Social and Technological Transformation of Farming Systems:

Diverging and Converging Pathways

Proceedings of the 12th European IFSA Symposium
12th - 15th July 2016 at Harper Adams University, United Kingdom

Volume 1

Andrew Wilcox and Karen Mills (Eds.)

Harper Adams University

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Preface

As a university that focusses on agricultural and environmental systems research and education it was an honour for Harper Adams to host the 12th European IFSA Symposium in the summer of 2016. These proceedings demonstrate that the event prompted a broad ranging debate about the future of farming, and the growing awareness of the potential to harness new technologies for application in agricultural practice.

With its overarching theme of social and technological transformation the Symposium was timely and necessary, given the changing political situation within Europe and its consequences for future farming support arrangements. These developments will require us to think again about how we secure future food supplies whilst better protecting the environment and, in some cases, to reimagine our approach to modern agriculture.

The organisers of the Symposium, including the Chair, Dr Andrew Wilcox, are to be congratulated for having assembled such an interesting programme. Contributors covered a variety of types of innovation including, importantly, examples where farmers had taken the initiative to improve their business performance by adopting new techniques. There was much discussion about the concept of sustainability, what this means for food chains and the environment and how it might be assessed. Some of the workshop sessions addressed the methodology for investigating farming systems transformation, while others considered questions of governance and policy, including vital issues such as the boundaries and respective roles in innovation systems.

The Symposium delegates had the chance to see some of the innovative activities being conducted at Harper Adams. These included our transformational research in agricultural engineering and precision farming that has recently led to the ‘world first’ Hands Free Hectare Project, where a barley crop was grown using only robots and drones. The technology is now available to take on such challenges, but the Symposium reminded us that it brings with it many questions for society that also need to be addressed. Our aim is therefore to create an ecosystem for collaboration between engineers, social scientists, crop scientists, livestock scientists and entomologists, now a hallmark of this institution, as a means to achieve greater understanding of how to address the food chain issues that face us all.

The Symposium reflected this endeavour. With participants from across Europe and as far afield as Japan, Nigeria, the USA, Uruguay, Australia and New Zealand, and from an equally wide variety of disciplines, the event provided a global assessment of the state of play in the development of our farming systems. There are many important questions for us to address as we face a rapidly changing world, but amongst these, one of the most important must surely be how we transform our approach to the production of food. The Symposium provided a unique opportunity for reflection on this vital topic, and Harper Adams University was delighted to have been part of that process.

Dr David Llewellyn

Vice-Chancellor

Introduction

Understanding farming as systems recognises the interconnections and dependencies among its many human and non-human dimensions. As changes in farming systems take place at all levels (eg individual to farm, local to global etc), understanding the nature of these interconnections and dependencies can be challenging. IFSA's 2016 Symposium focused on particular kinds of change - social and technological transformation. The Symposium considered not only what is changing in terms of these dimensions and their contexts, but also how they related to each other and how purposeful social and technological transformation of farming systems in different parts of the world are realised and how they could be brought about in the future. The concept of 'transformation' rather than just change is at the core of several different 'applied' systems traditions and is a particularly appropriate focus for IFSA. It is relevant to learning, methodology, sustainability, innovation, institutions and governance that all featured in the themes of the symposium. The focus on the social and technological was, however, not exclusive; interconnections and dependencies with other dimensions of change (eg environmental, economic or political) were fully discussed.

The relationship between social and technological dimensions of farming systems is particularly relevant to our current times with different communities responding to these dimensions in a range of ways – on diverging and converging pathways in relation to culture, values and purpose, capital intensity and to scales and nature of operation. In 2016, farming in Europe and indeed across the world faced many issues including climate change, food security, food quality and safety, water and soil security, waste management, energy, conservation of biodiversity, resilience of communities, multi-functionality, farm restructuring, competition and innovation. The situation in Europe became more complex following the decision of the UK to exit from the European Union.

The symposium welcomed a diversity of perspectives on farming systems and different narratives of pathways. The IFSA Steering Committee have strived to attract researchers and practitioners from both natural and social science backgrounds who are new to systems thinking and who may be able to contribute constructively to the debate on how we can design and deliver more sustainable farming and livelihood systems for the future.

Dr Andrew Wilcox

Crop and Environment Sciences Department, Harper Adams University

June 2018

Workshop Themes

Theme 1: Innovation, knowledge and learning processes

Currently it is widely acknowledged that the new context (including biophysical/environmental, technological, policy and socioeconomic challenges) relating to (sustainable) agricultural and rural development generates additional knowledge needs and calls for different ways to support learning and innovation. The need to address multifaceted and increasingly complex problems reinforces the requirement for new forms of research, learning and problem solving that integrates the varying perspectives and insights.

The cooperation of diverse experts and practitioners is required and various 'cross-disciplinary' forms of learning and research, taking into account the complexity of issues and the fragmentary nature of knowledge, needs to be employed. Such approaches accept local contexts and uncertainties, address both scientists' and society's diverse perceptions of an issue through communicative action and application in order to produce practically relevant knowledge.

Consequently, ideas about the generation, dissemination and use of innovations have also changed. The once dominant linear model, according to which scientists/researchers are in control of the production of technological devices, is nowadays severely challenged. Contemporary 'interactive' approaches emphasise the iterative, adaptive nature of innovation; systemic approaches such as AKIS and AIS have emerged. In this respect, the focus has shifted towards processes (instead of the emphasis on structures) with knowledge conceived as being constructed through social interaction. Thus particular attention is given to (social) co-ordination and networking. Moreover, to take into account power relationships and to avoid or overcome gaps (cognitive, information, managerial or system) and the resulting failures, growing attention is given to various types of (process) 'intermediaries' (facilitators, third parties, (knowledge/technology) brokers, bridging organisations, intermediaries, boundary organisations, etc).

Within these circumstances, Theme 1 aimed at exploring both the theoretical (concepts relevant to analyse innovation, knowledge and learning processes in the context of sustainable agricultural/rural development) and practical level (case studies exploring the results of relevant projects in different socio-cultural, economic and institutional contexts):

- The current state of art on innovation, knowledge and learning processes;

- Systemic and multi-stakeholder participatory strategies, methods and tools supporting network/ platform building, social learning and action, innovation and adjustment to policies in diverse AKIS/AIS configurations;

- Emerging 'intermediation' roles and advisors' needs in terms of training (capacity building);

- The current methods to assess the impacts of innovation (participatory, external) including the impact pathway approach.

We invited participants from natural and social sciences particularly, those interested in knowledge needs and support for learning and innovation within agriculture, to contribute to workshops that addressed the issues in this theme.

In Theme 1 ten workshops were held:

Workshop	**Title**
Workshop 1.1	Generating spaces for innovation in agriculture and rural development
Workshop 1.2	Monitoring and evaluation for learning and innovation
Workshop 1.3	Using a co-innovation approach to improve innovation and learning
Workshop 1.4	From farmer to “eco-preneur” in multifunctional agricultural knowledge and sustainable regional development: participatory curricula development and implementation of educational measures
Workshop 1.5	Pathways towards sustainability in the agricultural knowledge and innovation system: the role of farmers’ experiments and innovations
Workshop 1.6	Merits and limits of innovation platforms to promote sustainable intensification in farming systems
Workshop 1.7	Scaling up and scaling out transformative farming practices: critical assessment of tools, methods and skills
Workshop 1.8	Cooperation as a key issue for innovation and learning processes in sustainable land management
Workshop 1.9	Inclusive innovation
Workshop 1.10	Practical experiences and methodological concepts from the first years of EIP-Agri implementation

Theme 2: Methodology and frameworks of farming systems transformation

This theme intends to create a platform for methodological discussions regarding the development of innovations, technologies and practices. Farming Systems research, compared with “classic” approaches, regularly aims at a more holistic rather than reductionist understanding of agriculture and rural development. On the other hand, as “systems” are always models or pictures of reality and resources are limited, there is always the challenge to reduce complexity of the real-world in a meaningful and feasible way. Research within this context calls for a meaningful and creative use of methods and methodologies in both the natural and social sciences, be it single-person or large-group research. In the past decades a wide spectrum of methods has been developed. Important questions are related to the “transformation of methods”, ie what are the challenges with respect to transformation of systems, and what does this mean for development or adaptation of methods?

From the beginning farming systems researchers intend to create solutions for “real-live” problems. Such research is often case-specific analysis and calls for contextualisation of solutions. The question then is how to generalise findings?

More and more, farming systems research is confronted with the societal demand to go even beyond research, contribute to the implementation of solutions and thus bring their concepts and results into practical use. Such research is demanding for integration of concepts, theories and results, and for cooperation and participation amongst researchers (interdisciplinarity) as well as between science and practice (transdisciplinarity).

We invited participants from both the natural sciences and social sciences to offer workshops in order to discuss theoretical and practical approaches, concepts and empirical cases in various fields and settings:

- The state of the art of quantitative and qualitative methods in ecologic, economic and social systems analysis. Contributions may vary from new approaches in carbon sequestration to modelling of land use changes; from cost-benefit analysis to economic multi-agent models; from social network analysis to PRA/PLA;

- Methods to improve access to information and information exchange;

- Approaches and methods that enable a dialogue amongst various stakeholders and promote mutual learning;

- Methods to include practical knowledge, of generation and dissemination of knowledge in a transdisciplinary research setting;

- Action-oriented methods to promote implementation of complex solutions.

A focus of discussion was the aspect of “integration”, by method triangulations and/or approaches and methodologies in process and project management: Ex ante approaches such as scenario analysis and modelling, in-process approaches such as (participatory)

impact monitoring, or ex-post approaches of (participatory) monitoring and evaluation were also welcomed.

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In Theme 2 five workshops were held:

Workshop	**Title**
Workshop 2.2	Sustainability assessments at farm level for catalysing practical change
Workshop 2.3	Well-being in rural areas: how is it affected by different farming systems?
Workshop 2.4	Temperate agriculture sustainability assessment beyond the individual farm level
Workshop 2.5	Beyond participatory methods-approaches for facilitating transformation of agriculture and agri-food systems
Workshop 2.6	Management of interdisciplinary research processes

Theme 3: Pathways towards sustainable agri-food systems – tensions or synergies?

We are told that feeding the future world population will require a 60 percent increase in total agricultural production. This is set against the background of climate change, degraded natural resources (soil and water insecurity), and socioeconomic challenges (global economic drivers, competition, threatened rural livelihoods, social injustice). These multiple challenges require change (eg technical, social, cultural, technical, institutional) and have led to a range of responses with respect to developing sustainable agri-food systems which can produce food and maintain ecological functions (and in doing this deliver a multi-functional food system). These include approaches such as sustainable intensification, climate smart agriculture, ecological intensification, conservation agriculture, agro-ecological farming and organic farming. These share common principles, in that they aim to design more productive, sustainable production systems that save on inputs (pesticides, chemical fertilisers, water and fossil fuels), are less harmful to the environment, and so do not degrade ecosystem services. However, these approaches diverge significantly in other respects, notably they emerge from different paradigms (technically efficient, commercially-focused, large-scale agriculture versus socially responsible, community-centred agriculture often applying ecological principles). These are distinguished by the extent of capital investment, scale, tenure arrangements and labour inputs, but above all, values. The systems aligned to social development coexist more easily than others with rural development and other livelihood options (eg tourism, energy).

This sub-theme aimed to examine these different pathways to sustainable food production (theoretical and empirical) and addressed questions such as:

- What are the different pathways of sustainable food production in different contexts?
- What theoretical perspectives exist to understand pathways of sustainable food production?
- What methods are best suited to understand pathways of sustainable food production?
- To what extent do these different pathways (current and future) diverge or converge/have synergies?
- What needs to change to move farming systems along pathways to sustainable food production and how do we measure this change?
- Is scale an issue- is it only large scale commercial farmers who seek efficiencies and smart farming (eg sustainable intensification)? Is it only smaller scale farmers/smallholders who can follow a 'social' model (eg community supported agriculture, agro-ecological farming)? Or are these becoming stereotypes that might constrain how we move forward?
- Is it important to debate the different values, objectives and reward systems that are embedded in these systems, and who gains and who "loses" from these different systems?

We invited participants from natural and social sciences, particularly those experienced in interdisciplinary approaches to contribute to workshops that addressed any of the issues and implications that related to this theme.

In Theme 3 three workshops were held:

Workshop	**Title**
Workshop 3.1	Sustainability of food chains: contested assessments
Workshop 3.3	Pathways for land-use: the sustainable avenue of agroforestry
Workshop 3.4	Boundary spanning between agroecological and conventional production systems: implications or pathways towards more sustainable production

Theme 4: Emergence and application of new technologies

Globally, there is currently an unprecedented pace of change in the application of technology to support agriculture. There are many drivers of the change process, including improvements in techniques of animal and plant breeding, application of genetic modification, sustainable energy generation, development and use of robotics, remote data collection and monitoring systems, use of decision making tools and models, precision agriculture, use of drones and the increased use of Big Data. Many of these changes include some new technologies developed by scientists who previously have had limited connection with agriculture.

Whilst the potential benefits of these technologies are very easy to understand at a local scale, their potential impacts on farming systems are less well understood. For example, Blackmore (2014) has outlined plans to develop small robots that can intelligently detect if salad crops are ready for harvest using sensors and carry this out with minimum damage to the soil. If this technology was adopted on a wide scale, there is speculation that agricultural robots will eventually replace semi-skilled drivers and unskilled pickers. However, it has been suggested that an equal number of highly skilled agricultural robot engineers will be needed to service the new technology. There may also be a reduced need for management decisions on the ground as the technology also automates some of these processes. Potentially there are gains to certain sectors of the agricultural labour market, benefits to the environment and advantages to the consumer in the form of cheaper prices. However, this is at the expense of employment amongst both the least qualified individuals within the agricultural workforce and also individuals who possess higher level skills such as agronomists.

Such difficulties in predicting the outcomes of such developments in technology are further exacerbated by differences in the scale and type of farming operations, lack of standard methods of quantification, geographical location and government policy with regard to technological development. There are also implications in terms of side-lining/under valuing (and ultimately losing) land managers' local and experiential knowledge which some argue is irreplaceable.

This theme was an opportunity to engage in a constructive dialogue between farmers, educators and scientists about the systemic impacts of these new technologies within new social, political and environmental contexts and to explore the questions that they raise for research policy and practice and addressed questions such as:

- Can we classify new technologies more effectively?
- Who are the beneficiaries and losers following the adoption of new technologies in agriculture? How can we quantify this in a meaningful way?
- What are the effects of farming scale on the uptake and application of new technology? Are there any common themes between different types of farmers?
- Does new technology make agriculture more or less sustainable? Will technology improve food security?
- To what extent can we effectively model the impacts of a new technology in agriculture? Are the same models applicable for a range of new technologies?
- Will new technology facilitate significant changes within rural societies and their structures?

▪ What are the implications for land managers' learning and experiential knowledge production?

We invited participants from natural resources, engineering, human and social sciences, particularly those experienced in interdisciplinary approaches, to contribute to workshops that addressed any of the issues and implications that related to this theme.

In Theme 4 two workshops were held:

Workshop	**Title**
Workshop 4.1	Boosting research outputs: novel approaches for integrating research translation with interactive co-innovation
Workshop 4.3	ICT to help on participatory approaches for the agroecological transition of agriculture

Theme 5:

Agriculture is characterised nowadays by the diversity of pathways (organic farming, integrated farming, precision farming etc) that seek to combine a more sustainable use of resources with good economic and sociological conditions for the development of rural areas. These farming systems may be combined or compete at different levels, international, national or regional. The question addressed in this subtheme is about the intended and unintended effects of policy, governance and institutions on the convergence or divergence between trajectories of production systems. Do they enable a co-existence of different systems, or do they reinforce the domination of specific systems over others?

Many individuals and groups strive to bring about changes in relation to food, farming, rural areas and environment. Such changes concern livelihoods, wellbeing, communities, management of wastes, food, energy, technology, food security, productivity and biodiversity.

Interconnections among such changes or transformations are well recognised. As Donald Schön observed over forty years ago, transformations influence one another and the transformation of a system as a whole influences the context in which each local system experiences its own transformations. In recent years, as evident from IFSA's symposia over the past two decades, there has been increasing emphasis on collective multi-level learning processes and multi-stakeholder dialogue processes to bring about transformations at the level of 'whole systems' – for instance in relation to (i) catchment-based approaches to address issues of water scarcity, flooding and pollution and (ii) networks of local and regional food production and distribution.

A substantial discourse has also developed on what kinds of governance, policy and institutions enable and constrain such learning in moving towards collective action. It is this latter area that this sub-theme specifically wants to address. Different farming systems might need different forms of learning that could be supported by the adoption of different public policies such as technology transfer for precision farming and collective learning for agro-ecology.

Policies and institutions designed for one purpose often end up overseeing another unless governance is adaptive and responsive to potentially rapid changes in conditions.

Workshops in this sub theme addressed questions such as:

- Why do some initiatives (eg relating to organic farming, farmers' markets, farming and wildlife or land care) succeed in scaling up from a local level whereas others fail?

- How do services such as advisory services support innovation and orient the innovation choices?

- What kinds of governance enable systemic and adaptive responses to climate change?

- Which aspects of EU policy and legislation have enabled farming communities to do 'better things' (second-order change) rather than doing things better (first order change)?

- What kinds of public policy (incentives and subsidies, regulatory frameworks, R&D planning) can help build sustainable food systems - or further reinforce industrial agriculture?

We invited participants who are interested in the development, application and interaction of policies and governance within agricultural systems, to contribute to workshops that addressed issues and implications that related to this theme.

In Theme 5 nine workshops were held:

Workshop	Title
Workshop 5.1	Developing agricultural advisory systems for innovation: governance and innovative practices
Workshop 5.2	Farm succession, inheritance and retirement: challenges for agricultural futures
Workshop 5.3	Rural development policies in the peripheral Southern and Eastern European regions
Workshop 5.4	Exploring farmers' conditions, strategies and performances in a context of multi-dimensional policy requirements, market imperfections and globalisation: towards a conceptual model
Workshop 5.5	Value chain research and development – approaches for diverse farming systems
Workshop 5.6	Food governance for metropolitan and local food systems – connecting urban and rural
Workshop 5.7	There are other options: boundary issues in innovation system governance
Workshop 5.8	Enabling innovation – the transformative (innovative) capacity of farmers and rural institutions
Workshop 5.9	Public food procurement policies: local and organic food in public catering systems

Field Trips

Field Trip 1: Farming at different scales and intensities

This field trip visited two different farms that have alternative approaches to production. The first was Wall Farm, Kynnersley, Shropshire. Wall Farm is a 162 hectare mixed livestock farm which has been managed under UK Government Environmental Stewardship schemes for the last 25 years. The farm has received payments to reduce the intensity of agricultural management and has based their farming system wholly around this requirement. The farm has a mix of Aberdeen Angus, Stabiliser and Red Poll cattle and Hebridean sheep, two thirds of which are crossed with a continental ram. The farm sells animals as breeding livestock and for meat through outlets including Dovecote Park, for Waitrose, and local rare breed butchers. Twenty four hectares at the centre of the farm is a Scheduled Ancient Monument (statutorily protected under UK legislation). The earth ramparts of the Iron Age Lowland Hill Fort can still be clearly seen today and restrictions are placed on how this land can be farmed. The whole farm is managed under an extensive grazing system which suits the range of habitats that have been created under the various environmental agreements. As part of the environmental enhancement of the farm, a large area of species rich wildflower meadows and wet grassland for both breeding waders and over wintering birds have been established. We also have a small area of arable ground which is managed primarily for environmental objectives.

The second farm was Lea Manor dairy farm (http://www.grosvenorfarms.co.uk/our-farming/dairy-farming.aspx), part of the Grosvenor Farms estate, owned by the Duke of Westminster. Grosvenor Farms produce about 48,000 litres of milk a day, some 17.5 million litres a year which is processed by Müller Wiseman Dairies and sold to Tesco as liquid drinking milk. The new Lea Manor dairy farm is a significant investment into the future of food and energy and is intended to help meet the increasing demand for milk in a sustainable way. The farm has been carefully designed to be as comfortable as possible for the cows to live in. It has been built to the highest standards and incorporates the latest technologies to develop a farm that is industry leading in terms of animal health, welfare and comfort. This is considered to be the best way both to ensure the health and wellbeing of the herd and to provide the efficiencies which modern day farming requires to meet the nation's demand for good value milk. The system includes a sophisticated monitoring system which identifies each cow for lameness as they walk across a sensory platform after every milking enabling staff to identify any issues approximately two weeks before there would be any visual signs. The whole facility has also been fully badger proofed in order to better protect the herds from TB infection. Water is provided through an environmentally friendly bore hole and is used to clean the sand in the cattle's living areas ensuring about 85% can be reused. Solar panels on the south facing roof of one of the farm buildings will generate the energy to power the farm with the residual entering the national grid. Large cubicles and sheds provide space for the cows to eat, sleep, walk around and socialise in.

Organisers: Dr Andy Wilcox (awilcox@harper-adams.ac.uk)
Professor Liam Sinclair (lsinclair@harper-adams.ac.uk)

Field Trip 2: Agroforestry and forestry

Delegates opting for this programme visited two contrasting land management systems in which trees play a fundamental role, one in England, the other just over the border into Wales. The first visit was hosted by Mr. Peter Aspin at The Hollies, Wem, North Shropshire (http://www.silvaspin.org.uk). His specialist, organic small-scale (approximately 16 hectares) agroforestry system rears youngstock for dairy use on high-quality pastures with 'alleys' of grassland divided by rows of mixed species of trees. This system is described as, 'a method of land use whereby trees, perennial ground cover crops (in this case grasses, clovers and herbs) and livestock (in this case bovines) are produced on the same piece of land'. The system allows both grazing and browsing by the cattle and 'a rich and varied diet naturally leads to healthier and more disease-resistant animals.'

The second part of the trip crossed the border into Wales, to Coed Llandegla, west of Wrexham, where we were hosted by Tilhill Forestry (http://www.tilhill.com) the managing agents for the forest owners, the Church Commissioners. We explored the forest using the forest road system, guided by the forest managers. Coed Llandegla is a 650 ha. mixed-age commercial forest producing high-volume conifer crops, principally Sitka spruce (*Picea sitchensis*). It is also home to an award-winning outdoor recreation business providing extensive mountain bike, running and walking trails that attract over 250,000 visits per year (http://oneplanetadventure.com).

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Organiser: Jim Waterson MICFor., MRICS (jwaterson@harper-adams.ac.uk)

Field Trip 3: Organic and community farming

The first part of this trip involved a visit to Fordhall Farm Community Land Initiative (http://www.fordhallfarm.com). Fordhall Organic Farm, based in North Shropshire, England has been chemical free for over 65 years, rears cattle, sheep and pigs on an outdoor extensive grazing system and has been in community-ownership (8000 people) since 2006. This means that the owner, Fordhall Community Land Initiative, is committed to building a sustainable future whilst guaranteeing that farming will be an affordable way of life for generations to come. Fordhall Farm is also one of the longest running natural organic farms in England. Many of the initial supporters were personal friends of the late Arthur Hollins and recognised his ground-breaking research into organic farming. The visit focused on community ownership and eco-diverse approaches to sustainable land and livelihood systems.

The second part of the trip involved a visit to Timothy Downes farm at Longnor, South Shropshire. Tim is a partner, with his wife Louise, in the family 284 hectare organic dairy farm near Shrewsbury. He milks 300 cows, as well as producing 150 mostly Aberdeen-Angus cross beef cattle per year. The milk is free from antibiotics and is sold to the Organic Milk Suppliers Co-operative (OMSCo). The milk is exported to the US market and goes into cheese, milk protein & baby foods. Tim also plants trees on his farm to support his farming system (https://www.woodlandtrust.org.uk/publications/2013/05/how-trees-benefit-dairy-farms)

Organiser: David Gibbon, Agricultural and Rural Livelihood Systems

Field Trip 4: Integrated & organic farming

The first part of the trip was a visit to Robert Kynaston's Great Wollaston Farm at Halfway House near Shrewsbury, Shropshire. Great Wollaston is a mixed lowland farm which has been a LEAF (Linking Environment and Farming) demonstration farm since 2002. The main income is from a dairy enterprise consisting of an 85 cow closed herd with dairy replacements and beef cattle. Most of the feed for the cattle is grown on the farm with 85ha of arable cropping consisting of winter wheat and barley combined for grain and spring barley and peas taken as an arable silage. The grassland area consists of high clover leys and the remainder of the farm is managed as a variety of different habitats for wildlife including 10ha of woodland which also provides the feedstock for a 65kwatt biomass boiler. Robert has also recently installed 20kwatt of solar voltaic panels. Robert has worked with the Royal Society for the Protection of Birds on various projects and field trials as well as hosting various research projects and student visits for Harper Adams and other Higher Education providers.

We than visited Green Acres Farm which is a 220ha mixed organic farm in Shropshire. The cropped land follows a five year rotation driven by a one year clover ley, used either for grazing or silage by the pedigree Hereford cattle, or red clover seed production. Crops grown include, milling oats, wheat, peas and quinoa. Three types of peas are produced specifically for a retail company and packaged with the farm name. There is a substantial green-waste composting enterprise which receives garden waste from local communities and produces around 4000 tonnes per annum of compost, all of which is used on the organic land, raising soil organic matter and improving fertility. All the land is farmed under agri-environment schemes both to preserve and improve conservation and provide educational opportunities for local schoolchildren. Green Acres Farm is diverse in its enterprises, its cropping and its marketing.

Organiser: Louisa Dines (ldines@harper-adams.ac.uk)

Field Trip 5: Upland resource management

This field trip considered upland resource management and the issues that affect farming with multiple partners and owners and the transitions to sustainable land management. The first visit began at Carding Mill Valley which is part of the Long Mynd, a 2000 hectare area of upland in South Shropshire. Much of the land is owned and managed by the National Trust. The Long Mynd is also part of the Shropshire Hills Area of Outstanding Natural Beauty, a statutory designation offering protection to important landscapes. The Shropshire AONB is an important place for wildlife, geology and archaeology. Following an overview of the Long Mynd the visit drove to the top of the Long Mynd for interactive discussion with National Trust Staff and a landscape officer for the Shropshire Hills AONB Partnership. Discussion focused on conservation, agri-environment and the Upland Commons Programme. In the afternoon the trip continued with a visit to the Stiperstones National Nature Reserve (NNR) and a walk to the top of this contrasting Upland Area, led by the reserve manager from Natural England. Topics for discussion included visitor management and sustainable grazing.

Organisers: David Gibbon, Agricultural and Rural Livelihood Systems (dgibbon662@gmail.com)
Chris Blackmore, Open University (chris.blackmore@open.ac.uk)

Field trip 6: Special workshop and demonstration of Harper Adams robotics

This special IFSA workshop/ and demonstration considered social and environmental risks of robotics and autonomous systems (RAS) in major farming systems. The morning gave delegates an opportunity to learn about some of the current and possible future developments in RAS for farming. This included demonstrations of robotics and autonomous systems in the Harper Adams Agricultural Engineering Innovation Centre. In small groups, participants received demonstrations of:

- autonomous laser weeding
- controlled traffic farming
- robot tractor
- unmanned aerial vehicles

In the afternoon there will was a chance to hear about the relevant risk governance issues in other recent technology advances, and to contribute to discussion of the wider impacts and risks of RAS in different farming systems. There was a keynote presentation from Professor Phil Macnaghten (University of Wageningen, The Netherlands) on 'A framework for responsible innovation - lessons learned from GM crops and other technological innovations'. Four breakout groups each discussed one major farming system:

- large-scale agricultural commodity crop production
- protected horticulture and/or plantation crop production
- extensive rangeland livestock grazing
- intensive housed livestock

The session culminated in the identification of emerging themes and their relevance and impact on farming systems.

Organiser: Professor Peter Kettlewell (pskettlewell@harper-adams.ac.uk)
Dr John Reade (jreade@harper-adams.ac.uk)

Opening Plenary 1

A systems approach to improve potato varieties for organic farming systems

Edith T. Lammerts van Bueren[1,2], Ronald Hutten[2] & Christel Engelen[2]

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Potato late blight (*Phytophthora infestans*) is one of the largest problems in organic potato production due to a lack of late blight resistant varieties and of appropriate fungicides. As breeding varieties for the relatively small organic sector is economically a challenge for commercial breeding companies, a special (classical) breeding programme ('Bioimpuls') was designed in a participatory manner according to the traditional way of potato breeding in the Netherlands (Almekinders et al., 2014). The team consists of breeding researchers from Wageningen University and Louis Bolk Institute, and six commercial breeding companies. By setting up yearly breeding courses, over 10 farmer breeders are now linked to this programme and are actively involved in the yearly selection. To allow the new varieties to be adapted to organic farming systems, several variety characteristics need to be improved. These include (in addition to late blight resistance) resistance to other diseases such as Rhizoctonia, Alternaria, viruses and scab, as well as nitrogen use efficiency, good storability without chemical sprouting inhibitors, good flavour and, last but not least, good market performance, e.g. appropriate flesh colour and a smooth skin. The focus is not merely on varieties that are adapted to low-input and organic growing conditions, but also on variety characteristics that allow a resilient farming system to function as a whole. This includes long term durability of resistance and measures to avoid breakdown of the new resistances by combining genes from different wild potato relatives and by selecting for clones that are not too late maturing to reduce the time of exposure to late blight infestation. The results will lead to a diversity of varieties as not only the general requirements are taken into account but also the individual selection criteria of each participating farmer due to differences in soil type, rotation, specific disease pressure, nutrient requirements, etc. Active commitment of other chain actors such as wholesalers and retailers is essential and was developed during an additional EU project (COFREE) enhancing market acceptance of the current eight late blight resistant varieties. By embedding this breeding programme within the conventional breeding sector with commitment of the organic farmers and other chain actors, this systems approach does not only aim at ecological sustainability based on the values of organic agriculture but also on socio-economic continuity after the project ends.

Reference

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Biography of Edith T. Lammerts van Bueren

Dr. Edith T. Lammerts van Bueren (1952) was trained at Wageningen University in agronomy and has more than 25 years of experience in organic research and management. After being involved in a broad field of organic agriculture for many years, she specialised and pioneered in plant breeding and genetic resources for organic, low-input agriculture and has put this subject to the European agenda. She has held a chair at Wageningen University in the Netherlands as professor of Organic Plant Breeding since March 2005. She is also senior researcher Organic Plant Breeding at the Louis Bolk Institute in the Netherlands, a research institute specialising in organic agriculture, health care and nutrition. Edith was co-founder and president of the European Consortium for Organic Plant Breeding (ECO-PB) for 10 years, and is now chair of the Section Organic and Low-input Agriculture of EUCARPIA (European Association for Research for Plant Breeding). She aims at building bridges between existing expertise among both farmer breeders and professional breeders, and incorporating the efforts of other stakeholders towards chain-based or community-based breeding models. She is also active in a broader field of sustainability and chairs a Dutch scientific interdisciplinary think-tank Council for Integral Sustainable Agriculture and Nutrition, which published their first report in 2012, and successfully elaborated on two cases studies (2013, 2015), see www.ridlv.nl.

Opening Plenary 2

Globalization, China and the New Zealand Dairy Assemblage

Michael Woods

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This paper examines how the globalisation of agriculture is reproduced through small-scale processes and practices of assembling and re-assembling not only transnational flows of commodities, capital, labour and material inputs, but also the physical and organisational structure of individual farms, and how these changes impact on the wider rural environment and rural communities. A case study focuses on the recent evolution of the dairy industry in New Zealand in response to shifting global markets, particularly the growth in demand for milk powder from China. Since deregulation in 1984, New Zealand agriculture has been particularly exposed to global economic trends and competition, with adjustment driving re-structuring of the industry including the expansion of the dairy sector. By adopting an 'assemblage' approach that emphasises relationality, contingency and the combination of human and non-human actants and components, the paper analyses these developments at three levels. Firstly, it traces how the growth of New Zealand dairy trade to China was facilitated by the assembling of diverse technological, financial, transport and representational components, including the coding of New Zealand dairy produce as 'pure' and 'untainted'. Secondly, it examines how the rise in value of dairy products stimulated conversion of sheep and beef farms and forestry land to dairying, with conversions involving the re-assembling of farm systems, including the incorporation of components sourced internationally, such as cattle feed from Australia, hybrid maize seed developed in the US, and irrigation systems manufactured in China. Thirdly, as farms are embedded in rural environments and communities, the paper explores the wider consequential effects of dairy conversions, from watercourse pollution and changes in the appearance of the landscape, to in-migration by Filipino farmworkers and the wear of increased tanker traffic on rural roads. As such, the paper argues that globalisation as experienced in farming communities is not a top-down imposition, but is the outcome of multiple, inter-connected and inter-dependent actions at diverse scales.

Biography of Michael Woods

Michael Woods is Professor of Human Geography at Aberystwyth University in Wales and has research interests that primarily focus on issues of globalization and rural change, rural politics and protest, and community governance and participation. He is currently leading a European Research Council project, GLOBAL-RURAL, which is investigating the restructuring of rural economies and communities by globalisation, and is also Co-Director of the ESRC WISERD/Civil Society Research Centre and a former Co-Director of the Wales Rural Observatory. Michael is Editor of the Journal of Rural Studies and author of a number of books, including the textbooks Rural (Routledge) and Rural Geography (Sage).

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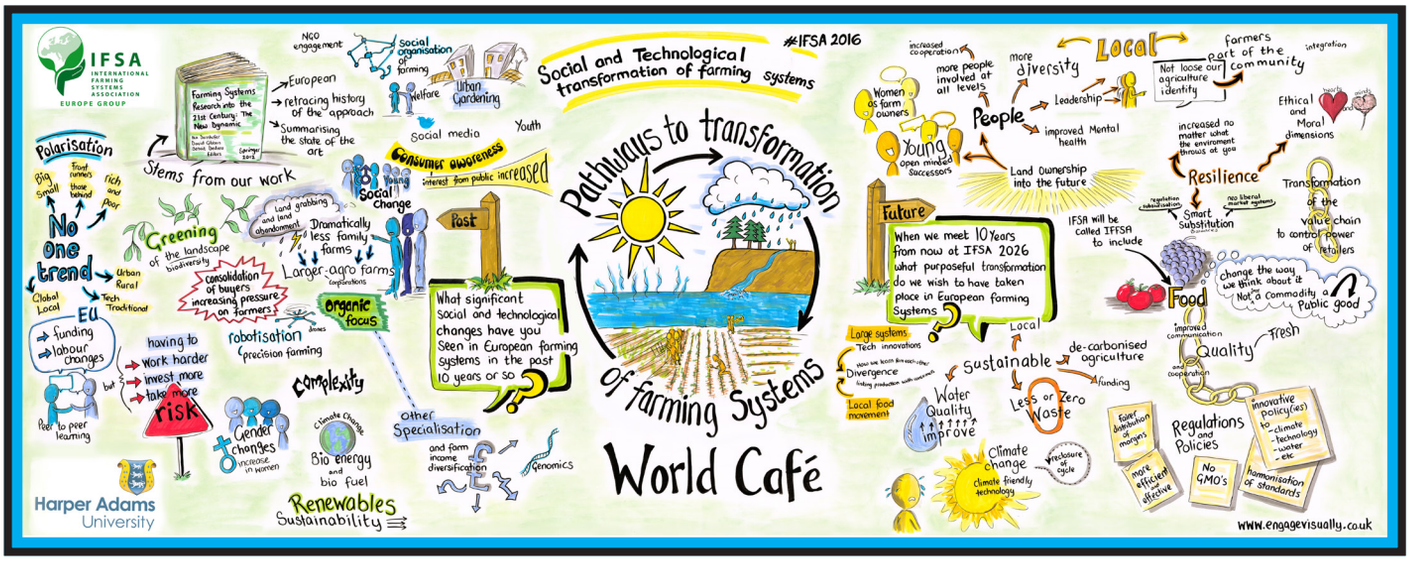

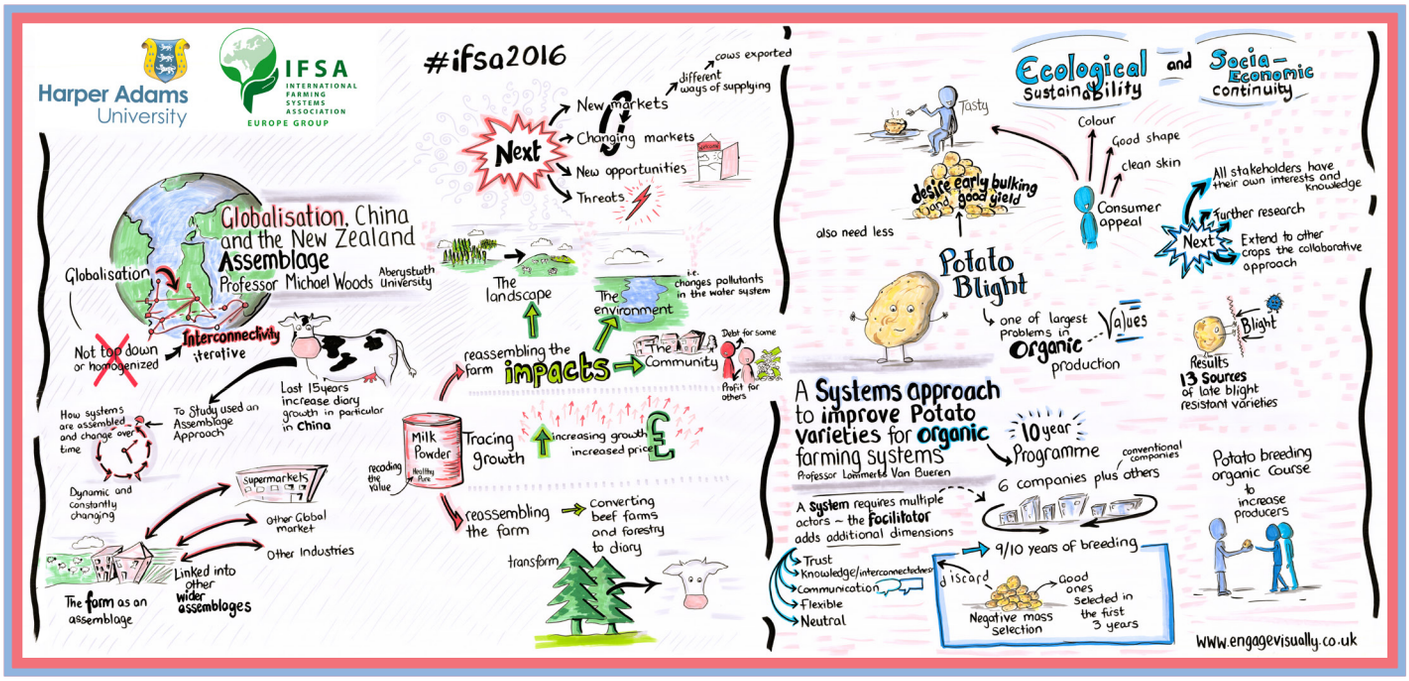

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