SUSTAINABLE INTENSIFICATION RESEARCH PLATFORM

SIPSCENE

The newsletter of the Sustainable Intensification Research Platform

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Editorial: The SIP platform's acronym: another name for 'Science in Practice'

It occurred to me recently that SIP could serve as an acronym for a variety of interconnected concerns. There's a multiplicity of SIPs out there…..

First up, 'Science into Practice', such is the Platform's marriage of basic research with issues of decision support. In a recent study conducted by SIP researchers, it was found that almost half of farmers used some kind of decision support 'tool' to inform decisions. It seems to me that the elaboration and uptake of tools for Sustainable Intensification will be one part of the legacy of the Platform work and its commitments to application. Second up, 'Science into Place', such is our interest in location. As you try to do, rather than simply say, sustainable Intensification, you quickly bump into fields, farms and landscapes: context and place matters. And since much in life seems to arrives in 'threes', let's think a little harder. So third up, SIP is perhaps also 'Science into Policy'. Clearly our ambitions for practical knowledge do not stop with muddy boots and the farm gate!

You will observe these 'multiple SIPS' in the latest edition of SIPSCENE. We learn for example about how 'Land Utilisation Capability Indicators', an ecosystem services model at the field scale, is being used to inform landscape policy for SI. We learn about the carbon footprint of three different pasture-based beef finishing systems. We learn about the fit between SIP and strategic evidence gathering needs of policy development in Wales. And, we learn about the Allerton Project in Loddington, our friends and partner in the Upper Welland. Their research involves a range of data collection measures to support local agri-environment partnerships dedicated to improving water and soil quality within the catchment. It's all bracing stuff for a post-truth world. So much information. So much talk of evidence. So much interest in testing, in refining learning, in prediction……..

Dr. Rob Fish, University of Kent, Reader in Human Ecology is an environmental social scientist

SIP Says

Views from in and around the Platform

Supporting the Welsh Government Sustainable Management Scheme with SI research on landscape scale interventions and collaboration

A key part of our role as the SIP landscape team is to apply and test landscape scale interventions, and explore the role of collaboration. We had opportunity to work with a group of farmers to do just that in the Conwy Tier 1 study area, through the Welsh Government Sustainable Management Scheme. The Scheme aims to promote landscape scale actions which improve the management of Welsh natural resources and, through this, enhance the well-being of rural communities. A call was put out in March 2016; there were 65 applications of which 11 got through. One of these was the group we are supporting, Fferm Ifan, a group of 11 farmers in the upper Conwy catchment. They are looking to improve provision of ecosystem services from their land whilst increasing (or at least not reducing) productivity. Fferm Ifan feel that collaboration is important for achieving social, economic and environmental benefits. The Centre for Ecology and Hydrology (CEH) and Bangor University have been working with the farmers to see how tools and approaches from the SIP could support the proposal and realise maximum benefits.

The LUCI (Land Utilisation Capability Indicator) model was applied to help to determine the best locations for the placement of new trees, hedgerows, wetlands and riparian zones. LUCI is an ecosystem services model, which can be used to map areas providing a range of environmental goods and services. This enables us to co-ordinate these field-scale interventions across the catchment to maximise benefits. Critically, the model simulates both habitat connectivity and hydrological flows for water and diffuse pollutants, at fine scales over the whole catchment, making it ideal for this sort of application.

Findings from LUCI have been combined with modelled and observed data on agricultural productivity, to produce maps at a resolution appropriate for field scale decision making. These were used in discussions with farmers to determine intervention locations, and to explore constraints on decision making which led to alternative placements. Modelled output for the final configuration of intervention placements will enable evaluation of the potential long-term benefits to ecosystem services, whilst also highlighting any trade-offs. This approach will both increase benefits to ecosystem services from the Sustainable Management Scheme, and demonstrate the value of ecosystem service modelling in practice.

To test the impacts of the interventions, CEH are developing a monitoring programme, incorporating citizen science alongside a structured survey. To enable data to be compared across Wales, the structured survey will incorporate elements of the existing national monitoring programme (GMEP) to assess natural resources and impacts of the Welsh Government's agri-environment scheme, Glastir (https://gmep.wales/).

Additional monitoring of vegetation, soils and water will target areas affected by interventions across the catchment. Citizen science may include downloading of data from in-situ loggers at field sites, soil photography for carbon assessment and collection of data on vegetation cover. As well as increasing the quantity of data which can be collected through the project, this approach will increase depth of farmer knowledge, and help them feel connected to the environmental outcomes of their actions. We plan to work with the group on preferred methods of communicating data and findings in a meaningful way that avoids jargon.

We will also use this work to ground-truth the "Dynamic Typology Tool", which was developed by the landscape team to identify where conditions are suitable for Sustainable Intensification (see SIPSCENE Edition 3, Spring 2016). The tool combines over 100 environmental, social and economic datasets on indicators from pollinators and farm efficiency to accessible green space. The Centre for Ecology and Hydrology has agreed to host this web tool after the lifespan of The SIP, to make it available to the community. Users of the tool can apply their own weightings to the environmental, social and economic outcomes according to personal or national priorities. In the Conwy, we will explore different interventions and needs suggested by the tool under different weightings, and try to match the priorities and actions of the group. This will provide a valuable test case of socioeconomic factors and the practical or administrative factors, which may cause farmer behaviour and choices to differ from those predicted by the tool.

Prof Bridget Emmett leads the Soil Science Area for NERC's Centre for Ecology and Hydrology. She has been leading CEH's SIP work in the Conwy catchment and is contributing to the development of the SIP Dynamic Typology Tool.

Dr Amy Thomas, Research associate at CEH Bangor, is part of the SIP Landscape team. She is involved in development of the Dynamic Typology Tool, as well as modelling and stakeholder engagement for collaborative landscape scale interventions.

Cronfa Amaethyddol Ewrop ar gyfer Datblygu Gwledig: Ewrop yn Buddsoddi mewn Ardaloedd Gwledig
European Agricultural Fund for Rural Development: Europe Investing in Rural Areas
Llywodraeth Cymru Welsh Government

SIP in Focus

The what, how and who of SIP Research

Landscape in Focus – the Allerton Project in the Upper Welland river basin highlights synergies between economic and environmental objectives

The GWCT Allerton Project's research and demonstration farm at Loddington is located in the upper section of the Welland river basin. The landscape is characterised by clay soils overlying ironstone, undulating topography, and mixed arable and livestock farming. Lower down the river basin, the underlying geology changes to limestone and the landscape becomes more open, ultimately forming the Fens, and at the coast, the Wash.

The focus of the Allerton Project is on the headwater landscape, which characterises much of lowland England, and presents challenges for land use that are shared with countless farmers and other land managers across the country. The Allerton Project has been researching a wide range of agri-environmental issues since 1992, always trying to identify the synergies between economically viable farming and environmental objectives. Much of this research has been on farmland ecology, soil management, and the relationship between land use and water.

Upstream from the Allerton Project's own farm at Loddington is the Water Friendly Farming project, which is run in collaboration with the Freshwater Habitats Trust. This comprises three tributary headwaters covering a total area of about 3,000ha. The project follows a rigorous experimental design, and we have been collecting data covering flow, nutrients, sediment and pesticides at the base of each of the catchments since 2012. The project also has 240 survey sites where ecological surveys are used as indicators of water quality.

Having established a very strong baseline in the first three years, we have subsequently been introducing mitigation measures such as detention ponds and stream-side fencing, and recently, working directly with farmers to influence management of the cropped area to reduce its impact on water. In doing so, we can draw on the results of various soil management research projects at Loddington, external expertise and advice, and the knowledge and experience of the farmers themselves.

The Allerton Project and the Water Friendly Farming project are nested within a broader set of initiatives associated with the Welland Valley Partnership, a collaboration of the Welland Rivers Trust, the Environment Agency, Natural England, National Farmers Union, CLA, Anglian Water and others. The Partnership's Resource Protection Group is active in applying its combined expertise and resources with the Allerton Project's research results to guide best practice at the farm level. As one of the Water Friendly Farming project's 'treatment' catchments is the headwater of a Catchment Sensitive Farming (CSF) catchment, we can also reach out to CSF more widely.

We also host an AHDB Arable Business Group, enabling a small group of local farmers to benchmark the economic performance of their businesses against each other, and to gain advice on improving performance through AHDB. Recognising the importance of soil quality to their crop performance, group members have requested soil organic matter surveys of their fields, in order to enable organic matter benchmarking across fields and farms. As well as providing an insight into this measure of soil quality at the landscape scale, this initiative provides a clear example of the synergies between economic and environmental objectives.

Chris Stoate is Head of Research at the Game and Wildlife Conservation Trust

Farm Scale SI - Analysing the Carbon footprint of three different pasture-based beef production systems at the North Wyke Farm Platform (NWFP)

Graham A. McAuliffe, Taro Takahashi, Mark Eisler, Paul Harris, Robert Orr and Michael R. F. Lee

The objective of this research was to carry out a carbon footprint analysis of three distinct pasture-based beef production systems on the North Wyke Farm Platform (NWFP) in Devon, UK (Figure 1). The systems studied were: 1. [Green system] permanent pasture of perennial ryegrass (predominately Lolium perenne) unploughed for > 15 years with conventional N fertiliser application; 2. [Blue system] a mix of high sugar perennial ryegrass (Lolium perenne cv. Abermagic) and white clover (Trifolium repens cv. Aberherald) reseeded between 2013 and 2015 with reduced N fertiliser application, and; 3. [Red system] high sugar perennial ryegrass (Lolium perenne cv. Abermagic) monoculture reseeded between 2013 and 2015 with conventional N fertiliser application. Each system has 30 Charolais x Hereford-Friesian cattle which enter the NWFP at the time of weaning.

We set the model boundary (the outer limit of the studied system) at the farm gate (Figure 2), covering inputs and outputs associated with the NWFP's 14-month production cycle from the purchase of calves to their departure to the slaughterhouse. The environmental performance of each system was quantified using the unit of kg CO2 emissions per kg liveweight gain (LWG), with other greenhouse gases such as nitrous oxide and methane converted to their CO2-equivalent values. Emissions from soil and livestock were calculated from primary data collected throughout the NWFP according to Intergovernmental Panel on Climate Change (IPCC) equations.Amongst key input variables to these equations, digestible energy (DE%) was calculated from modified acid detergent fibre (MADF) content, and crude protein was estimated from total N content of pasture and silage samples. Cattle live weight gains (LWG) was calculated from fortnightly weighing data. As an internationally unique attempt, the carbon footprint was derived for each individual animal over

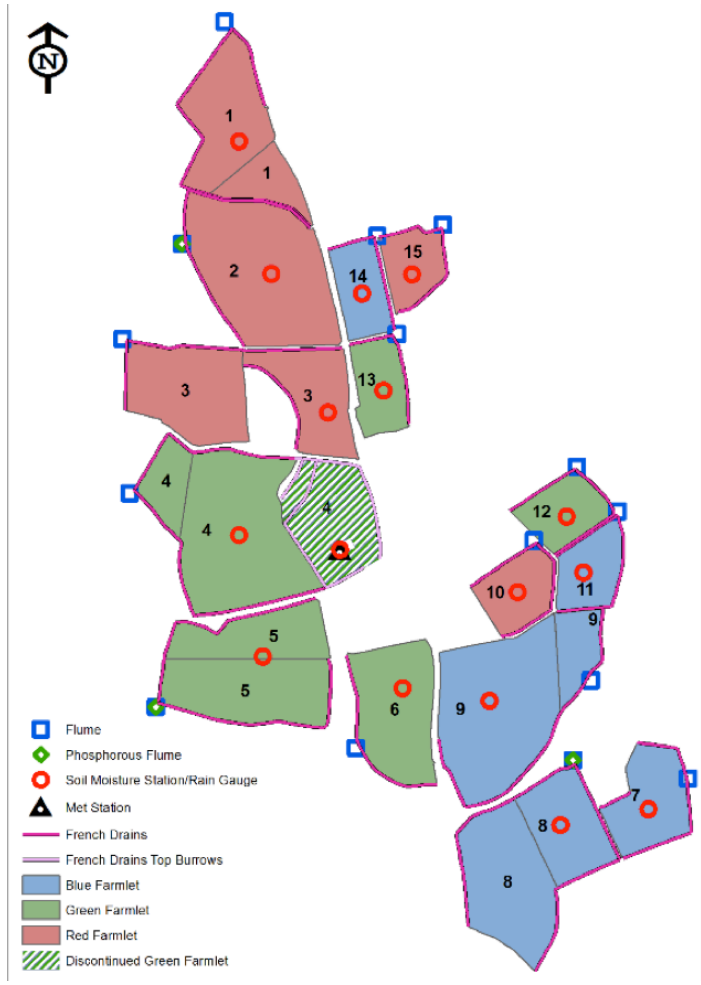

Figure 1. The North Wyke Farm Platform. Green fields are permanent pasture, blue fields are high sugar perennial ryegrass and white clover mix, and red fields are high sugar perennial ryegrass.

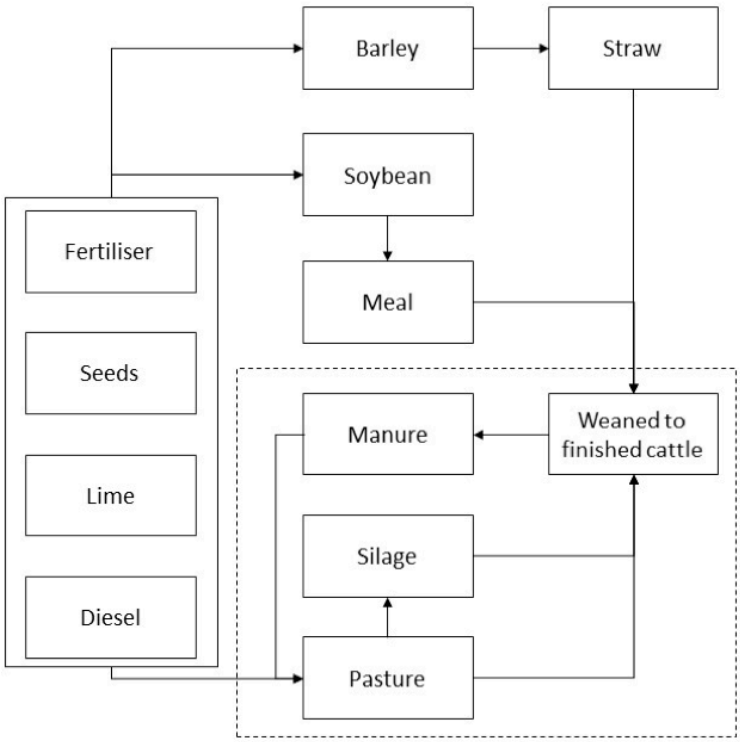

Figure 2. System boundary of the research. The dashed line represents the NWFP. Everything outside the dashed line is upstream from the farm platform.

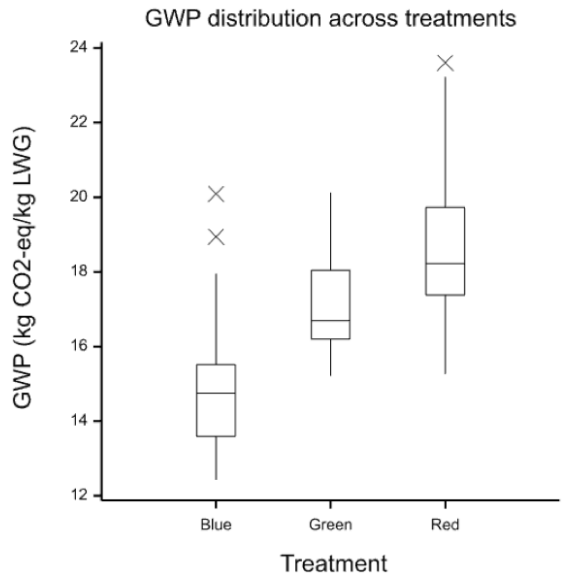

Figure 3. Distribution of global warming potential results for the three systems. Crosses represent data outliers (greater then 1.5 times the length of the interquartile range (box) from the box). The green system has a much lower range of values, suggesting it was the most stable between the three treatments.

each weighing period, providing an analytical framework to investigate intra-herd heterogeneity.

Figure 3 demonstrates the distribution of carbon footprints for each animal in the three systems. The results suggest that the blue system (white clover and high sugar grass mix) has a significantly ($P < 0.01$) lower global warming potential (GWP) than both the green (permanent pasture) and red (high sugar grass) systems. This is primarily driven by the lower application rate of inorganic N fertiliser, made possible by the ability of white clover to fix N. Livestock on the green system had a significantly lower ($P < 0.01$) GWP than the red animals, due largely to better livestock performance. Overall, the green cattle had the most stable growth performance as well as environmental performance, the latter of which can be confirmed from the "flatter" shape of the distributions.

The study provides scientific evidence that sowing clovers could be an effective means to lower the carbon footprint of beef finishing systems. However, further research is required to examine economic trade-offs between costs saved from reduced N fertiliser application and costs incurred for establishing legume-based pastures. Importantly, the physiological performance of cattle on the blue (white clover) system on our farm was, in general, lower than the cattle on the other two systems, indicating a need for a carbon credit system to induce commercial producers to adopt this low-carbon strategy. It should be noted, however, that this study was carried out in the first year following the completion of the NWFP's reseeding programme. Research is ongoing to assess the conditions of these swards and associated animal performances.

Thinking at a landscape scale – Collaborative interventions mitigating the use of herbicides in addressing blackgrass

Collection of pesticide data at the base of the three headwater catchments of the Water Friendly Farming project has been primarily to aid the development of hydrological models for wider application in the project. However, they also provide a valuable dataset linking arable land use to drinking water quality. Propyzamide is an herbicide that is used in oilseed rape and beans to control the competitive weed, blackgrass. Blackgrass is a major challenge for arable farmers across lowland England and propyzamide is an essential herbicide for its control. However, the herbicide is applied in the winter when ground conditions are cool and wet and runoff in these conditions often results in the statutory drinking water threshold (0.1ug/L) being exceeded in the streams.

As a result, there is concern that propyzamide use could be restricted or withdrawn, resulting in considerable impacts on both national food production and the economic performance of farm businesses. We are working with farmers in one of the 'treatment' catchments to explore to what extent it might be possible to reduce the propyzamide concentration in water at the catchment scale.

Research by Dow, the manufacturer of propyzamide, has revealed that reducing soil disturbance reduces movement of the herbicide to water, and application to a well-established rape crop also limits the amount reaching water. This can be achieved at the field and farm level, but we are also exploring the possibility of spreading applications across the autumn to reduce the amount of pesticide present in the catchment at any one time. This requires modelling and would also need collaboration between farmers to agree timings. The final approach is to reduce the area of rape in the catchment by introducing an alternative crop that can be used to limit blackgrass but does not require propyzamide. We are working with Syngenta on this, introducing the vigorous winter barley variety, 'Hyvido' in one part of the catchment where rape would otherwise have been grown.

While the focus of reducing the concentration of a single pesticide in water is narrow, the implications are considerable. Reduced soil disturbance has multiple benefits in terms of soil structure, organic matter, soil biology, crop rooting and nutrient uptake and reduced loss of soil to water and sedimentation of drainage channels lower in the catchment. Increased crop diversity has benefits for biodiversity at the landscape scale, including breeding birds, pollinators and brown hares, as well as enhancing landscape character. But, most immediately, the exercise will improve our shared understanding of the constraints and opportunities associated with collaboration between farm businesses to meet private and public objectives.

Christ Stoate is Head of Research at the Game and Wildlife Conservation Trust

Researcher in Focus – Ron Stobart

Ron Stobart is Head of Farming Systems Research for NIAB TAG and looks after the SIP arable farm platform based at Morley (Norfolk). Ron has been involved in research at the Morley site for over 16 years, having joined Morley Research Centre as an Agronomist in 2000. Morley Research Centre later merged with Arable Research Centres (ARC) to become The Arable Group (TAG), which then went on to join up with NIAB, leading to the current NIAB TAG brand that we see today.

With a degree in Applied Biology from Liverpool and a Masters Degree in Crop Production from Essex, Ron has worked in the Ag-chem industry, the commercial seed trade and in the development of speciality and industrial oilseed crops. However, soils, systems and rotation research have increasingly become a key area of interest. At Morley, Ron has been running the charitably funded 'New Farming Systems' project for over 10 years and working closely with The Morley Agricultural Foundation and Morley Farms. This research dovetails neatly into the SIP project at Morley with crossover and synergy between both projects on areas including soil management and amendments, cultivation systems and cover crops. These approaches are key to the field scale intervention methodology being examined with SIP at Morley.

Viewpoint

SIP in the context of Wales' strategic long-term aspirations

The SIP is funded by the joint England and Wales Research and Development budget. The Welsh Government considers that the outputs of both Projects 1 and 2, will provide a key part of the evidence base for policy development and decision making in the coming months and years.

The policy landscape in Wales has a major focus on sustainability and the environment, and this is of particular relevance to the agriculture sector which accounts for some 80% of the country's land area. Not only is the farming industry a cornerstone of rural economies, it underpins wider economic and cultural aspects, such as the Welsh language and the tourism industry. In addition, the agriculture sector is a key driver to achieving goals relating to biodiversity, water quality and regulation, air quality and soil condition. Moreover, the Welsh Government has aspirations in place for annual sales in the food sector to increase by 30% by 2020. This, in turn, has clear links to levels of on-farm productivity.

The Programme for Government – Taking Wales Forward was published on 20 September 2016 and is a bold, strategic and ambitious programme that focuses on delivering real improvements in the every-day lives of people in Wales. Although the Brexit referendum result has changed things fundamentally, the Programme will be in place for five years and embraces sustainable development as its 'central organising principle'. During the previous term, this manifested itself through the introduction of two major pieces of legislation: the Well-being of Future Generations (Wales) Act 2015 and the Environment (Wales) Bill. The former is about improving the social, economic, environmental and cultural well-being of Wales. It introduces seven well-being goals and five new ways of working, which together with the four cross-cutting strategies of the Programme for Government – Taking Wales Forward will deliver the promise of the Act. The Environment Bill will put in place the legislation needed to plan and manage Wales' natural resources in a more proactive, sustainable and joined-up way.

With these legislative cornerstones in place, all measures and interventions for agriculture, land use, rural communities and food production must deliver multiple actions to support the creation of resilient farm businesses with better incomes and productivity, as part of vibrant rural economies. This must be achieved alongside environmental enhancements, and deliver on commitments that position Wales as a low-carbon, green economy. Sustainable intensification is integral to the decision making processes that will seek to set priorities and balance the multiple demands that are made on our landscapes.

The Welsh Government therefore sees great benefit in engaging – not only financially but also through continued dialogue and support at all levels of the project - with the latest scientific developments that the SIP delivers. An ability to identify and subsequently monitor and evaluate viable sustainable intensification innovations together with an understanding of whether these are best implemented by individuals or groups of farmers working in collaboration will be key to selecting the most effective methods of support that the Welsh Government can provide to the industry – for instance through the Farming Connect advisory service, the Glastir sustainable farm management scheme, or through financial contributions and support for collaborative working under the Welsh Government Rural Communities – Rural Development Programme 2014-2020.

Dewi Jones works for the Forestry Policy Team in Welsh Government.

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