRI and TOPMARD emphasized the multifunctionality of rural areas and the central role of farming in the provision of public goods (Cairol et al., 2009; Bryden et al. 2011). The findings of this research have been confirmed in a major IEEP study on the provision of public goods through agriculture (Cooper et al., 2009). The BIOSCENE project showed that biological diversity is crucial for rural viability and agricultural activities (at different spatial and temporal scales) (Olsson et al., 2011). The transformation of public goods in the rural economy was the focus of the TOPMARD project, and the DORA, RESTRIM, INSIGHT and ETUDE projects (Bryden et al., 2004; Cecchi & Micocci, 2004; Knickel et al., 2009; Van der Ploeg & Marsden, 2008; Milone & Ventura, 2010) emphasized the central role of social capital and of less tangible factors in the dynamics of rural areas and positive change. The DORA, MULTAGRI, TOPMARD, and a number of ESPON and other research projects emphasize the incidence of pluriactivity and income combination as well as the context-dependency and diversity of development trajectories both at farm and at regional level. Taking a systems approach to sustainable farming, Darnhofer et al. (2010) turn to resilience thinking with its focus on the interdependence of social and ecological systems.

In our analysis, farming is conceptualized as being part of a set of systems spanning several spatial scales and including agro-ecological, economic and political-social domains. Within such a complex system, farm sustainability can only be achieved through adaptability and change. The analysis focusses on conflicting goals and on potential synergies while explicitly recognizing the complexity of challenges, the diversity in situations and the multidimensionality of strategies and ways forward. An example is the integration of various land use functions that can reduce conflicts and land consumption while the related coordination processes need to be enabled by policy measures as well as in local actions.

In all case studies, and in the subsequent analysis and discussion, we adopt a more integrative systems perspective and try to avoid focussing on a small segment of the ‘whole’. Interrelationships and understanding interrelated change dynamics, I think, is critically important.

Multidisciplinary, multi-method approach in data collection and analysis

The analysis is based on the assumption that 14 carefully selected case studies will improve our understanding of the multiple mechanisms underlying rural prosperity and resilience. Four clusters of research questions or themes were used to gather data and they are also used to structure the comparative analysis.

The four thematic clusters and key questions are:

(1) *Resilience*: What are the key features of resilient agricultural systems and what strengthens the resilience of farming and agricultural land use (mechanisms, strategies)? How do market forces, societal demands, resource constraints and place-based actions interact to create both opportunities and constraints for more resilient agricultural systems?

(2) *Prosperity*: What pattern of development enhances rural prosperity? Or, more specifically, how can we shift from a focus on costs of production, productivity and cost-efficiency (i.e. input-output relations) to effectiveness (i.e. adequacy to accomplish a purpose such as quality of life). How are opportunities identified and used? What trade-offs are involved? What underlying logic can be identified? What development trajectories (and patterns) can be identified across different case studies and regions? How can urban-rural relations be shaped in a way that increases rural prosperity?

(3) *Governance*: What are the strengths and weaknesses of different governance structures identified in the range of case studies? How do actors respond to increasing demands and finite resources? How are the relationships between rural areas and agriculture expressed, functionally and spatially? What is the role of multifunctionality in land use? How can the relationships between rural areas and agriculture be shaped in a way that enables collective actions, increases rural prosperity and strengthens resilience? What is the role of multi-stakeholder partnerships and cooperative approaches?

(4) *Knowledge and learning*: What is the role of human resources, social learning and of different knowledge bases in the changes observed and outcomes obtained in different case studies? What meaning does 'farm modernization' have in the particular case? What are the key parameters from the point of view of various stakeholders? What kind of knowledge is used and how is it accessed? How is knowledge connected with innovation? How does the collaboration between regional authorities, farmers, research and extension support positive developments?

The main purpose of the case studies is to analyse and learn from examples that have been developed by practitioners and that have been – in one way or another – successful. In order to ensure comparability, a common analytical framework was applied in each of the 14 case studies in order to guide the gathering and compilation of empirical evidence. The analytical framework included for each of the four themes a set of qualitative and semi-quantitative indicators. For a complete description of conceptual and analytical frameworks, see Darnhofer *et al.* (2014, 2015).

Each case study was to provide an in-depth assessment of two or three thematic areas. Case study reporting followed a common reporting template. In the relevant sections of this reporting template, each theme and issue were addressed through specific questions, common tabular overviews, maps and charts. Each piece of information provided was to be supported by empirical evidence with explicit references to sources of data and methods. The most important sources of

information included expert interviews, results from workshops and/or focus groups, discussions in national stakeholder groups, official statistics and survey data. Sections for 'additional case study-specific issues' allow you to include information that you consider relevant but does not fit in the other sections of the template. Researchers were asked to collect quotes from key actors, practitioners and stakeholders as well as graphical material for illustration of findings (incl. photos, images).

In the concluding section of the template were asked to relate the main results of their case study back to the overarching research goals and questions. Two internal review rounds were organised in order to ensure a high quality of all case study reports.

The 14 case studies

Detailed information on all 14 case studies including the complete case study reports is available on the RETHINK project website. In this section, I will therefore only provide a short overview (**Table 1**).

Based on the analyses and data presented in these 14 case study reports, I will ask in subsequent sections in how far and where precisely the different cases represent alternative trajectories of agricultural development. In each case study, we can find very particular links between social, economic and ecological systems. I argue that this expresses differences in contexts (resource endowment, agricultural and non-agricultural opportunities, socio-cultural features and preferences, etc.) as well as different ideas about modernization. Focus in each case study report is on the interrelations between agricultural change (and modernization), rural development and resilience as well as the importance of adaptive management and ecological modernization concepts.

Discussion of the interrelations between agricultural change, rural development and resilience

The concentration of farming has marginalized many rural areas

The last decades have – in spite of the particular support provided to less favoured areas – seen a very substantial concentration of agricultural production and polarisation of agricultural structures in Europe. Given the increasing demands for a more balanced regional development, both the intensification of agriculture in favourable areas and the simultaneous desertification of marginal areas are problematic (e.g. abandonment of cattle farming in mountainous grassland areas, desertification of vast farming areas in southern and eastern European countries).

Factors that will influence the future of European agriculture and of rural areas include likely demographic changes, the further development of food (value) chains, urban-rural relations, anticipated trends and perspectives in

Table 1
Overview of the 14 case studies discussed in this paper

	Case study	Relevance for the questions addressed here
BE	New forms of governance in landscape development	The case study focuses on the establishment and governance of a landscape fund. Central questions include alternative strategies for landscape development that could more effectively address the demands of people in peri-urban areas, and the role of alternative financing mechanisms to potentially revalorize multifunctional agriculture, increase the resilience of local farming systems and improve urban-rural relations.
CH	Sub-urban food production systems in a Swiss agglomeration	The growing number of local agriculture initiatives and their diversity reflects, among others, the wish of many people to reconnect with basic values and the increasing concern about the sustainability of agricultural and food systems. This case study is about local agriculture initiatives in the agglomeration of Bern. It explores the question of economic and social links between local farmers and inhabitants through local food product markets.
DE	Opportunities for creating an eco-economy: Lessons learned from the Regional Action and Bio-energy Regions schemes	The case study focuses on the role that rural areas and agriculture can play in a low-carbon resource-efficient economy. Rethinking farm and rural modernization is discussed in terms of more resource-efficient, low-carbon processes and products, the re-valorisation of different kinds of knowledge, and new forms of governance in the related change processes. The analysis concentrates on the related transitions and changes. It contrasts key factors and determinants of an eco-economy in comparison with a bio-economy with its implications for farm and regional development.
DK	Landscape strategy making and agriculture	The rural landscape as the spatial frame for agriculture, agricultural future development and rural development is the subject of the Danish case. The overall objective is to explore and reflect upon how collaborative strategies for the design of future agriculture landscapes can contribute to the development of more well-functioning agricultural landscapes and how such elevated landscapes can be considered a rural development factor in general. Experiences with collective and individual landscape management are examined in order to gain knowledge about how agriculture and landscape, and agriculture and rural development may be reconnected and how social and ecological landscape services can be enhanced through different kind of collaborative arrangements and initiatives.
ES	Innovation and social learning in organic vegetable production in the Region of Murcia	The case study focuses on the evolution of the Camposeven cooperative, founded in 2007 by farmers with over 40 years' experience in the agricultural sector and in the production, processing and marketing of horticultural crops, both organic and conventional. Emphasis in the cooperative is on the use of sustainable techniques, new ways of working together based on trust and transparency, and prioritizing quality over quantity. Governance, knowledge and learning are considered in this case study almost as tools that result in increased prosperity and resilience.
FR	Transitions towards ecological production	The French case study includes a sociological and agronomical analysis of the greening of the agri-food system in the Drôme Valley (Biovallée). In an economic analysis, the strengths and weaknesses of market-mechanisms for biodiversity preservation are assessed and new market mechanisms devoted to support a continuous improvement of agricultural practices explored. The starting point is an analysis of farmers' trajectories towards ecological production including various degrees from integrated production to organic farming. It is asked, how dynamic combinations of both specialization and diversification in the fruit and vegetable sector can lead to a better resilience at farm scale. The study includes a systemic analysis of the role of the different actors in the agri-food system, their interactions, the social learning processes and the forms of coordination and governance at the territorial scale.
LT	Resilient farming systems and market differentiation: Challenges and opportunities in farmers' markets	Alternatives in the food sub-sector are identified across regional and national differences and across farmers' markets. The focus will be on how farmers, local inhabitants and consumers respond to increasing demands and finite resources, and how local added value in the food sector can be maintained. Key questions relate to the significance and role of dedicated marketing, farmers, local inhabitants and consumers views, and the relationships between rural areas and agriculture. Consumer needs are explored as well as farmer's attitudes and change behaviour. The issues that key actors connect with farm modernisation and related bottlenecks are identified.
LV	Small farms' development strategies	The case study is focused on Tukums region that is a centre of Latvian fruit growing with comparatively long traditions, well-established research institutes and farms. It is analysed how farming and food supply chain modernization influences resilience of farming systems, prosperity of farmers and rural areas. Special attention is paid to organizational innovations and initiatives that try to shape local agricultural and food markets in new ways. It is asked how small farmers succeed to build, sustain, and develop resilient farms in dynamic and often unfavourable conditions. Diverse practices of market, territorial, social and political involvement are identified that assure not only their own existence and development but contribute to viable rural communities and sustainable rural development.

	Case study	Relevance for the questions addressed here
IE	Farmer adoption of a new nutrient management technology	Milk and beef production are the two most important farming sectors in the Republic of Ireland, accounting for around 60% of total agricultural output. Ireland envisages a future for agri-food based on the continued development of the sector where efficient and environmentally-friendly production delivers sustainable export growth on global markets. Achieving this expansion without compromising environmental quality poses a significant policy challenge. The case study is conducted among livestock farmers participating in the Irish Agricultural Catchments Programme over the course of a one-year farming cycle. In the case study, a farm extension agent will promote change and adoption of a new nutrient management technology. Focus is on the role of innovation in the sustainable intensification of grass-based production.
AT	Organic farming and resilience	The innovative farmers in Salzburg are at the heart of developing an alternative approach to modernisation, one that very selectively uses technology, couples it with traditional elements and addresses societal and consumer needs through an 'artisan economy'. Rather than focusing on economies of scale and supplying commodity markets, they focus on economies of scope and niche markets, they search for new business models, around creative ideas that allow them to use their skills and knowledge.
IT	Extensive pig production systems	The Italian case study is about alternative extensive and outdoor pig farming system based on commercial or local pig breeds (e.g. Cinta Senese, Romagnola, Casertana, Apulo-Calabrese, Nero Siciliano, and Sarda). Focus is on the newly established high value-added food chain for Cinta Senese. The food chain combines traditional handcrafted methods with contemporary management and modern technologies and marketing. The Cinta Senese breed represents Tuscan traditional farming and its products are perfectly integrated in the regional gastronomic tradition. For the local population, Cinta Senese products represent an element of prestige and pride. For tourists it represents an extra element of interest and cultural and gastronomic richness that complements the list of products typical of Tuscany.
IL	Rural innovation in global fluctuation: The Arava region case study	The case study is set in the Arava region, just south of the Dead Sea in the desert area of Israel. The region is currently undergoing a major crisis that challenges its traditional sources of resilience. This crisis has sparked a process of deliberation and is already pushing stakeholders to revisit some of their long-standing perceptions and motivations regarding the region and their own role in its prosperity. The analysis examines the new directions for agricultural and rural innovation that individual farmers and regional institutions such as the Arava Research & Development have begun developing and are experimenting with. It explores the process a highly successful farming community is currently pursuing, following a developing regional crisis, the tools available to them and the new ones they are creating in the process.
SE	Peri-urban agricultural transformations in Gothenburg	Focus in the Swedish case study is on the sustainability of developmental trends in agricultural landscapes in a peri-urban region (Gothenburg) and a rural grain farming region (Östergötland). Trends between peri-urban and rural areas are compared in order to identify differences in landscape development and key determinants. Focus is on the system of incentives and regulations and how it affected changes in agricultural land use in the rural and peri-urban regions between 1990 and 2020. Particular attention is paid to assessing the sustainability of landscape and land use in a socio-ecological perspective, considering ecosystem services produced in different land use categories.
TR	Resilience and competitiveness of small ruminant farms in Isparta	The case study region is the Isparta province of Turkey, located in the West Mediterranean Region, which is also known as Lake Region. Isparta is famous for its natural resources, landscape and agricultural production, such as cherries, apples, oil roses and livestock (especially small ruminant). The analysis aims to identify the role of farmer organisations in the resilience of farming, innovation and their competitiveness in the market. Three types of farmer organisations are examined: cooperatives, producers' unions and growers/breeders' unions. Where relevant, also other kinds of farmer organisations are inspected.

biotechnology, biomass energy and bio-based products, and issues revolving around resource depletion.

How does farming contribute to more prosperous rural areas? Cairol *et al.* (2009) emphasized the multifunctionality of rural areas and the central role of farming in the provision of public goods. The findings of this research have been confirmed in a major IEEP study on the provision of public goods through agriculture (Cooper *et al.*, 2009). Olsson *et al.* (2011) showed that biological diversity is crucial for rural viability and agricultural activities. The transformation of public goods in the rural economy was the focus of research led by Bryden *et al.* (2011). IAASTD (2009) found that markets are

necessary, but do not guarantee sustainability of public goods such as food security, conservation of natural resources, or protection and enhancement of the environment. Knickel *et al.* (2009), Van der Ploeg and Marsden (2008), von Münchhausen *et al.* (2010) and Milone and Ventura (2010) emphasized the central role of social capital and of less tangible factors in the dynamics of rural areas. The same authors emphasized the incidence of pluriactivity and income combination as well as the context-dependency and diversity of development trajectories both at farm and at regional level. From these different studies it seems clear that rural prosperity is not just a question of economic performance, and that economic performance is not only connected with agricultural production.

Shaping agricultural development: The role of knowledge

Institutions and networks that are able to combine different types of knowledge and experience, and learn, tend to be more effective in shaping future development. Other attributes favouring a positive development are responsive governance structures, and flexibility in decision-making processes and problem-solving (see **Table 2**). In the ideal situation, the agricultural knowledge and innovation system comprising education, research and farm advisory services is well connected with local knowledge and farmers networks (Moreddu and Poppe, 2013). Knowledge related to natural resources and ecosystems, and their use, includes understandings, interpretations, know-how and resource use practices, all based on long-term interaction with the natural environment (Röling and Jiggins, 1998).

All 14 case studies illustrate the important role local knowledge plays in managing farms and production systems. Local, informal knowledge plays a particular role where farmers emphasise the management of agro-ecological systems and where the aim is to develop more resilient farming systems and practices. Many cases are illustrative of the advantages of more holistic management approaches that combine contemporary managerial and scientific knowledge and approaches with traditional ecological knowledge and thinking. In 'modern' resource management systems, in contrast, traditional and local knowledge tends to be undervalued. The same still tends to be the case in mainstream agricultural knowledge and information systems as well as in current innovation systems and policies. The role of local knowledge is sometimes also diminished by inappropriate policy instruments. Payments in support of organic farming are an example. They have sometimes contributed to a very rapid expansion of farmed area while advisory services, processing and certification were left behind.

And the millions of semi-subsistence farmers in the new EU Member States?

It is often ignored in descriptions of the changes in European farming that agriculture is extremely diverse in farming practices, systems and strategies. Van der Ploeg (1994) was one of the first to emphasize the fact that there exist many different shapes and styles of farming. Multiple job holding, pluriactivity, income combination and semi-subsistence farming have always remained important – despite contrasting views in particular in agricultural economics. Davidova *et al.* (2013) estimate that in 2010, there were 5.8 million semi-subsistence farms in the EU-27. Of these, 61% are in Romania, and about 89% in each of Hungary and Poland. 11% are in Italy, with over 100,000 in each of Bulgaria, Greece and Lithuania. Semi-subsistence farms also comprise a significant share of all holdings in Cyprus, Latvia, Malta, Slovakia and Slovenia. Over the EU-27 as a whole, semi-subsistence farms account for almost half of all agricultural holdings, and about three-quarters of small holdings with less than 2 ha of utilised

agricultural area or under €2,000 of standard output. Davidova *et al.* argue that such a large sector, which provides livelihood for millions of rural inhabitants, cannot be ignored politically: “Many poorer EU-27 member states [...] have large numbers of semi-subsistence farms which provide food for low-income households. The relative rural poverty in some member states, and the hardship stemming from the economic recession, are factors contributing to the in some cases proliferation of semi-subsistence farms.”

Redman (2012) describes subsistence farmers as “idiosyncratic and individualistic; focusing on the wider needs of the subsistence farming community”. He demands that we “discuss intensification with creativity and imagination: knowledge intensive, renewable resource, appropriate technology, communication and cooperation intensive”. Avenues for different pathways of modernization for smallholders and different kinds of innovation need to be developed. Relevant starting points are the (partly overlapping) modernization discourses and practices around small holdings which since the 1990s have been ‘diversification and cooperation’, and then more recently ‘innovation’ (which smallholders have practiced individually and collectively).

The case studies from Lithuania, Latvia and Turkey in particular deal explicitly with the situation of smaller and semi-subsistence farms. In all three cases, it can be seen that smaller and semi-subsistence farms have their particular strengths and weaknesses and that they require different strategies. They make very clear that there cannot be a one-size-fits-all development model for agriculture (see **Table 2**). In some respects it even seems worthwhile to revisit small farmer strategies as they often – not always – point to ways of efficiently using given, local resources that often are renewable and low-emission. Related to policy development, we also need to take into account that today, in most regions across Europe, there are much lesser opportunities in non-agricultural markets and often unemployment is high. A diverse agricultural sector that is closely linked with regional economies and food systems might in the short and medium term be rather beneficial in buffering and simply providing livelihoods for many.

Connecting economic, social and environmental systems

Table 2 provides for each of the 14 case studies a brief characterisation of the way, that practitioners define agricultural and rural development in new ways. The information provided is just indicative of the key findings in the case study report. The table also includes a brief indication of key resilience and prosperity outcomes.

The information provided in **Table 2** indicates that each single case can be seen as an expression of innovative development trajectories, highlighting potential synergies between farm modernization and sustainable rural development. Remarkable too is that each single case, starts with the needs and opportunities of economic, social and environmental systems and the attempt to minimise conflict and better integrate different goals.

Table 2
Key insights obtained in the 14 case studies related to the redefinition of modernization and outcomes

	Case study	How practitioners (re)define agricultural and rural development, and modernization	Some key resilience and prosperity outcomes
AT	Organic farming and resilience	Rather than focusing on economies of scale and supplying commodity markets, farmers focus on economies of scope and niche markets, they search for new business models, around creative ideas that allow them to use their skills and knowledge. These farmers, as 'artisan entrepreneurs', take responsibility for the economic destiny of their farms, which sets them apart from those that feel powerless in the face of global markets and resentfully dependent on direct payments. While the business might grow from 'micro' to 'small', they do not aim for further growth or mass production. They are more likely to network with others, search for social innovation through novel cooperation models, among other with chefs in restaurants or hotels that emphasize the uniqueness of the region.	The approach used is reflective and selective rethinking, questioning both tradition and modernity, seeking to go beyond both, while preserving those elements that serve their purpose. Farmers have a territorial understanding of farming, rather than a sectoral approach, thus seeking cooperation with others in the region. In these cooperations they demand a fair partnership.
BE	New forms of governance in landscape development	Land used for agriculture is the only qualitative open space left and improving and maintaining the quality of this open space is a priority for the quality of life in the area. The governance mechanism adopted allows farmers to be managers of qualitative open space without compromising their incomes. With shared efforts, the farmers, companies and inhabitants collaborate in the development of 'their' landscape.	The voluntary cooperation of farmers, companies and inhabitants is a key success factor and companies contribute to nature development in their region.
CH	Sub-urban food production systems in a Swiss agglomeration	Most initiatives in the case study represent alternative systems, approaches or models of food production, paying stronger attention to social, human and community development processes. Relationship building with consumers and networks, participation and space for knowledge sharing are key. Capacity building and exchange of experience among farmers and processors and organisation facilitators seem to be key success factors as well as knowledge and experience sharing and thus mutual learning	Social value creation and awareness among consumers concerning local agriculture, farming and farm household realities.
DE	Opportunities for creating an eco-economy: Lessons learned from the Regional Action and Bio-energy Regions schemes	'Rethinking' the modernization of farms and rural areas in the case studied refers to valorising renewable resources in ways that are sustainable and adapted to regional conditions. In this development process, new forms of governance – notably expressed in new actor network constellations – play a vital role. The on-farm bio-energy activities accompany the establishment of bio-energy villages that aim at using local resources in smaller-scale distributed systems and establishing cross-sectoral linkages. Key determinants are the kinds of technology, the investment capital needed and suitable forms of governance. Fulfilling the new roles and the new farm-related activities necessitates the establishment of cross-sectoral linkages as well as a substantial amount of 'learning'. In the study region, actors prove to be capable of recognising regional potentials – of the agricultural sector as well as wider rural development – and they are open for novel approaches with regard to securing the future prospects of their rural area.	Bio-energy activities foster diversity at the level of farms, the agricultural sector and the regional economy. Local farmers – in an interplay with other rural actors – contribute crucially to opening up a future perspective for their rural area. Pilot programmes like 'Regional Action – Shaping Rural Futures' (RA) and 'Bio-energy Regions' (BR) were found to be important catalysts.
DK	Landscape strategy making and agriculture	Agricultural modernization in Denmark has for several decades meant concentration, specialization and industrialization of agricultural production. Production has as a result largely been concentrated on few, large farms that are increasingly separated from rural communities while food processing mainly takes place in cities. The significance of non-agricultural functions such as residential, recreational and ecological functions is increasing in importance in territorial decision-making. Collaborative strategic decision-making and planning on a local scale can contribute to a sustainable development towards more resilient agricultural landscapes and counteract the current decoupling of agricultural businesses from the landscape.	Local actors perceive learning not only as an individual process but also as social capital building. Farmers through a collaborative landscape strategy making process can learn to adapt to new knowledge about the functionality of the landscape as well as to reshape their internal relationship.
ES	Innovation and social learning in organic vegetable production in the Region of Murcia	The Camposeven producer association is based on cooperation, trust and transparency, and on prioritizing quality over quantity. These pillars have allowed adapting to a complex and highly competitive market context. Camposeven is known for its good practices and for pioneering organic farming systems. The association cooperates closely with other companies such as the research group GESPLAN of the Technical University of Madrid. This collaboration is developing professional practice in cooperation with different actors, connecting knowledge and action through joint projects. It stresses the value of experienced knowledge and the integration of joint learning.	Governance, knowledge and learning are in this case study considered almost as tools that result in increased prosperity and resilience. The Camposeven producer association has enabled its members to be more autonomous, also experimenting on their own farms, generating a dynamic of sharing ideas and mutual assistance between partners.

	Case study	How practitioners (re)define agricultural and rural development, and modernization	Some key resilience and prosperity outcomes
FR	Transitions towards ecological production	The ability to combine long-term vision and short-term opportunism has been a skill exemplarily developed in the Drôme Valley. In the territorial agri-food system, stakeholders from farming, marketing, processing and retailing sectors, advisory services, public policies, civil society have a rather collaborative attitude and a long experience of multi-actors projects and governance. From the early 1990s, local policies aimed at turning the valley from the “hinterland of the productivist period” into “a foreland of quality”. Prosperity and resilience are both associated to diversity and diversification in products, in marketing channels and in production modes sometimes (organic, conventional, geographic indications etc.). Direct links to consumers, local authorities and sometimes to school canteens are seen as rewarding by farmers.	Younger farmers who have not known this “golden age” [the past era of prosperity when farmers got much better prices for their products] have a completely different definition of prosperity, rather linked to quality of life and well-being, autonomy in their daily work and in their relationship to the market, coherence with their values and their personal project.
IE	Farmer adoption of a new nutrient management technology	The Republic of Ireland is the largest beef exporter in Europe and the 10th largest dairy export nation in the world. Milk and beef production account for around 60% of total agricultural output. Approximately, 90% of beef output and 85% of dairy output are exported and there is a plan to increase milk production by 50%. Achieving this expansion without compromising environmental quality poses a significant policy challenge. Efficient farm and field level management of nutrients has consistently been found to be an optimal strategy in the management of environmental risk from agricultural production.	Optimal use of expensive fertiliser has the potential to deliver a double dividend of reduced nutrient loss to the wider aquatic ecosystem while maximising economic returns to agricultural production thereby making the farm system more resilient within the farm gate to external shocks.
IL	Rural innovation in global fluctuation: The Arava region case study	The Arava case study demonstrates the ambivalent correlations between farm modernization, regional resilience and rural development. A decade ago, the Arava farmers thrived economically. However, over the past few years they have come to acknowledge a growing crisis as most farms grow pepper (capsicum) using similar agricultural practices. Overall, the region produces about 60% of the total Israeli export of fresh vegetables and agriculture is highly economically dependent on exports to Europe, Russia and the United States with minor distribution in the local market. The recent crisis has placed a strong demand for finding either “the next pepper” or new economic directions altogether. The single crop approach represents a continuation of the old mind set: expecting a single solution that will replace a product that can no longer provide for farmers in the region. One idea is to approach pharmaceutical and biotechnology companies that use certain kinds of plants which the region is especially suitable for growing, aiming to establish completely new regional supply chains.	The Arava R&D Centre looks for ways to commercialize the region’s unique knowledge in farming, to adopt new types of agricultural activity for numerous industries, to support new local entrepreneurship, and to bring in new investors that may help scale up the region’s business activities. The aim is to try out new business models that may help commercialize local knowledge, and create new partnerships that contribute to employment in the region.
IT	Extensive pig production systems	Unlike in intensive indoor farming, pigs in extensive systems are not housed in fixed structures in masonry, but reared in open surfaces of agricultural and/or forest land bounded by suitable fencing systems. Extensive and outdoor systems are also common in other European countries (e.g. Spain, Portugal, United Kingdom, France, and Hungary) with the aim to produce high quality fresh pork and processed products. Successful initiatives require an effective cooperation of all actors of the supply chain i.e. pig farmers, breeders, fatteners, feeding companies, slaughterhouses, processors, advisors, butchers, multiple retailers and restaurants plus veterinary, environment protection and food safety authorities. Multifunctional agriculture is perceived as the backbone of agriculture in Tuscany with direct marketing, organized groups of consumers, a very strong presence of agri-tourism farms and clear rules for the preservation of the typical landscape.	Quality of life in rural areas is linked to a social life characterized by networks, shared norms and expectations that facilitate the ability to get things done collectively and a sense of belonging. The Cinta Senese breed represents the Tuscan traditional farming and its products are perfectly integrated in the regional gastronomic tradition.
LT	Resilient farming systems and market differentiation: Challenges and opportunities in farmers’ markets	Nearly three-quarters (73.3%; 2010) of the Lithuanian farms larger than one hectare are semi-subsistence farms with an economic output of less than 14,000 per year. Among small farms, a flexible use and re-use of resources, and a step-by-step development based on the available local social and natural resources prevail. Farmers’ markets that promote the consumption of local products are becoming more and more popular. One of the reasons, why farmers are only to a limited extent engaged in farm-based processing and direct marketing is the lack of technological, marketing and communication knowledge.	Food markets in Lithuania are becoming more differentiated and a fast growing number of consumers give priority to healthy, authentic and environment friendly produced food.

	Case study	How practitioners (re)define agricultural and rural development, and modernization	Some key resilience and prosperity outcomes
LV	Small farms' development strategies	Small farms, which compose up to 90% of all farms in Latvia, are facing various long-term political, market and socio-demographic pressures, and their number is constantly declining. In the case study, it is argued that diverse practices of small farmers ensure not only their own existence and development but contribute to viable rural communities and sustainable rural development. The examples given show that small-scale farming represents an alternative form of sustainable modern agriculture, where farm modernization reinforces rather than hinders sustainable development, rural prosperity and resilience. Diversity opens up diverse paths for modernization, especially if we consider contemporary societal needs and demands including sustainable provision of food, maintenance of rural livelihoods, environmental conservation and sustainable growth.	Small farms illustrate the holistic multi-faceted and long-term character of prosperity, where farmer, farm, community and territorial levels are interconnected. Farmers interpret prosperity in terms of family well-being, a sufficient level of income, the freedom to organise one's own life and work, the reproduction of natural resources and contribution to community livelihoods through employment and social relations.
SE	Peri-urban agricultural transformations in Gothenburg	The transformation of and contemporary conditions for farming in a peri-urban area is an increasingly important issue. Gothenburg provides an illustration of a more general trend for peri-urban areas regarding land use. The transformation from a rural agricultural landscape with mixed farming systems including livestock and arable production of food for the nearby urban market into a peri-urban landscape with strong imprints of urbanisation puts substantial pressure on farm households. Yes, agricultural production is just one part and has to accommodate leisure demands and facilities for the urban population, among which the horse riding activities are dominating. The demand for land for housing and settlements increases the pressure on agricultural land. This is counteracted by a general municipality strategy of sustainable livelihoods that includes agricultural activities for local food production and active cultural landscapes.	The importance of the different types of ecosystem services demanded in particular in peri-urban areas has changed from mainly provisioning services to mainly cultural services. The study shows that agricultural practices like grazing livestock within a nature reserve can be useful for preserving cultural landscapes, biodiversity related to semi-natural habitats and ecosystem services.
TR	Resilience and competitiveness of small ruminant farms in Isparta	The small ruminant sector in the three provinces Antalya, Burdur and Isparta has been selected because goat and sheep production is traditionally and socio-economically important for the western Mediterranean region. Animal husbandry is based on extensive grazing and the shepherds are generally the herd owners. Social life totally depends on production activities and shepherds are most of the time out of villages with their animals. The main characteristics of the farms are that they still use traditional methods, and the family workforce is the dominant resource. Most of the farmers have taken over from their families and they have been involved in farming since they were children. Recently however they do not want their children to take over their businesses, and young people tend to find jobs in urban areas. At the same time, in the last decade, the goat milk and goat cheese market value has increased because of the increasing demand for "natural", "organic" and "healthy nutrition". Producers who go for product diversification and succeed in marketing tend to have better incomes.	Recent developments in the sector encourage farmers to be organised and keep records. The use of new technologies in small ruminant production is expected to reduce workloads and increase the welfare level of families and their involvement in social life. Farms that use milking machines have a higher productivity with better milk quality, a lower labour intensity, more leisure time and a higher family income.

Synopsis of some key findings from the case studies

It is to be stressed that the insights gained from the 14 case studies can only be indicative of the diverse rural and farming realities across Europe. Yet, some of the findings are in line with other research, and they provide great illustrations of underlying mechanisms. They include:

- Farm structural, natural, social, cultural and economic conditions differ hugely across Europe. Some countries like the Belgium, Denmark, France and Germany have for a long time had very high levels of agricultural investment (and investment support). In those countries, farm and regional-level specialisation might have become too strong ((IAASTD, 2009; Knickel *et al.*, 2014).
- Other countries like Lithuania and Latvia lack investments. Policy instruments that proved effective in the old EU member states might not provide the kind of support needed in these very different situations (Dwyer *et al.*, 2012; Davidova *et al.*, 2013). Support mechanisms therefore need to be sufficiently differentiated.
- Communities and individual entrepreneurs need to be able to deal with changes in markets (the Arava case study), environmental and or climatic changes, the resulting unpredictability and the related new opportunities (the German bio-economy case). Folke *et al.* (2002) emphasize that resilience, and the capacity to adapt to change, are key properties of sustainability.
- Many of our case studies are pointing to the tremendous importance of adaptive management and the need to combine different types of knowledge. In line with our findings, Jiggins and Röling (2000) argued that learning can be enhanced by combining different kinds of knowledge.
- In particular in our case studies in Austria, Germany, France and Latvia, it was emphasised that to enhance resilience is a major concern for farm families as well as rural communities. Milestad and Darnhofer (2003) discussed the features that can be conducive to building farm resilience. Central in their argumentation is that "*sustainable agriculture should not be seen as a set of practices to be*

fixed in time and space, but must include its ability to cope with change". Pretty (1997) and Hinterberger *et al.* (2000) argued that the corresponding skills required are not just the ability to define goals and measures, but also the necessity to continuously deal with uncertainty. Our case studies provide manifold illustrations of this attitude and the related processes.

- The case studies in Israel and Germany in particular, provide an excellent illustration of Joseph Schumpeter's (1943) argument that industries must incessantly revolutionize the economic structure from within, that is innovate with better or more effective processes and products. In the context of our discussion we can translate 'innovating from within' to first, economic innovations can be effectively combined with social and organisational ones, and second, practitioners and their knowledge and experience play a central role.
- Knowledge and learning played a central role in most of our case studies. Usually it was a more diverse group of actors, often led by some very dedicated professionals that managed to cross-sectoral and societal boundaries. This finding is in line with Münchhausen *et al.* (2010) who argue that innovation partnerships and development networks or groups need motivated individuals in lead functions. I like to add that such groups should function as learning vehicles towards more resilient agricultural production systems – and, as I argued earlier, as learning vehicles towards multiple rural modernities. As suggested by Brunori *et al.* (2013) the goal of sustainable agriculture implies a systemic change: Learning and innovation networks can develop innovative patterns of production by generating new knowledge.

Conclusions

More than one trajectory of agricultural modernization

While our 14 case studies can only be indicative of the diverse rural and farming realities across Europe, I think I could show that there is a multitude of trajectories of agricultural modernization and rural resilience. It follows that agricultural and rural development frameworks need to be differentiated according to the particular farm structural, natural, social, cultural and economic conditions in order to be meaningful and effective in the longer term. In particular, in Eastern European member states, more emphasis needs to be given to more fully appreciate given strengths and resources', and the related opportunities.

As a result, of the lack of more appropriate, future-oriented development frameworks, there often appears to be an overemphasis on traditional development models and instruments. Future research needs to focus on more effective support mechanisms for alternative modernization trajectories and resilience pathways, maybe in particular in countries with very capital and resource-intensive agriculture and sometimes an extreme concentration of production. More capital-intensive systems are also often less resilient because farmers are likely to be more indebted and, as a result, vulnerable.

Issues like the role of agency and of enabling institutional structures, the factors that encourage the creation of synergies in agricultural and rural development, and the role of learning networks and knowledge systems in boosting innovation in the small farming sector need to be further explored. Local capacities for transdisciplinary research need to be strengthened to support decision-making in public and private sectors.

Promoting adaptive management concepts

The importance of adaptive capacity is rapidly growing because of the mounting vigour and incidence of global environmental and or climatic change. Communities and individual entrepreneurs need to be able to deal with the related unpredictability. Resilience and the capacity to adapt to change are key properties of sustainability.

More diverse systems tend to be more adaptive and therefore more resilient economically and socially. Mixed farming systems tend to be more resilient than specialized production systems in particular under rapidly changing climatic and market conditions. A sound analysis of the vulnerability of different socio-ecological and farm systems to climate change, and of opportunities for adaptation needs to be the basis for further strategies.

Emphasizing ecological modernization

Ecological modernization is based on the idea that economic systems are likely to benefit from the integration of environmental goals. Environmental productivity relates to a productive use of natural resources. This includes increases in energy and resource efficiency as well as process innovations such as environmental management, sustainable supply chain management or the development of new eco-products and services. Our case studies indicate that the scope of ecological modernization sometimes also includes value orientations and lifestyles. However, research and training still tend to focus on only one particular model of capital-intensive agricultural modernization, and purchased inputs. More research and training are needed that focus on how to use local resources more efficiently.

Terms like 'resilient agricultural growth' and 'sustainable intensification' are an attempt to bring together supposedly conflicting pathways. Ensuring that technologies are appropriate, affordable and effective is vital. Critical too is who decides and who controls technology.

The important role of learning and social capital in innovation networks

Innovation partnerships and development networks or groups need to function above all as learning vehicles towards more resilient agricultural production systems. The goal of sustainable agriculture implies a systemic change, and this systemic change often requires the combination of new knowledge with rural actors' experiential and local knowledge. Many grassroots

initiatives have relevant experiences. For the same reason, more emphasis should be on the potential of social innovation and social learning to achieve on-going adaptive changes. This needs to include effective governance mechanisms that nurture learning processes.

Related to the implementation of the new European Innovation Partnership 'Agricultural Productivity and Sustainability' (EIP-AGRI) at EU member states and regional/local level it seems critically important that administrations find ways to enable motivated individuals and civil society action. Focus should be on supporting future-oriented investments that maximize added value *within* agriculture and rural areas. In particular, the Latvian and Lithuanian case studies indicate that rediscovering the value and potential of the small farming segment and boosting collaborative innovations is in many areas an important part of that. Administrations need to level the agricultural playing field where capital-intensive sectors dominate. The main challenge for agricultural knowledge systems is to be open-minded and responsive.

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