Valorising European Research for Innovation in Agriculture and Forestry



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Draft Report on barriers to research uptake
Deliverable D3.7.2

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1 Introduction

1.1 Aims

This final deliverable from WP3 addresses the contextual factors that influence the application of research knowledge in the field. Although the focus of VALERIE has been on providing knowledge from research for innovation, it is acknowledged that land managers operate and are situated in a wider context and their actions and ability to utilise innovations are influenced by multiple factors. Scientific knowledge is only one component of the agricultural innovation system and there farm level and wider systemic challenges to be considered. As recognised by the EIP "a new idea turns into an innovation only if it is widely adopted and proves its usefulness in practice. This will depend not only on the new idea itself, but also on the market possibilities, the willingness of the sector to take it up, cost-effectiveness, knowledge and perceptions, accidental external factors etc." (EIP, 2016). Social, institutional, economic and political factors affect both the conduct of agricultural science and the translation of research results into farming practices (Sewell et al., 2014, Hall et al., 2001); also innovation is often required at different points along the value chain to achieve effective utilisation (Vanclay et al., 2013)

This report presents results from meetings in case studies (CS). The main aim of the report is to examine the barriers and enablers to utilisation of research outputs in CS. The report collates and analyses the results from stakeholder and Case Study Partner assessment of barriers in CS. These assessments were carried out in CS in June-Nov 2017. The results are supplemented with a commentary for each case study drawn from previous case study meeting reports, and Case Study Partner interviews.

1.2 Context and background to the barriers study in the case studies

The challenge in VALERIE is to make innovative research output in the agriculture and forestry domains accessible to end-users. The overall objective of WP3 is: Co-innovate with stakeholders in case studies on innovation, the detailed objectives are:

- mobilise practitioners and related stakeholders in order to assess their innovation demands as well as to capture their knowledge and experiences for integration into *ask.Valerie*
- translate "promising" research results into end-user content and format
- integrate feedback on the potential for innovation from practitioners and draw conclusions for further research
- refine and test applications of research results within reach to assess the technical and economic viability of the innovative solutions
- **reveal social, economic and cultural barriers to research uptake**
- elicit stakeholders' knowledge, experience and innovation needs; for storage in the form of an ontology (Work Package 4)
- field-test *ask.Valerie* with stakeholder communities.

This report focuses on the objective "**reveal social, economic and cultural barriers to research uptake"**

Ten CS were selected to represent different regions and production systems across the themes, and are organised around a particular supply chain, a farming / forestry sector, or landscape, and so cover different scales and dimensions and incorporate different stakeholder communities. A Case Study Partner (CSP) for each CS facilitates and coordinates the stakeholder community. The stakeholder driven methodology (also described as a co-innovation process) carried out with stakeholders in the 10 case studies, underpins WP3 and is described below. Full details of the project methodology can be found in the DoW.

Table 1 Case studies

Name	Case study partner and country	Topic	Stakeholders
Catchment scale resource use efficiency	GWCT UK	Sustainable farming at landscape scale	Environment agency, NFU, NGOs, professional nutrient management group, agric. levy boards
Soil management in livestock supply chains	GWCT UK	Sustainable soil management in livestock production	Farmers, advisers, supply chain, NGOs
Sustainable forest biomass	TAPIO Finland	Sustainable forestry management and smart use of biomass	Researchers, forestry organisations, forest owners, ash processers, policy makers
Agroecology: managing plant protection	CETIOM France	Sustainable cereal cultivation	Farmers, technical institutes, agricultural chambers, machinery companies
Innovative arable cropping	ACTA France	Reducing herbicides use in arable crops	Technical institutes, agricultural chambers, farmers, research institutes, storage agencies
Sustainable forest management and ecosystem services	USSE Spain	Improving the economic and environmental performance of forestry in Navarra	Forest owners, municipalities, forest authority and extension service, value chain organisations
Improving milling wheat quality	Cadir Lab Italy	Fertilisation, IPM and fungi control in sustainable milling wheat supply chain	Farmers, wheat-stocking cooperatives, seed companies, pesticide companies, wheat-buying companies
Drip irrigation management in tomatoes and maize	Cadir Lab Italy	Sustainable water and nutrient management	Farmers, cooperative for tomato transformation, public experimental station
Sustainable onion supply chains	DLV Netherlands	Improvement in onion quantity and quality	Farmers, seed companies, packers, exporters, suppliers of fertilizers and pesticides
Sustainable potato supply chains	DLV Poland	Sustainable potato production for the French fry industry	Farmers, processing and exporting industry, suppliers of fertilizers and pesticides, experimental station and research

2 Stakeholder-driven methodology (co-innovation): identifying innovations and solutions in case studies

2.1 The methodology

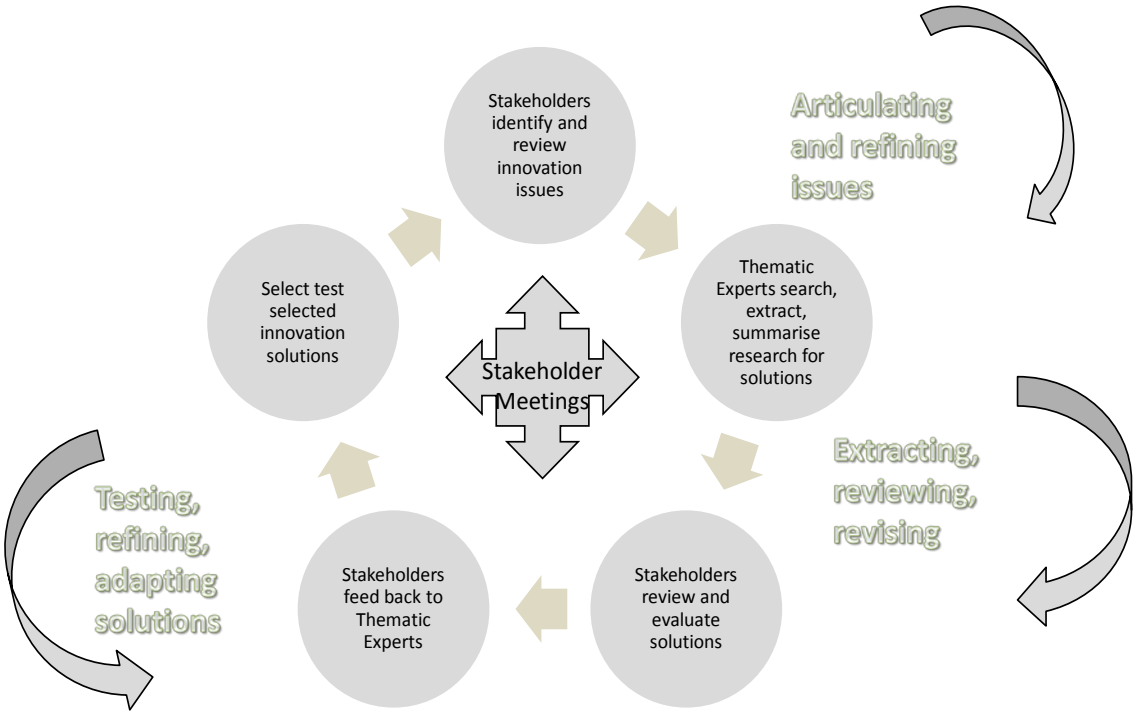
Central to the project is an iterative methodology in which the research team can collect a wide range of innovation issues (research questions), and provide innovation solutions (research answers to these issues), and understand how stakeholders identify, articulate issues and screen, filter and test research outputs, as part of the translation process. Case studies (CS) and their stakeholder communities are at the core of this process. A series of participatory meetings with stakeholders (6-9 months apart) were held (a minimum of five), these are reported in Deliverable 3.341 *Co-innovation plans: report of first round of case study meetings.*

The methodology is underpinned by an iterative or cyclical process based on regular participatory meetings with stakeholders in CS (Fig 1). The cycle starts with stakeholders in each CS identifying *innovation issues* and articulating these as issues, research needs or questions in participatory meetings. These meetings are facilitated by Case Study Partners, project partners who are extension specialists connected to the CS. Thematic Experts, who are project scientists (who also attend the meetings) then search existing scientific literature for *innovation solutions* to address these issues, and extract, synthesise or summarise the relevant solution-oriented research findings. Stakeholders screen, evaluate and refine these solutions for their innovation potential and feedback to the project Thematic Experts, thus completing one cycle. The cycle is repeated and, at each iteration, innovation issues and solutions are reviewed, re-articulated and refined, further information or clarification (by stakeholders and Thematic Experts) is sought and new or modified innovation issues and solutions are generated. A key tool in the process is the Dynamic Research Agenda (DRA) which Case Study Partners use together with stakeholders to monitor, review, revisit and refine the innovation issues and solutions at each meeting. As the cycles progress the stakeholders identify trials to apply and test the potential of selected innovation solutions in the local context. This process and the DRA for each CS is described further in Deliverable D3.7.1 *Collated Research Outputs for Case Studies.*

The research team has been working together with the stakeholders not only to apply, test and refine screened research outputs in CS, but also evaluating their innovation potential in the local context, assessing the viability of solutions and **exposing barriers and bottlenecks** that limit their uptake**.** This completes the full picture of stakeholders' activities (motivations etc) and also provides insights for policy formulation with respect to incentives and integration of promising innovations into policy frameworks concerning all themes.

Throughout the participatory meetings stakeholders have discussed the context of the CS and previous and current experiences with research outputs revealing a range of barriers limiting research uptake. Drawing on these insights a final Case Study Partner-led activity was carried out in the CS in June-November 2017 specially to assess the nature and extent of barriers to research outputs and to discuss opportunities to overcome these (enablers).

Fig 1 Co-innovation methodology



2.2 Barrier and enablers –background to analytical framework

The term barriers has been used to understand how to realise potential in terms of diffusing new sustainable practices, behaviours and technologies, together with understanding how to enable the potential through incentive and policy measures. Barriers and enablers operate at different scales –farm, landscape, region etc. and come from different parts of the Agricultural Innovation System.

2.2.1 Factors affecting adoption

In agriculture there is a long history of examining factors that affect diffusion and adoption of innovations. This has been reviewed in general (e.g. (Rogers, 1995) and for agriculture (e.g. (Feder and Umali, 1993, Knowler and Bradshaw, 2007); Ruttan 1996). These show that adoption depends on awareness and a range of personal, social, cultural and economic factors, as well as on characteristics of the innovation itself such as relative advantage, compatibility, and trialability. Very generally these have been related to three sets of issues: the process of learning and experience, the characteristics and circumstances of the landholder within their social environment, and the characteristics of the practice/innovation (Pannell et al., 2006). The significance of support either through a peer group, a wider network or an advisory community is known to be high (Prokopy et al., 2008).

Work in different disciplines has identified similar barriers to uptake of innovations for example GHG mitigation practices in agriculture barriers are physical–environmental constraints, lack of information and education and personal interests and values, and enablers have been identified to address these such as incentives (Feliciano et al., 2014). In the renewable energy literature barriers identified include: lack of awareness and information, economic and financial constraints, technical risks, institutional and regulatory barriers, market barriers and market failures, and behavioural barriers (Long et al., 2016, Reddy and Painuly, 2004). This corresponds to work in other contexts looking at influences on land-manager decisions about agri-environment activities where: economic, social, cultural, physical–environmental and farm situational factors are important ((Mills et al., 2016). This is part of an understanding that barriers/enablers go beyond technical and economic, they include social and cultural: that is, social norms, attitudes, perceptions and conventions play roles alongside costs and practicalities.

This thinking has evolved and expanded to include consideration of wider innovation systems.

2.2.2 Taking a Systems Approach

The notion of Agricultural Knowledge and Innovation Systems (AKIS), as systems that links people and organizations to promote mutual learning, to generate, share, and utilize agriculture-related technology, knowledge, and information has become established. AKIS comprise linked networks of diverse actors from the private, public and non-profit sectors supply chains, and farmers relating to agriculture ((EU, 2013). Building on this commentators have noted how innovation support services (institutions, administrations and extension services) can become barriers to innovation if they do not work effectively, for example *(Knickel et al., 2009) states..*

We argue that technical and economic factors used to analyse drivers and barriers alone are not sufficient to understand innovation processes. The related social and institutional aspects of cross sector as well as intra sector processes are explored. Overall, we emphasize that innovation functions as a process where farmers' and rural entrepreneurs' knowledge, motivations and values play an important role. We emphasize that institutions, administrations and extension services, whose mission it is to support changes, can become barriers to innovation if they do not acknowledge that the needs of farmers and of society have changed.

Another systems perspective, the Agricultural Innovation Systems (AIS), (Hall et al., 2006) is a framework for understanding the multitude of players and sub-systems that characterize innovation. This pays more attention to the role of markets (especially input and output markets), the private sector, the enabling policy environment, and other disciplines and sectors than the AKIS. According to (Klerkx et al., 2010):

"AIS are essentially about multi-actor interactions and structures (infrastructures, policies, institutions) that may serve to enhance innovation, with an understanding that innovation goes beyond technology development, but also often requires an improvement of parts of the innovation system itself to enable co-ordination of the relevant subsystems"

This aligns with the broad Innovations systems (IS) concept used for studying how societies generate, exchange, and use knowledge and proved a framework for examining barriers but also where support might be directed ((Spielman et al., 2009). An innovation system has three elements: (1) the organization and individuals involved in generating, diffusing, adapting, and using new knowledge; (2) the interactive learning that occurs when organizations engage in these processes and the way this leads to new products and processes (innovation); and (3) the institutions—rules, norms, and conventions, both formal and informal—that govern how these interactions and processes take place. In terms of barriers and enablers for uptake of certain innovations, the IS approach widens the analysis to the Enabling Environment (Political stability, law and order, infrastructure, governance favorable micro-macro and sectoral policies); and Facilitating Institutions (Policies, legal framework, market, information, quality control research, extension, training, credit etc).

2.2.3 Analytical framework

Drawing on these different bodies of literature a framework was developed around six key themes (Table 2). These provided the basis for the CS activity where the main objective was to reveal social, economic and cultural barriers to research uptake.

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Table 2 Analytical framework for CS assessment of barriers and enablers

Themes for assessment of barriers and enablers
Information • *Awareness of the innovation* • *Ease and cost of accessing relevant information* • *Capacity to understand the potential value of the innovation* • *Effectiveness of advisory/ extension services to support farmer with the innovation* • *Ability to collect sufficient information on the innovation, and to try it out on the farm* • *How does this set of issues relate to the different positions/understandings of different groups of stakeholders?*
Economic considerations 1. *What are the costs versus the benefits of using the innovation?* 2. *Will the innovation make the SH more competitive?* 3. *Are there costs preventing its uptake*? *Explain what the costs are (e.g. new machinery, more labour) and how do they differ for different SHs?* 4. *Are there economic risks involved in using the innovation? Explain what the risks are (e.g. uncertain effect on yield/quality, volatile markets, loss of contract) and how they differ for different SHs(e.g. different levels of resilience between farms)* 5. *Are there any economic incentives for the innovation?* 6. *How do these economic incentives relate to different groups of stakeholders?*
Technical/ agronomic • *Does the innovation work in the bio-physical context/farming system? Is it compatible?* • *How difficult is the innovation? Are there agronomic/technical risks involved?* • *Does the innovation require extra skills, knowledge, education, training? For the advisors and/or for the farmers? Will farmers need to learn it from a trusted source? – consider whom* • *Do the SHs have sufficient levels of scientific understanding/ technical competence to make full use of the innovation?* • *How does this relate to different groups of stakeholders?*
Social • *Do SH personal motivations and values prevent uptake?* • *Do cultural aspects (e.g. traditional ways of doing things, accepted behaviours, habitual attitudes) prevent uptake? For example farmers say 'we've always done it*

this way – why change now?'

- *Are there supportive social networks, peer support if SH want to learn about or uptake up the innovation?*
- *How does this relate to different groups of stakeholders?*

Institutional

- *Are there policy measures (subsidies, regulations, controls) that prevent or enable the use of the innovation? What are these?*
- *Is the advisory/extension service (or supply chain support) equipped to support SHs with new innovations? For example are they well trained, component, innovative, well resourced, reasonability priced or the opposite?*
- *How does this relate to different groups of stakeholders?*

Market/supply chain issues

- *In what way will using the innovation impact upon retailer/processor contracts and conditions, food assurance scheme requirements or the prices or market shares potentially available to producers?*
- *Does the supply chain (and specific actors within the chain) support innovation by farmers/foresters and if not, how does it discourage innovation and why?*
- *How do these aspects relate to different actors in specific supply chains?*

2.3 Methods for assessing barriers and enablers

Based on the analytical framework, a set of guidelines were prepared for use in the CS. Each CSP was provided with these guidelines to carry out the consultation with stakeholders. These comprised instructions for collecting data, either using holding a participatory meetings using a Force Field Analysis method to provide some scoring as an indication of the relative strength of barriers and enablers (see Annex), interviews with stakeholders or in one case the CSP completed the assessment themselves with the help of colleagues. As in all meetings of the project, CSP were given flexibility in how they conducted the data collection (by interview or with a full case study meeting). The methods and format of results presented below reflect the different approaches used.

3 Catchment scale resource use efficiency, UK

3.1 Context

The Welland Valley Partnership (WVP) was formed in 2011 with the aim of bringing together stakeholders from the catchment of the River Welland and its tributaries, ro address water quality issues related to catchment land management. The partnership is chaired by the Welland Rivers Trust, with a wide range of stakeholders, from individuals, local authorities and government agencies such as Environment Agency (EA) and Natural England (NE), farming representatives such as the National Farmers Union (NFU) and Country Land and Business Association (CLA), Non-Government Organisations (NGO's) and the local water company Anglian Water (AW). The Game and Wildlife Conservation Trust (GWCT) is a partner in the WVP and employs the CSP. Representatives of this group all met at the VALERIE kick off meeting; since then local farmers have been meeting and discussing possible trials and demonstration work.

3.2 Methods

A series of three in depth interviews and a specific barriers and enablers meeting took place with key stakeholders in the Welland Valley Partnership Case Study. The key stakeholders interviewed were

- Head of Farming at the Allerton Project; the Allerton Project is a commercial farm within the Welland Valley where research and demonstration is carried out on topics driven by farmers within the catchment.
- Welland Valley River Trust Trustee and Chair of the Welland Valley Partnership Resource Protection Group. The Welland Rivers Trust strives to take action to address all the issues affecting the quality of habitat, wildlife and water in the area.
- Natural England Project Officer; Natural England are key stakeholders in the Welland Valley Partnership; they administer agri-environment schemes across England.

Stakeholders views expressed during other work undertaken during the case study have been incorporated as appropriate.

3.3 Innovation: direct drilling

The innovation discussed, direct drilling and the associated use of cover crops, is commonly used in farming businesses where combinable crops are a major part of the production cycle. There has been a significant move towards the use of direct drilling as the preferred method of crop establishment in many parts of England and the Welland Valley is no exception. The potential benefits of this approach to the environment range from improved soil structure and soil organic matter to improved water quality in surrounding eater bodies. There are also farming benefits from reduced costs to improved margins.

3.4 Barriers and enablers

3.4.1 Information

All of stakeholders in the case study were aware of the use of direct drilling to establish combinable crops in an arable rotation. The majority were aware of the perceived benefits for soil structure, soil biology and reduced production costs. The wider stakeholders involved in the project all recognised the possible benefits to soil management and the consequent positive impact on water quality that could be achieved by implementing the innovation. All stakeholders interviewed agreed that addressing the issue of soil erosion is essential to ensure the long term sustainability of many combinable cropping farm businesses. It was understood that implementing cover cropping is an important tool for erosion control and that direct drilling is a key part of successful implementation of this approach.

The clear message from a number of stakeholders, at the full meeting, was that a significant amount of the information available on the adoption of direct drilling is either "sales information" or "pure science". This was encapsulated by an experienced farmed environment adviser, who said:

> "*Sales information is at the forefront, science based practical advice is required at a grower level and not salesmen trying to sell you something. There's also so many different variations (types of drill), there's no one single approach. Farmers could be trying so many different things it becomes unapproachable- no single sales point, both the beauty of it and the disadvantage".*

It has been clear during all of the interaction with stakeholders, throughout the project, that there is a large amount of information available but there is a feeling that it is not always accessible. In the same way as information about the drills is viewed, there has been caution expressed about the information on the impact of the use of cover crops. The use of cover crops as an entry into spring cropping is very much associated with direct drilling systems.

With respect to enablers there was a clear view in the meeting that dissemination of information, to farmers, on this type of topic is important. Suggestions were made as to the best approach for this. Many agreed that this is best achieved through demonstration and by peer to peer knowledge exchange. An experienced agronomist in the meeting commented:

> *"There are so many variations to direct drilling; which do we use or recommend? The peer to peer approach will take a long time to filter through but it's an evolutionary approach. There are several farms out there taking on this approach (direct drilling), which can be considered a success, compared to ten years ago. The information will trickle down but will take time"*

An experienced researcher said *"Education is key, there is not necessarily enough digestible information available, which makes it difficult to pass on to the people that want to hear it. There is enough info out there if you can find a way to pass it on."*

The discussion around this issue led to the group agreeing the points listed below were all important when considering information / knowledge exchange when looking to encourage the uptake of innovations such as direct drilling; these points are:

- Use a range of different people – agronomists, farmers and researchers as well machinery manufacturers.
- The drip-drip affect – there was a strong feeling that the fact that when encouraging people to change "we should be looking at it (change) as a slow evolutionary process".
- Use "new media" rather than traditional methods; it was recognised that information spreads quickly via social media especially where the message comes from a respected source and tells a story over time.

One note of caution from a young, recently qualified, agronomist was *"Don't forget bad news spreads fast and can put people off an innovation for a long time".* It was recognised that a "bad news" story can spread quickly via social media.

3.4.2 Economic considerations

The discussion around economic considerations focussed on the barrier of investing in new equipment. In many cases the farm's existing drilling equipment is seen as fit for purpose for the current system. It is recognised that changing from a plough based or minimum tillage system would save money in operating costs; this can be up to a 70% saving in diesel costs across a farming year. The benefits to soil structure and organic matter in the medium to long term were also understood by stakeholders including farmers. However, a significant number of farmers and their advisers have doubts that they will achieve viable yields, across a full rotation.

Considering enablers the views expressed when discussing this topic reinforced the comments about the need for long term demonstrations showing both the financial and environmental benefits of adopting a direct drill system. This was supported by an experienced agronomist who said *"Economics are key. If the costs of changing override the financial benefit then no one will change. If there is a financial incentive attached to change then it will help drive that change"*

Getting the economic message over was highlighted as important, as this experienced farm manager in the interview said:

> "*Timeliness of advice and demos are important as farming can be a bit insular at times, but sharing knowledge which is less anecdotal and placing more focus on economic figures to demonstrate the points of benefit for farmers is really important."*
>
> *"The question that must be asked is can I reduce the amount of diesel and labour I use and the capital I must invest in my cultivation and drilling equipment and that is a key driver for going into this sort of system."*
>
> *"The margin is most important, it has to make money, rather than focusing on the yield.*

3.4.3 Technical issues

The technical guidance and information to utilise this innovation was thought to be readily available and in a format that is easily understood by all parties involved. It was recognised that both farmers and advisers had concerns about the agronomic impact of implementing the innovation. There is also concern about the impact of slugs and black grass in a direct drill system.

3.4.4 Social pressures

In the meeting and the interviews, a key barrier to implementation of the innovation was felt to be cultural. This is linked to agronomic concerns and the need for information and support to make the transition, as demonstrated by the following comment by an experienced researcher:

> "*Adopting something new that could cost money and might not work gets the response "I can't do that" Especially without guidance of how to change. Same happened with CTF; in general, the older generation are adverse to change and can make it difficult for younger people within the farm business."*

An experienced Farmed Environment Adviser referred to the impact of "traditional behaviour" on a number of occasions throughout the meeting, one brief comment that summed up some of the social pressures was *"Appearance of the farm is important; farmers take pride in the appearance of well managed land; the perception is direct drilling is scruffy"*

The experienced farm manager agreed saying:

"*The first growth stage in direct drilling, it is known in the industry as an embarrassment as the crop is pretty thin, but eventually the crop catches up. However, for those looking over the fence, this can present a social barrier.*

3.4.5 Institutional drivers

If correctly used, institutional drivers were all thought to be enablers rather than barriers. The key aims of introducing this innovation are to "minimise the possible impacts of soil erosion" and "to help improve soil structure, reduce the possibility of leaching and retention of nutrients". The innovation is not prevented by any regulation or regulatory control such as Cross Compliance. It is encouraged through greening measures, when combined with cover crops and can be supported through existing agri-environment schemes.

There was also an understanding that well thought through and proportionate regulation about improving soil health and reducing soil erosion combined with relevant agri-environment schemes could be the trigger required to bring about change. An experienced farm manager said

> "*When it comes to regulation you can't just have a group of soil experts and policy experts, without bringing on board the farmers who are going to be doing the tasks to make the system work. Farmers need to help set out regulation. Making sure the people working in the industry have their say will help make the regulations work…..Small area payment, which helps compliance with regulation, may alleviate some of the financial worries of entering into this system".*

Providing support and advice is seen as important, including the role of the agronomist as an influencer. All stakeholders interviewed believed that continued demonstration was the best way to increase uptake of the innovation. The experienced farm manager said "*More knowledge transfer and demos are needed."* He added *"And then passing this info onto the agronomist is critical as this then may change farmer's perspectives"*

4 Soil management in livestock supply chains, UK

4.1 Context

Outdoor pig production can offer the producer a cost effective management regime. Outdoor pig production can also provide a good "break crop" in an arable rotation. The advantages include an effective means of clearing volunteers and savings on the use of inorganic fertilizers for the following crop due to the deposition of pig manure. However there are a number of environmental challenges posed by year round land occupation and nutrient deposition.

Two key environmental issues associated with outdoor pig farming are nutrient losses and soil erosion. The manure deposited by the pigs can result in high levels of nitrate and phosphorus building up in the soil. Nitrate readily leaches into streams or down into groundwater where it can cause pollution; phosphorus can be lost in soil erosion and cause environmental problems in streams and rivers. Erosion can have economic effects on the farm as it removes topsoil rich in nutrients and organic matter and reduces rooting depth and water availability. Sediment from eroding fields can cause damage by blocking drains, being deposited on roads and damaging other property. Increased run-off and sediment deposition can also increase flood hazard of rivers.

The case study lead representing farmers is now Fawley Farms; this business has 17 outdoor pig producers and has a working relationship with BQP.

The key stakeholder organisations are:

- Suffolk FWAG
- Kings Seeds
- Fawley Farms
- 12 outdoor pig producers/herdsmen
- BQP

Key issues raised by the stakeholders included:

- Maintaining good soil cover on outdoor pig breeding fields
- Enhancing buffer strips established to contain soil run off so that they can deliver multiple environmental benefits.
- The benefits that can be gained by the following crops from the presence of an outdoor herd on that site
- How green cover can be established by undersowing in the previous crop.
- Mitigating possible compaction caused by the presence of an outdoor herd.

4.2 Methods

This report summarises a series of five in depth interviews which took place with key stakeholders for the Outdoor Pig Case Study GWCT are leading as part of Project Valerie. The key stakeholders interviewed were

- South West FWAG, an advice provision charity that focusses on farmed environment advice and who had coordinated the case study trials work.
- Wessex Water, a regional water company, who facilitated the monitoring work undertaken during the trails work.
- Kings, a seed supply company, who provided the cover crop seed and technical advice on management of the site.
- Stakeholders views expressed during other work undertaken during the case study have been incorporated as appropriate.

4.3 The innovation: cover crops established as the pigs leave the field in the early autumn

The innovation being trialled is commonly used in farming systems where combinable crops are a major part of the production cycle. In this case study cover crops are established as the pigs leave field in the early autumn. The aim is for the established cover crop to help minimise the possible impacts of soil erosion on these fields prior to combinable crops being established in the following spring. In addition to this key objective the innovation should also help with prevention of leaching and retention of nutrients for use by the following crops in an arable rotation.

It is worth noting here that the pig producers are usually tenants on larger arable farm businesses; they are usually on fixed two year contracts which are renewed as a herd is moved to a new site.

4.4 Barriers and enablers

4.4.1 Information

The majority of stakeholders in the case study were aware of the use of cover crops in arable rotations and the perceived benefits for mitigation of the impacts of soil erosion and there was a good understanding of the probably benefits to nutrient cycling. It was also felt that the information required to establish and deliver successful cover crops is readily transferable from the arable sector, with advisers also available and qualified to deliver advice.

This was highlighted by an experienced seed supply chain manager working on the case study, who when asked "Would you say the information is readily available for people to be able to take the approach up?" replied:

> "*Yes, there are things sign posting them to consider these options, the techniques, knowledge and mixes are all available and transferable from the arable sector. Should be relatively straight forward, but it's how the information is packaged*"

However one of the key issues affecting wider uptake is that the managers of the outdoor pig herds did not have an understanding of the innovation or it's possible benefits to soil management as fields are returned from their control back to their landlord.

This in fact was highlighted in the same interview as that quoted above, with the following question "Are outdoor pig producers aware that cover crops are an available option?"; and response "*Not immediately no, one or two of the forward thinkers are aware, but overall no they're not.*"

4.4.2 Economic considerations

The key issue raised here is that the implementation of the innovation was likely to be more of a benefit to the arable farmer / landlord than to the herd owner. It was felt that the main economic benefit would come from medium to long term improvements in soil structure and nutrient recycling and this benefit would sit with the arable farmer / landlord.

It was also recognised, in all of the interviews, that the efficiency of the transfer of pig herds to new sites is a key consideration for the successful implementation of this innovation. If the move to a new site is delayed, the establishment of a cover crop on the old site will be delayed and the success of crop establishment could be compromised.

The move process could be more efficient if a second set of equipment was set up immediately the new site becomes available. This means additional cost, and a negative economic impact, to the herd owner.

It was recognised in all the interviews that one of the key risks in outdoor pig production is soil erosion and it was also recognised that this risk was at its highest at the end of a two year stay on a site prior to the establishment of the following arable crop. The use of cover crops will not only help condition the soil for the following arable crop, it will help reduce the risk soil erosion and thus reduce the risk a breach of Cross Compliance rules. This could in turn reduce the risk of a fine or loss of income from the Basic Payment Scheme; in most circumstances this loss would be incurred by the landlord.

All stakeholders interviewed agreed that addressing the issue of soil erosion is essential to ensure the long term sustainability of many outdoor pig herds; it was felt, therefore, that implementing erosion mitigation techniques such as cover cropping is important and has a long term economic benefit to both the pig and arable farming businesses. This was highlighted in the interview with the experienced Farmed Environment Adviser who said "

> T*he other attribute is the cover crops ability to intercept runoff and improving water infiltration. From a pig farmer's point of view, their biggest headache is soil erosion and it's what both landlords and customers are most concerned about as it is most visible. So if cover crops can be seen by both their landlords and customers to be reducing that risk then it could become an attractive proposition."*

4.4.3 Social pressures

In all the interviews the key barrier to implementation of the innovation was felt to be cultural. This was demonstrated by comments in two of the interviews.The experienced seed supply chain manager said "Pig p*roducers may question why they should do green cover crops as they are in the pig business. Forward thinkers will see the benefits of establishing green cover."*

During the interview the experienced Farmed Environment Adviser referred to the impact of "traditional behaviour" on a number of occasions throughout the interview. The social issues are best summarised in his following statement:

> *"There is often an amount of lack of understanding between the landlord / arable farmer and the pig farmer, in terms of what they actually need. Tends to be landlord driven and the pig farmer complies. There could be more support given to the mutual understanding between both parties. This would be particularly useful when considering how to maximise the beneficial impact of organic matter and nutrient availability, provided by the pigs, to following arable crops whilst at the same time minimising the impact of the wider environment. There is an opportunity to engage in this conversation when considering cover crops particularly when thinking about nutrient cycling and management. It's more of a n opportunity than a barrier. Pigs may be seen as a break crop, by the landlord, but not an integral part of the arable rotation. I think there is a beneficial economic consideration, in that the arable farmer could spend less on arable additions, by introducing cover crops"*

4.4.4 Institutional drivers

The institutional drivers were all thought to be enablers rather than barriers. The key aims of introducing this innovation are to "minimise the possible impacts of soil erosion" and "to help with prevention of leaching and retention of nutrients" on land where outdoor pigs have been present. The innovation is not prevented by any regulation or regulatory control such as Cross Compliance. It is encouraged through greening measures and can be supported through existing agri-environment schemes.

There was clear recognition, from the pig farmers involved in the demonstration work, that adopting the innovation could help with better compliance with existing regulation but there was a lack of understanding of when a breech in compliance may occur. There was some frustration, from the experienced water company adviser, that existing regulation hasn't and isn't always used to bring about change; "*Regulation doesn't seem to work. There is definitely more scope to promoting this approach to farmers."*

There was a recognition from all interviewees that there is a network of well trained, knowledgeable advisers who are equipped to provide the correct advice to see the innovation widely implemented. The key barrier is the fact that in most situations advisers have to deal with two separate businesses, the pig farmer and their landlord, to see the innovation or any required mitigation measures implemented. The experienced seed supply chain manager identified this issue answering the question "Is there an advisory service out there, capable of advising people to adopt this innovation?"

> *"Yes, FWAG are doing the pig wise reports, but there are no bodies specifically going out there saying this is what to do and how to do it, the barrier is usually the relationship between the pig farmer and the landlord."*

The positive outcome from the interviews is that two of the non-farming stakeholders could see the benefits of providing on-going support for both advice and demonstrations to show the potential benefits of implementing the innovation.

4.4.5 Market and supply chain issues

There is a real recognition within the supply chain that there is a need for good effective management of outdoor pig herds to show that there is minimal impact from soil erosion and leaching of nutrients. There are a range of very complex issues around herd management, animal welfare as well as environmental impact that mean this sector of agriculture can be difficult to engage when it comes to environmental advice.

It was clear from the interviews undertaken that the supply chain is seen to have a major influence on production systems. The feeling was that the supply chain was very supportive of the adoption of this type of innovation in the appropriate circumstances. The following comments demonstrate the impact stakeholders felt the supply chain could have.

> *"The supply chain could really help drive adoption of this innovation if they pushed and it will help with compliance with their standards."*

> *"Adoption of this type of innovation allows the producer to have a stronger case for sustainability and environmental considerations within the supply chain."*

5 Sustainable forest biomass, Finland

5.1 Context

Wood ash is a waste product from biomass power stations. There is a need to understand the potential value of wood ash as a forest fertilizer, and so contribute to the circular economy in Finland. Wood ash fertilizer is already used effectively on peat forest soils in Finland but little is known about the impacts of using it on mineral forest soils. The possibility of using wood ash for road construction is of interest to the stakeholders. There are ecological benefits as granulated ash is a valuable fertilizer that can be used instead of artificial fertilizers. Utilizing ash as a fertilizer is a part of circular economy in wood production, and it also helps to compensate the CO2 emissions of wood burning.

TAPIO working with the VALERIE project has brought together forest owners and managers, ash producers, ash operators, researchers, developers, and policy-makers to identify innovations in forestry practice in Finland. It was particularly important to get the decision makers to understand the value of wood ash.

5.2 Methods

Stakeholders' views on using wood ash fertilization in forest mineral soils were collected throughout the project but primality in two activities

1). The demonstration field trip a questionnaire was completed by 12 stakeholders from different interest groups (ash producer, ash operator, researcher/developer, policy-maker) regarding the potential of using wood ash on mineral soils in general. This took place before the analytical framework was devised.

2) A workshop held to specifically discuss *a proposed business model* .described below. The idea for the business model was refined in the workshop with producers and other participating stakeholders (12 research facilities & consultancy, 5 Distributed energy generators; 4 Forest management; 3 Ash handling method producers). Most of the producers in North Karelia attended or were already familiar with this particular idea. The resulting business model was described in a public summary report of the workshop, delivered to all participating stakeholders. This followed the analytical framework.

5.3 Innovation: utilization of wood ash on mineral soils and a business model to achieve this

The main innovation is using wood ash on mineral soils as a fertilizer, using granulation with enhanced nitrogen and spreading machinery, as described in the CS trial leaflet. A further innovation was also considered, in which a common contractor with a mobile granulator who would travel from one producer to the other to solve the problem of wood ash distribution and spreading. In this business model an economical symbiosis is formed, consisting of (1) one contractor serving (2) a group of distributed small-scale energy generators (Producers), located close to each other. In addition, (3) forest management organization participates the symbiosis to provide adequate information of wood ash fertilization possibilities to the (4) forest owners, a fourth group of actors in the symbiosis.

The actual business model is created for the contractor. The contractor may be an existing forest contractor that already delivers fuelwood for producers. In the business model, the contractor also provides service to granulate the ash formed in the energy production with a mobile granulator (loose ash) or with a screener crusher (self-hardened ash). If needed, the contractor also provides storage (big bags or silo), prepares informative labels and commercializes the granulated material. The contractor also has the equipment to spread the fertilizer to forest, and this can be done simultaneously with the forest/fuelwood harvesting.

5.4 Barriers and Enablers

5.4.1 Stakeholders' views about wood ash utilisation in general

These views were collected from the demonstration trip questionnaire and conversation, are, in summary:

- Stakeholders strongly support ash fertilization because it offers a use for the waste product of the combustion process. It is a natural fertilizer and helps to restore the nutrient balance of forest soil after felling. For them the positive impact on soil fertility is that it lasts considerably longer than that of artificial fertilizers.
- The most significant obstacle to ash utilization seems to be the lack of knowledge about the beneficial effects (on soil nutrient content and tree growth) of wood ash fertilizer. The higher total cost of ash fertilization compared to artificial fertilization and the lack of operators offering ash fertilization were also mentioned as limitations.
- The main risks and challenges of ash fertilization (compared to the use of artificial fertilizers) according to the stakeholders are:
    - the product and its composition (e.g. N-content) are unknown,
    - the ash quality is important, any contamination with other wastes will negatively affect the quality of ash (*if the heat plants transfer to wood utilization in large-scale, construction waste is inevitable which will affect the quality of ash)*,
    - demand and supply (ash production and granulation) do not necessarily coincide in the same area,
    - the spreading of dry ash is especially difficult, and
    - there is a lot of regulation related to ash fertilization.

  Other comments raised were:
  - Waste status of ash causes more problems in Helsinki metropolitan area than in Eastern- or North-Finland
  - Fertilization made on independent plots is more difficult to implement. Current forest fertilization is often too local, but in large-scale the quality of ash will be the limiting factor.
  - A machine which permits the spread of ash along with felling would be beneficial

When asked what should be done to remove the barriers, stakeholders agreed that improved information and practical education (work guidance, workshops etc.) showing the positive growth effects, and making the price competitive, are needed. The positive growth effects and other features of ash fertilization should be made known, and especially forest owners' interest in the matter should be reinforced. Ash granulation of small heat generators should be enabled (supply to terminals or exchange of containers e.g. by Ecolan, a local processor . In particular stakeholders felt that policy makers and forest owners need to understand the value of wood ash, and regard it as a useful by-product rather than a waste product.

Stakeholder views collected in the workshop discussing the business model are presented below framed by the analytical framework.

5.4.2 Information

The forest owners are aware of the possibilities to utilize ash as fertilizer, and relevant data is available through the internet. On the other hand, the usage of ash is still very minimal. Most of the producers in North Karelia were familiar/presented the innovation (business model) as a

solution for ash utilization. The capacity to understand the potential value of the innovation was evident within the workshop but this is unknown for all growers. The innovation is a symbiosis network of stakeholders, creating value for each of them. All the participating stakeholders were able to understand its benefits, and also willing to create a profitable model for the incoming contractor (not participating the workshop).

In terms of the effectiveness of advisory services to support farmer with the innovation it was considered that external services and advice is required. This can be provided by forest management organizations, in cooperation with the contractor responsible for the actual work in forests. Information of the benefits should be delivered, and also the calculations of the actual needs of the soil for fertilizers. The selection of the fertilizer (ash plus boron or nitrogen) should also been done by professionals, e.g. existing forest management service providers.

Considering the ability to collect sufficient information on the innovation, and to try it out on *the farm, s*ufficient information can be collected from the networks of producers and forest owners. Implementation of the business model can be piloted, an idea of local piloting was suggested by a university of applied sciences, together with a few producers; one known contractor will be contacted in near future.

Regarding the different groups of stakeholders, all the stakeholders participating in the workshop found the solution relevant. Some competition between stakeholders may arise: the novel business model will capture a market share from present ash fertilizer producers and service providers (both participating in the workshop). On the other hand, the present service has not filled the needs of the producers, and only fair competition can profit the economy of the small-scale energy production. Co-operation with the existing actors is also possible. It was assumed, that the contractor will come from outside the stakeholder groups in the workshop. It is crucial, that the stakeholders willing to participate the symbiotic model are accepted, and vice versa.

5.4.3 Economic considerations

The participants considered the costs versus the benefits of using the innovation. The current expenses related to the utilization of ash are relatively low, since smaller amounts of ash can be utilized in various ways, however the costs of handling, storage, logistics and labour/equipment needed to spread the ash are high. For the contractor taking the responsibility of the actual business, investment costs are moderate, and public funding is possible for business development. The cost of the service for the producers and utilizers depends on the actual costs of the contractor: logistics and labour. While refining the final business plan and economic symbiosis, the costs have to be resolved in order to satisfy the demands of each participant. As a result, payment to the contractor for treating the ash, will only have a minor effect on the costs of producers. Forest owners will benefit since the ash is planned to be spread simultaneously with other forest management operations, saving time.

Use of a contractor to spread ash should make the growers more competitive. Currently, the ash from heat production is a problem for some producers. Loose ash is expensive to store and to transport, and even if it is utilized as a fertilizer, its spreading is difficult and slow. A contractor who granulates the ash, stores it and spreads it in forests at appropriate time, eases the work of producers and saves their time for other duties. It is proven that wood ash enhances the forest growth, so using it as a fertilizer in forests will be beneficial to forest owners. It is supposed that the price of ash fertilizer will be competitive when compared to other fertilizers.

In terms of *costs preventing its uptake* the service will become too expensive for the stakeholders in symbiosis, if the direct (actual) costs concerning the workload of contractor are too high. The costs have to be calculated and negotiated beforehand to minimize the risk.

With respect to economic risks involved in using the innovation the services should be priced in such a way that they are not too expensive for the producers but will still make the business profitable for the contractor. While the business model is based on economical symbiosis of certain group of actors, major risks are i) producers leaving the symbiosis, and ii) the market of the final product remaining too small. In addition, the quality of the ash always depends on the quality of fuelwood. If the product cannot be accepted as fertilizer, other possible utilization possibilities has to be found, and additional costs for this has to be covered.

Economic incentives for the innovation would involve lowering of costs of storage and treating of loose ash, and making the price of granulated ash as forest fertilizer competitive with other applicable fertilizers; and lowering spreading costs of the fertilizer. Due to the enhanced growth of forest, indirect economic benefits are possible. New business possibilities will benefit the contractor, by creating a sustained platform for operations and a known group of customers. If the cost of the ash fertilizer (as spread) was lowered it will benefit the forest owners; additional indirect benefits are possible as forest growth is enhanced. If the costs for producers are lowered; indirect effect can possibly be seen in the energy price.

5.4.4 Social pressures

Considering whether personal motivations and values prevent uptake of the innovation, the stakeholders said no, as loose ash causes problems to producers, and it is expected that the value of the innovation will be well understood. Regarding any cultural resistance, using ash as fertilizer in forest has a long tradition in Finland. The heat producers have been waiting for a new way to treat their ashes. Only smaller distributed energy producers have stated, that they have a working system, and have no need for new solution.

With respect to the availability of supportive social networks, peer support if stakeholders want to learn about or take up the innovation, there appears to be a supportive environment. The participants said that the results of the workshop are available, also the R&D facilities participating in the workshop can be contacted for more information. There are also companies and contractors who granulate and/or spread the granulated ash in small scale, and they are willing to share their information and experience, if needed. Also some of the producers have experience on spreading their ashes. This so called economical symbiosis can be created between producers, contractors and forest management organizations. All the data needed can be collected and utilized within this group of stakeholders. The symbiosis or mutual support – allows the contractor to be supported when he is starting his operation and the producers benefit if the operation starts smoothly and without problems.

5.4.5 Institutional drivers

Regarding policy measures (subsidies, regulations, controls) that prevent or enable the use of the innovation the production and quality of wood ash used as a forest fertilizer is regulated. Producers are responsible for product acceptance. Ashes from different producers need to be analyzed separately before commercialization, and they cannot be mixed if the requirements are not filled. In general, pure wood ash usually fits well in these limits, and offsets can be avoided by controlling the quality of the fuelwood. The analyses of the ash will be performed by accredited laboratories.

Support services may be needed if the contractor applies for economic support for purchasing the devices and starting the business. The funding parties are generally open to new innovations and aware of new technical solutions. Services for the forest owners are readily available (forest management organizations) but still some lobbing is to be done to accelerate

the selling of the solution. Currently, the ash producers have taken care of analyzing their ashes, and that is not expected to change. The contractor may need to be in contact with funding parties to be able to start the business. The contractor needs to know that the ash he gets will be qualified to be used as a fertilizer. The forest management organizations should be notified of the expectations.

5.4.6 Market and supply chain issues

With respect to the innovation impacting upon retailer/processor contracts and conditions, the relevant contractor is already a cooperator, fuelwood provider, with producers. If there are other fuelwood providers acting with the producers in the business model proposed, some negotiations would need to be carried out to solve possible overlapping; for example subcontracting is possible. Currently, the producers have spread their ashes in their own forests by themselves, or given the ashes to forest owners for free or for a small fee. While building up the business, contracts will be made between the contractor and producers for treating the ashes, and also between the contractor and forest owners for selling and spreading the granulated ash.

As the granulated wood ash is not very expensive, it is not expected to have an effect on the price of fuelwood sold for the producers. If the granulated ash is used instead of artificial fertilizers, the market share of artificial products will shrink.

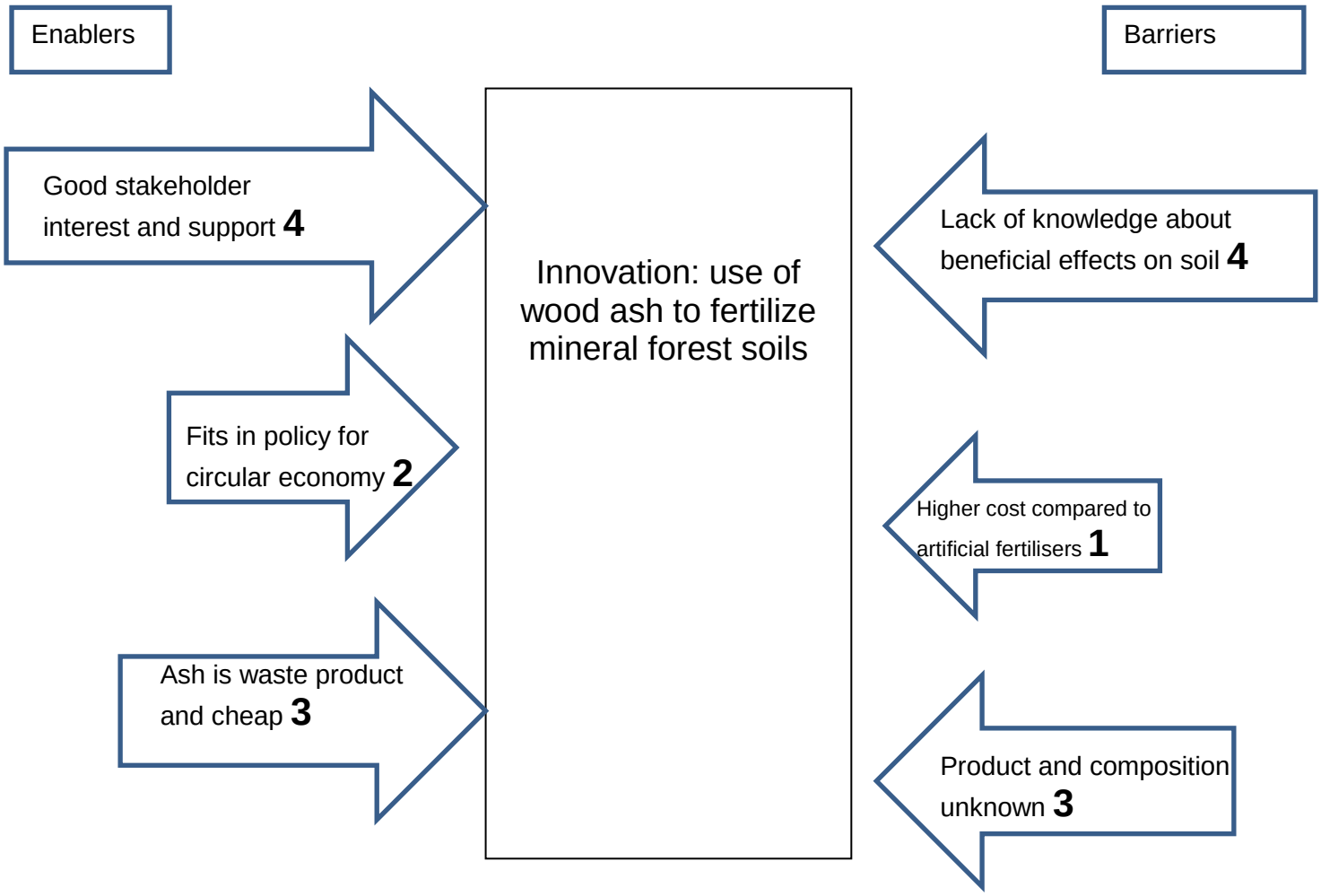
Some parts of the supply chain may discourage innovation. The supply chain is expected to be mostly supportive. Some actors may try to question the benefits of wood ash as a forest fertilizer to prevent it to replace artificial fertilizers. Other fuelwood providers may be against the new business, if their contracts with the producers are in a risk to be ended/altered.

Forest owners and producers are expected to support the innovation, as it is beneficial for them: forest owners get ecologic fertilizer that is proven to enhance forest growth, and producers get rid of their ashes. Producers and sellers of artificial fertilizers may be against the innovation, as it is expected to reduce the need of artificial products.

Force Field analysis worksheet

Enabler	Score		Innovation: Business model for economical symbiosis to utilize ash as fertilizer.		Barrier	Score
1. Information						
Awareness	5					
Availability	4					
Understanding	5					
Effectiveness of services	4					
Piloting ability	4					
Stakeholders	3					
2. Economic						
Cost versus benefit	4					
Competitiveness	4					
Low costs	4					
Risks						2
Incentives	3					
Stakeholders	3					
3. Technical						
Compatibility	5					
Easiness	4					
Skills needed	3					1
Enough competence	3					1
Stakeholders	3					
4. Social						
Motivation	3					
Culture	4					
Social networks	2					
Stakeholders	3					
5. Institutional						
Policy					2	
Support needed	2					
Stakeholders	2					
6. Market/supply chain						
Present contracts					2	
Support from the supply chain	2					
Reflect to actors					2	

Force Field Analysis output diagram for Finland ash fertilizer use



6 Agroecology: managing plant protection, France

6.1 Context

This case study is concerned with agro-ecological farm management. It draws on an existing project run by the Qualisol cooperative. This cooperative has set up a project funded under the agro-ecological plan for France called CASDAR "collective mobilization project for the agroecology ". This builds on a previous initiative with 31 interested farmers. Covering the area of a watershed, the project brings together relevant technical partners: two other cooperatives, technical institutes, an agricultural college, a water association and research teams. The project focuses on the thematic priorities for Arable Farming Systems in a water stake territory:

- Reduction in the use of plant protection products (main theme of the project);
- Agro-ecological management of pests and risk-taking;
- Lengthening the rotation and its economic consequences;
- Limiting nitrate leaching and its impact on changes in agricultural techniques

6.2 Methods

A meeting was held with the following stakeholders

- 9 farmers engaged in the GIEE “quality cropping”, members of Qualisol cooperative
- 8 farm advisers (Qualisol), among whom : the agronomy service responsible, a PhD student on social sciences on collective action on dried legumes
- Sonia Ramonteu (ACTA)

This meeting was held at Maubec and involved a participative session on barriers and enablers to innovation. This exercise was done in plenary discussion, because the number of people was manageable without organizing a ‘post-it’ participatory session.

6.3 Innovation: a combination of agroecology practices

The barriers and enablers to innovation in general for agroecology practices were addressed, and specifically concerning the reduction of pesticides (including herbicides) but also redesign at the cropping systems level (fertilization practices, diversification of the rotation with the insertion of a new crop).

6.4 Barriers and enablers

All the categories were filled when addressing the barriers for innovation. But for enablers, no items were proposed for the institutional and information categories. For both barriers and enablers, the economic consideration is key, but there are also other determinants to consider. Tables in the sections below summarise the key points raised by the stakeholders.

6.4.1 Barriers

Economic	• Farm economy : financial risk
	• Investment / farm profitability
	• Meteo alea : investment in a water reservoir in case of dryness
Institutional	• Administrative burden (regulatory changes, uncertainties)
Technical / Agronomic	• Adapted equipment availability
	• Appropriation and cost of new technologies (mapping)
Market / supply chain issues	• Pay : return on investment, visibility on the added-value
	• Uncertainty and uncertainty of commercial outlet for niche market
Social	• Lack of time to experiment
	• Complexity of change : adaptation capacity
Information	• Information is accessible but there is a reliability problem : discernment towards miracle products

6.4.2 Enablers :

Economic	• Profitable price (viability, risk taking)
Market / supply chain issues	• Willingness to stand out commercially compared to neighbors: new markets, even create demand, create scarcity, export / domestic markets
Social	• Change from routine : a fulfilling profession
	• Group dynamics: spirit of mutual aid (ex. spreading the harvest period), conviviality and sharing, reassurance / individualist spirit
	• Individuality of pionniers and support : role of reflexion cell and extension, to disseminate operational solutions
Technic / Agronomic	• Climate change opportunity : rising of t° requires modified crop rotations

7 Innovative arable cropping, France

7.1 Context

The arable farmers in the Berry region from central France (departments of Indre and Cher) grow mainly rapeseed, wheat and barley winter. Their farms are between from 100 to 500 hectares on various soil types but principally on superficial calcareous clay. Despite progress in crop genetics, the average yields have not increased for over 20 years. Since 2005, some farmers have met in a group with their adviser Gilles Sauzet to find solutions to maintain the economic viability and sustainability of their farming systems. For these farmers who are keen to move towards more efficient systems, in economic terms and productivity, improving soil quality is the primary objective.

Short rotations have been identified as the first weak point, and as responsible for recurrent weed problems. To tackle them, farmers have gradually shifted towards simplified tillage in terms of number of operations and working depth. However, this simplified tillage is not always beneficial to the structural qualities of the soil. A slight crop diversification to extend the intensive, high input production systems based on a short rotation of rapeseed, wheat and winter barley, took place in the last ten years. Farmers introduced various crops: sunflower, corn, durum wheat, and legumes mixed in the crop or between crops.

In summary, the group of farmers coordinated by the adviser aim to develop new techniques and investigate alternative approaches that reduce the impact of farming on the environment and improve soil properties. Amongst them:

- Improving the quality of oilseed rape drilling and autumn growth in order to better withstand autumn weed and disease threats, and limit spring nitrogen input
- Direct seeding in permanent cover: e.g. oilseed rape sown together with cover crops, then direct seeding of wheat under cover of clover or alfalfa
- Integration of associated oilseed rape

7.2 Methods

Three stakeholder meetings were held examining barriers and favourable factors for adoption of the innovation, one meeting just with farmers, one with advisers and then one with both groups together at which ideas were discussed and decisions made about which innovations to adopt and/or trial.

7.3 Innovation: integration of associated oilseed rape with wheat

The innovation discussed is integration of associated oilseed rape with wheat.

7.4 Barriers and enablers

For the above innovation an analysis was made of the levers that can be used to encourage adoption of new techniques by farmers, so long as their value is proven. The graph shows on the x-axis a scale from weak/feeble to difficult/very difficult, and on the y-axis hardly important/ only a secondary consideration, to very important or absolutely crucial.

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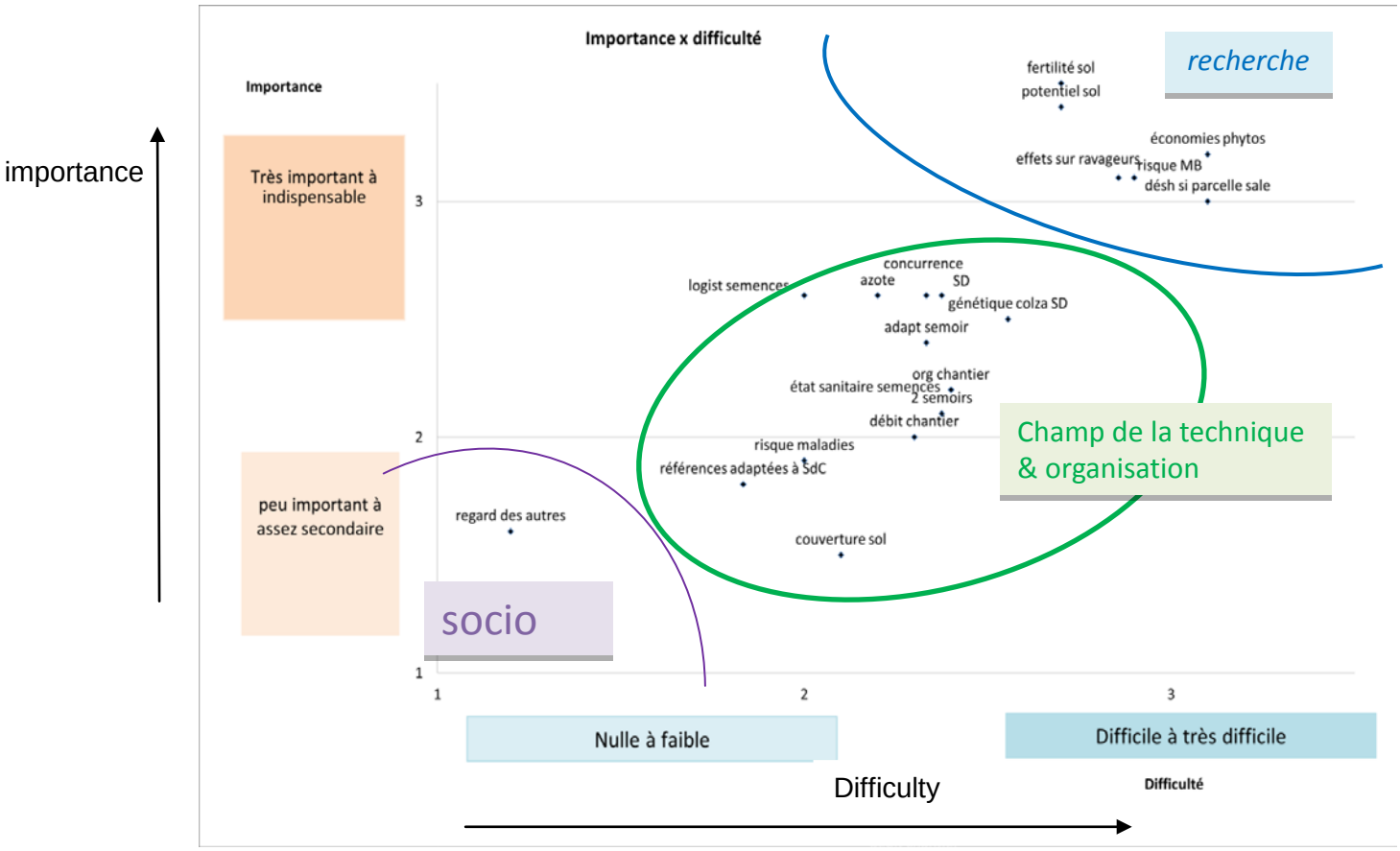
Fig 1 Farmers' views on barriers to associated oilseed rape with wheat



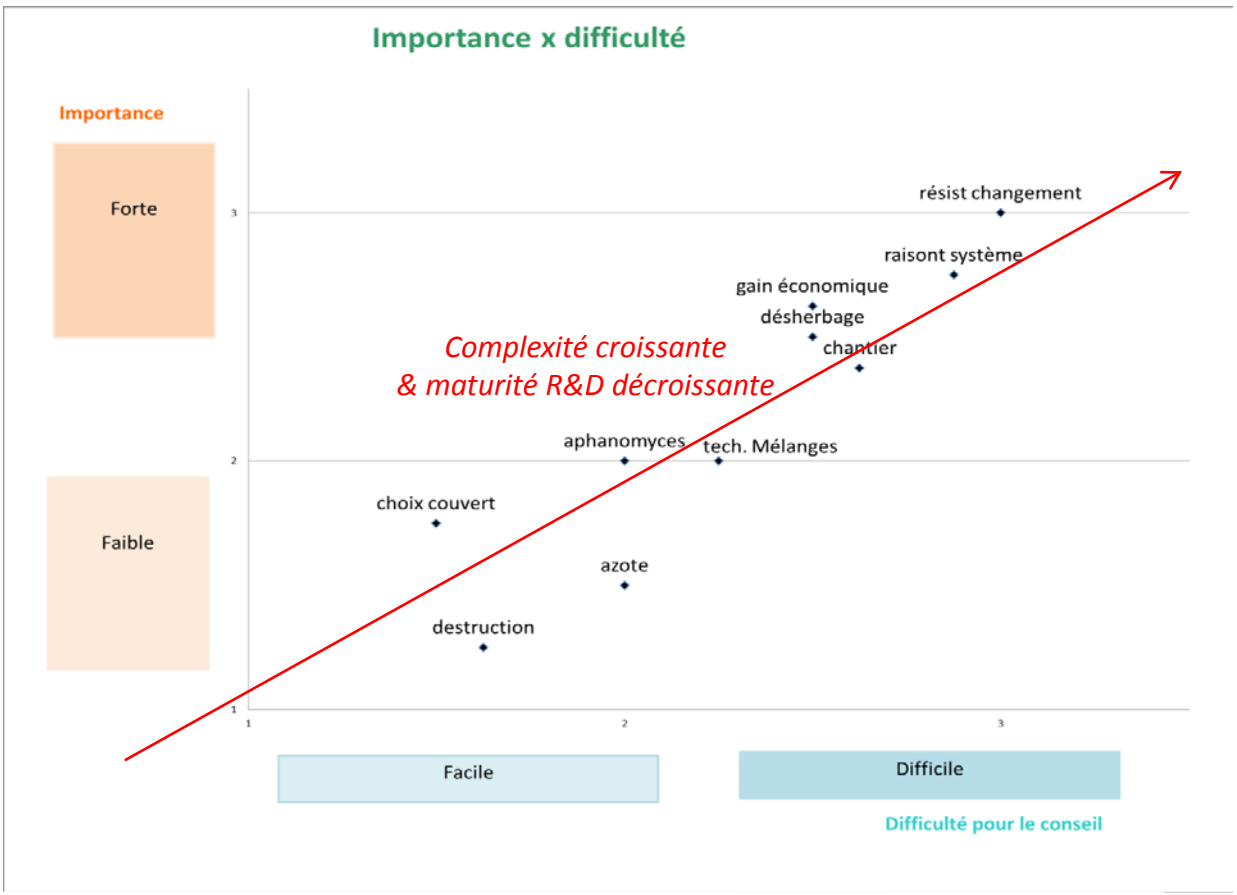


Fig 2 Advisers' views on barriers to associated oilseed rape with wheat

In Fig 1 different levers/factors are plotted against the tow axes to show where farmers perceive them on these scales. So, factors coming from research (in terms of research still being limited in what it produces) are generally deemed difficult/very difficult but very important (e.g. soil fertility and potential, pesticide savings, impacts on predators), those relating to techniques and management are felt to be quite important but also quite difficult (e.g. risks of disease, adaptation of sowing techniques, competition for nitrogen, genetics of rapeseed), whereas social factors are felt for this group of farmers less important and easier to tackle (e.g. other farmers' views about what you do). The overall comment is that the technique will not be adopted on the basis of just one piece of evidence

For Fig 2 this graph uses the same axes but presents what advisers think are the characteristics of different factors, they think the choice of cover and use of nitrogen are easier to respond to and less important, whereas economic gain and farmers natural conservatism are the most difficult things to change but very important.

The overall comment here is that the success in respect of economic indicators is the basic unifying factor for farmers which will ultimately determine uptake, but that you need to find ways to enable the system to evolve in a positive direction. The comment in red is that as the complexity of the options grows, the maturity of research findings on these topics reduces.

Interestingly while farmers thought social factors are less important, the advisers identified the farmers' natural conservatism as one of the most difficult things that affects uptake.

8 Sustainable forest management and ecosystem services, Navarra and Basque Country, Spain

8.1 Context

In many parts of the Pyrenees sustainable forest management had declined in recent decades. Forest ownership is often characterized by small and fragmented plots which are a barrier to economically viable forest management practices and the maintenance and enhancement of biodiversity and ecosystem services. There is an opportunity for forest owners to achieve sustainable management through joint forest management planning. However, a major barrier in the planning process is a lack of empirical data on the physical characteristics of the forest which can be used to inform management. Light Detection and Ranging (LiDAR) technology has the potential to provide much of the required information.

The VALERIE project has brought together a wide range of stakeholders, including individual forest landowners, the local authority, technical staff and forest engineers from the Navarra Forestry Society (Foresna), technical staff from the Mediterranean regional office of the European Forest Institute (Efimed) and the Government of Navarre's technicians and officers responsible for the Roncal area. Meetings have been carried out with forest owners to identify their problems and to show them the proposed innovation, both a forest management plan and the use of LiDAR to achieve this. There are also regular meetings with the Government of Navarre´s technicians and officers.

8.2 Methods

The assessment was done by interviews with a range of stakeholders/technical experts. The interviews can be divided into two groups, those from Navarra and those from Catalonia (*Interviewed: Catalunya: 20 associations; Navarra: 2 or 3; Valencia: 5).*

Interviewees

CAT: CPF representative	28/09/2017
NAV1: Agrupación forestal Roncal, Tesorero representative	05/10/2017
NAV2: Agrup. Forestal Isaba, Secretario representative	05/10/2017
NAV3: Agrup Forestal Isaba, President	05/10/2017
VAL: Asoc. Prop. Forestals Tinença-Els Ports, Gerent representative	02/11/2017

8.3 Innovation: developing a joint forest management plan using LiDAR

The innovation considered is the creation of a joint forest management plans using Light Detection and Ranging (LiDAR) to provide information which maps the physical characteristics of the forest, the landscape and the infrastructure to inform management decisions.

8.4 Barriers and enablers

8.4.1 Information

There was a range of awareness of the LIDAR innovation. Some of the interviewees, mainly Navarra, knew of two or three sources of information while another (Catalonia) said he knew of over 20. In Navarra, FORENSA is the main source of information, in Catalonia the main source of information is the centre for private forestry owners, in other regions it is a relevant agent

conducting advisory activities.. Where no advisory services are institutionalized (i.e. Valencia), the forest technician (consultants, association manager) acts as the major provider of information. There is a perception that three is an absence of specific technical information. Growers Trust the professionalims of these providers. They carry out field visits with the landowners, also their opinion is reflected in the forest management plan. Word of mouth is relevant for new forest owners to enable them to connect to each other.

It was reported that it was difficult to establish the joint Forest management group. A lot of time and effort is needed to get people organised and informed about the context of the project and to help them start discussing the issues.

Information about LiDAR is also an issue. Not all of the people interviewed understood what it is and what it does. FORENSA has played an important role in informing all the other stakeholders about the potential of LiDAR to collect data using the creation of joint forest management planning. During the Valerie project FORENSA has learned a lot about the use of LiDAR data from a practical point of view and how to use it in management plans. It is this expertise, rather than a technical expertise, which has been shared with other stakeholders, for example Forest owners and planners in various government and non-government organisations. It was reported that it would be very unlikely that Forest owners would be able to interpret and use raw LiDAR data provided by suppliers. FORENSA provides the expertise which can interpret the raw data in ways which are useful to forest management planning.

In terms of enabling use of the innovation, it was reported that Forest owners had a deep trust of the forestry advisory services. There did not appear to be much suspicion of scepticism about the intentions and motives of the advisers and the organisations they represented. There is a trust of their professionalism and their ability to give impartial advice and advice that will not be detrimental to the Forest owners' interests. FORESNA are very experienced in building trust with Forest owners. A very practical technique they use is to invite Forest owners to accompany the adviser/field worker as they undertake survey work in the Forest. FORESNA spends a lot of time seeking the opinion of the forest owners.

Again with respect to enabling the forest management plan to be developed, in Navarra it was reported that the role of advisers (FORESNA) was crucial to setting up the Forest Association and the joint forest management plan. There was no spontaneous upsurge of interest. The possibilities and opportunities of joint action had to be carefully explained by the advisers. In most cases, building community action requires facilitation. It is quite rare within the region for this to happen spontaneously. Facilitation, providing access to information, providing technical advice are all very important steps in building capacity within communities so that they can start to take action.

It was reported that the capacity to understand the potential value of using LiDAR data in forest management planning goes beyond the forest owners' stakeholder community and also needs to include other stakeholder groups, such as the government authorities which approve forest management plans.

With respect to the perspectives of different stakeholders, a particular group of stakeholders (wood dealers) may potentially have some misgivings about the creation and development of forest management associations (groups of forestry owners) as they could be perceived as a threat to the wood dealer's activities

8.4.2 Economic considerations

A potential barrier could be the transaction costs involved with the setting up forest management associations and joint forest management plans. This involves the annual cost of being a member of an association and the one-off cost of paying for the joint management plan as well as intangible costs such as time devoted to the association. However this barrier can be broken down to some extent through the offer of subsidies e.g. Valerie support in Navarra,

or subsidies in Catalonia or Navarra, or by special projects in Valencia. Markets do not offer a solution, given that there are few management plan spontaneously emerging. LiDAR reduces the costs of the forest management plan.

In terms of benefits, there are some fiscal advantages (in Catalonia for example) of being a member of a Forest Association. These incentives can be quite attractive to forest owners and encourage them to become members of forest associations. Another major benefit is the information provided by the forest Association and joint management plan. This can include detailed information about the physical characteristics and economic potential of individual forest plots. This information should not be underestimated, particularly as many owners no longer have an intimate relationship with their land and trees. As such they can learn more about their parcels, their real market possibilities (forestry information); as well as intangible: social cohesion, learning on how to work together, better regulation of uses performed in the forest parcels.

Regarding economic benefits to growers, It was reported that forest owners recognise the value of participating in the forest management plan. These included both monetary and non-monetary values. Overall, it was reported that financial gain was the most important motivating factor for forest owners. By working together forest owners hope to improve the financial viability of forest management.

> *"In Catalonia, the issue of forest fires and regeneration and the parts of the forest that are not profitable is the main objective. In Navarra they are more orientated towards timber and it is more profit orientated. There are a variety of motivations."*

Developing the forest management plan is costly, due to technical labour, especially for the inventories. This constitutes a bottleneck, because an inventory is the basis to program the planned interventions. The transaction costs of setting up a forest management plan (identifying owners, mapping ownership boundaries, undertaking inventories and fieldwork, and paying for technicians to create the plan) can be prohibitively expensive. Using LIDAR reduces the cost of the management plan. However in Valencia, the joint forest management would reduce the costs but still the landowners are not very convinced due to very low profitability of forest products.

Another barrier is the lack of a maintained forest infrastructure of access routes and roads. Timber is a very bulky product and the lack of maintained access and transport route ways places very high costs on bringing back into production forest areas which have been long neglected.

The administration is still not ready for Forest management plans with LiDAR, therefore a risk is that it will not be approved. The LiDAR costs as an investment is less risky in Navarra because the forest group technicians engage with forest service technicians, as such there is a greater chance to get it approved because the plan follows the requirements of the administration.

With respect to incentives the current Rural Development Program includes a measure to promote joint forestry. Yet, not all the Spanish autonomous communities have adopted it. Some have but they have not issued the calls, therefore in practice it is inactive.

8.4.3 Technical issues

The management plan is compatible with existing approaches to forest management. It is not perceived as difficult or risky by technicians. The risk comes from not implementing the innovation, i.e. forest abandonment, which entails a higher risk of wildfires and pests. One interviewee remarks that the "forest owners do not see risks, but difficulties".

Using LiDAR does not require extra skills or knowledge, because landowners trust the technicians. FORESNA as advisors had to learn new skills. They contracted the service of some further expert, meetings with them and search information was enough to interpret. They

have test through inventory parcels in the forest to confirm LiDAR. Adoption of innovation, learning curve interested also for the Forest Service; for future management plans LiDAR will be surely used. Stakeholders have sufficient levels of scientific understanding/ technical competence to make full use of the LiDAR innovation. Otherwise they ask for clarifications to the technicians managing the group.

8.4.4 Social pressures

Sometimes stakeholders' personal motivations and values prevent uptake e.g. in Valencia despite the strong wildfire risks, forest owners are still too individualistic to engage in joint forest management; yet, some mentality change has been observed. In Catalonia, it has been also reported that having some politicians in local-level associations may hinder the group thriving in case of political change owing to personal enmities.

It was reported that trust was important to facilitate the process. Another important social factor in this case study was the flow of information about the forest management plan from FORENSA to the forest owners. FORENSA was very successful in communicating with Forest owners who lived in the local area, however, it was much more difficult to contact and build trust with the many forest owners who no longer live in the area. A lot of effort was made to build and improve links with the absentee forest owners by the Forestry Association. There was a perception that absentee landowners and also the younger generation may not fully understand all of the issues because they have lost their connection with the forest. This can lead to barriers which prevent the adoption of the innovation.

> *"In terms of barriers, some people say that some of the landowners culturally very urban and have no more connection and knowledge about forestry production aspects…. There is an issue that the young people may be less interested than the older ones. This may be a cultural problem."*

Joint forest management planning requires collective action and some of the Forest owners have very strong personal views about how the forest should be managed. Individual interests can sometimes outweigh the collective interest. It was reported that local politics can be an important social process which can both enable and provide barriers to the adoption of the innovation. As an enabler, local politics, often driven by the town Mayor, can provide both impetus and inertia for improving forest management

8.4.5 Institutional drivers

Political plurality has been remarked as a requisite in these local-level groups. Plurality means transversal decisions that rely on technical criteria (rather than on political ones); this helps opening doors to all government levels independently of their politics.

Some regions provide subsidies for technicians managing the associations (Navarra, Catalonia). Regarding regulations, the instructions for approving management plans are crucial. Where they exist (Catalonia, Navarra), they need to be adapted to the new technologies like LiDAR. Regarding the policy mandate, while all regions have the mandate through their Forest law to promote joint forests management, its application is very varied: from strongly supported in Catalonia, to increasing in Navarra, and inexistent in Valencia (despite some movements were done in the past). There also may be an issue with the fact that LiDAR technology is so new that the government officials are still trying to work out how they should legally incorporate the information within forest management plans. There was a feeling on some of the people interviewed that government officials were still trying to work out how they should treat LiDAR data and how it relates to the approval process for the Forest management plans

Considering whether the advisory/extension service (or supply chain support) is equipped to support stakeholders with new innovations, FORESNA (Navarra) does have this level of

competence but not in the case of CPF (Catalonia). As there is no extension service in Valencia, this does not apply.

8.4.6 Market/supply chain issues

It was reported that there should be economies of scale developed through joint forest management planning, so that Forest owners working together can negotiate higher prices for the timber produced. There should also be benefits for the wood dealers in that there should be greater long-term security in the supply of timber. In Navarra it is too early to tell if these changes will actually take place, however, the people interviewed were optimistic that in the long-term joint forest management planning will strengthen the supply chain. The biggest bio energy plant in Catalonia has created an alliance with a number of forest associations because they need a lot of timber for the biomass plant. They really see the benefits of working with Forest associations, they know that they are trustworthy and reliable. Biomass plants know that if they work with forest associations, which have a joint management plan, there would supply is secured for at least 10 years. Also the fact that a joint management plan has been approved by the government means that all the laws and regulations have been considered and accounted for.

9 Improving milling wheat quality, Italy

9.1 Context

Problems with the quality of the local bread wheat production are increasing for many farmers. This is firstly due to the continuous drop of prices of the global and local market. Secondly, the national authorities have reduced the number of available and permitted pesticides to prevent environmental and health issues. Moreover, atypical weather conditions during the growing season increases the stress on plants while it is developing important tissues and nutrients. Furthermore, the customer and therefore the industry are more interested in alternative ways of farming, especially if they help reduce the use of chemicals.

The VALERIE project has brought together stakeholders representing: farmers, co-operatives offering storage facilities, millers of various sizes and capacity, seed and pesticides companies (retailers and producers).

9.2 Methods

The stakeholders listed above were interviewed

9.3 Innovation

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10 Drip irrigation management in tomatoes and maize, Italy

10.1 Context

In the county of Alessandria, the availability of water for agricultural use is low and unevenly distributed. Highly productive crops, such as maize and processing tomato (and other industrial crops), require a large amount of water which is drawn from limited underground sources (wells). Over the last few decades, farmers have started adopting more sustainable techniques for irrigation, such as sprinklers and drip irrigation system. In this way, they have reduced the amount of water required. The use of low-volume irrigation systems requires a higher level of technical knowledge in terms of crop needs and irrigation scheduling according to weather data. Decision Support Tools (DST) (and Systems) could help farmers manage water shortage and increase water efficiency use during the summer, ensuring yield and crop quality.
These irrigation systems can represent an important investment for farmers since they require disposable materials every year and durable equipment, such as irrigation structures, engines, pumps and tanks. In order to reduce the pay-back time and increase the value of the investment, farmers can benefit from using DST to increase the effectiveness of the irrigation system. The DST investigated in this CS is described below.

The stakeholders comprised a small group of farmers, technicians from cooperatives and processing factories and a few retailers concerned with increasing yield and the viability of irrigated crops in the area. These are:

- Farmers – 8 members
- Irrigation system suppliers - 2 members
- Processers - 2 members
- Cooperatives – 3 members
- Seed and pesticide companies – 2 members
- Technicians – 3 members

10.2 Methods

In this exercise stakeholders and technical experts were consulted including 4 farmers + 1 technician and 1 processor. Individual interviews were conducted through diverse channels (phone calls, direct contact)

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10.3 Innovation: weather and humidity sensors for irrigation management in processing tomatoes

The chosen DST for this field demonstration comprises a “sensor station” which is able to detect simultaneous weather data and soil humidity values, covering a wide area thanks to wireless technology. Every sensor station is composed of: 1 weather station connected to 2 wireless units in which 2 soil humidity probes are connected. The sensor station can transfer all data in real-time by GPRS network to a web platform, accessible from any electronic device with internet access, such as a computer, tablet or smartphone. The front-end of the web platform is intuitive and user-friendly. Netsens (www.netsens.eu) have developed this innovation, in cooperation with some Italian Universities, in previously financed projects.

10.3.1 Information

- All the interviewed stakeholders are aware of the innovation and they are very interested in this type of technology. “It would be interesting and more useful to have this type of system at a cooperative scale, rather than at farm scale” said the technician of the cooperative of tomato producers of Alessandria during the interview in the field.

- "We need a technician to access information about this technology" said one of the farmers who has to manage all the farm alone with some seasonal employers. In fact, information on the innovation is available through websites but some technical specifications are not written or are difficult to retrieve at first use.

- All the interviewed farmers agreed that with the shortage of rainfall, this system is very useful and helpful to avoid water stress in plants. The processor added "This innovation can help bypass a lot of problems related to quality and yield. We do need quality production and every year is a big question mark for our work". All stakeholders understand the value of the innovation for multiple reasons that are related to the same objective: product quality and income!

- As we reported in the previous points, advisors and technician are useful and helpful for farmers to use the innovation. Nevertheless, after addressing the first problems related to the set-up of the innovation, the system is very easy to use and user friendly. "I adjusted my irrigation plan looking at the graphs and figures that the system provided. Well, I wasn't able to look at it everyday, or better, every night after a full day of fieldwork, but I managed to give a glance every 2 or 3 days and I understood that I was doing great" said one of the farmers who manages more the 50 hectares of processing tomato per season.

- No additional information is needed to apply the innovation to try out on the farm since the technology is ready to use and very easy to set-up. It is necessary to get some advice on positioning of the sensors at the beginning by a specialized technician.

The different group of stakeholders perceive this innovation in two main different ways: competitiveness and improvement in quality. The former is related to the increase of competitiveness of the production sector, which is interesting for the producers and for the processors. The latter is more interesting for the processors and for the consumers who are looking for a higher quality product, with an added value (sustainable, local and with a good taste).

10.3.2 Economic considerations

This type of innovation can have different levels of cost, depending on whether the technology is owned or not by the user. According to the market price, each system (including weather sensors + soil humidity probes, connected through Wireless and GPRS technology) can cost up to 4000 euros, with very low energy and maintenance cost during its lifetime. Compared to other investments on the farm, e.g. machinery, the cost of the innovation is not very high. However, it can be difficult to calculate precisely the benefits of the use of the innovation in terms of saved water and increase of quality during the crop cycle. The main impacts relate to a sensible improvement of irrigation management for the crop and of the water resources at farm level. When the innovation is not owned by the user, many of the costs are lowered and thus have a small impact on the farm income. In this case, an upper level of ownership is need and the use of the innovation can be sold as a technical service to the farmers.

Considering the main issue related to water management due to climate change, competitiveness is a key issue for most irrigated crops. With limited resources and higher temperatures than usual, the viability of some crops, such as processing tomato, can be gradually compromised. "If you calculate the cost of investment of the crop you obtain an initial expense of 3,200 €/ha of consumables: seedlings (1.300 €/ha) + fertilizers (800 €/ha) + chemicals (800 €/ha) + Irrigation system (300 €/ha). If you add fuel, water and personnel costs, the sum is even higher! Nevertheless, the price is slowly decreasing every year" argued the farmers "and we didn't add the cost of our worked hours!". At least, with this type of innovation,

some of the inputs can be decreased or used in a more responsible way: “It can be used to implement some prediction modeling on mildew and other diseases or to quantify the localized rainfalls, which are typical in here during summer”.

The theme of competitiveness is strongly influenced by the market dynamics but the innovation could be helpful for this purpose. “Even if it’s an additional cost, I bought the system for my fields” said one farmer that tried the innovation in 2016 and was convinced by its reliability. While the cooperative in the local area is interesting but is concerned about the use of the innovation for a wider area: “isn’t there a way to increase the distance between the sensors?” asked one of the associated farmer.“we would like to submit an investment plan to get some money from the Rural Development Plan, if possible” (which provides funds for farmers if they fit some requirements)- “could you help us? Can you find the funding way for that?”. These were the main questions related to this innovation but we weren’t able to help them in the short run.

The non farmer stakeholders are interested and favorable to this type of innovation because it could help strengthen the productive sector, which is historically the weaker part of the supply chain. Whether or not this innovation increases the competitiveness of the farming sector, it increases the possibility of measuring the use of resources and it improves their technical level.

10.3.3 Technical issues

The system is compatible with the bio-physical context of the farming system because the technology used is very flexible and modular. It means that it can work in many different farming situations. Our activity of testing it during three years helped us to find the most suitable way of setting up in our farming system. We started exploring the use of the systems in three different crops: onion, maize and processing tomato. For maize, the first issue regarded the height of the crop and the hoeing of the crop (when not irrigated with dripping system). The big mass of canopy impeded the communication between the wireless receptor and the central station, to send data to the web server. For onion, we encountered some technical problems related to the deepness of the sensor, but beside that, the system could be adapted and function within this cropping system as well. For processing tomato, we had the most successful experience and good feedback from the potential users within the group of stakeholders.

With respect to how difficult the innovation is and whether there agronomic/technical risks involved. The innovation can be defined difficult to use because there are a lot of adjustments that must be taken into account when setting up. There are high risks of damaging the sensors in the field during the usual intervention of the farmer with multiple machines, e.g. some components of the tractor or the machine can damage some parts of the sensors that can compromise their functioning (especially the wireless transmitter), some other tools can cut the wires connecting the probes with the transmitter, and so on.

Regarding whether the innovation requires extra skills, knowledge, education, training, if we don’t consider the issues and risks illustrated previously, some extra skills are required to use and understand the innovation. Even if the system is quite intuitive with a good design, the user (either the farmer or the technician) needs to have some basic knowledge about soil hydrology and water movement within the soil. “I read this percentage but what does it mean for my crop? Is it good or not? How can I know that what I read is good? When I used it, I’ve mostly watched the humidity line when it went down or too high” said one of the farmer who used the technology. The first step to use this innovation is to know the texture of their soils and with some formula; it is easy to find the range and threshold of humidity. Many farmers understand this concept but are not able to type down the specific function on excel. For that reason, we (Cadir Lab) elaborated an excel file to help farmers and technicians to understand the number obtained by the sensors.

The main constraint related to the uptake is the available time and the actual position of the field that can be surrounded by some of physical obstacles (buildings and vegetation).

10.3.4 Social pressures

From the social point of view, we did not find any stakeholders having personal motivations and values preventing the uptake of the innovation. Many of the stakeholders have an interest in this technology since it's very useful for their practice. Most of the farmers of the processing tomato supply-chain are younger and have a high technical level. They are less reluctant to try new market solution and find new innovative ways of farming.

10.3.5 Institutional drivers

With respect to policy measures (subsidies, regulations, controls) that prevent or enable the use of the innovation, there are some possibilities through the Rural Development Plan to apply for a project for further application of the technology in the territory although this is not applicable to the single farm but only as an Operational Groups. In our Region, we are quite late and there are no other possibilities for farmers or cooperatives to find the funding source. On the other hand, there are no other policy measures preventing the adoption of the innovation

Regarding whether the advisory/extension service (or supply chain support) are equipped to support stakeholders with new innovations, in this case, the extension service of the stakeholders can be identified in our society CADIR LAB and its shareholder SATA. During the project, we studied together with the stakeholders the functioning of the innovation. In Italy there is no public extension service body, supporting farmers and supply-chains on the technical innovation. The only semi-public institutions are represented by farmers associations/unions which provide assistance for the CAP policies and regulations and other bureaucratic procedures but they are not specialized in technical consultancy. Between the different groups of SHs there are no differences concerning the institutional point of view.

10.3.6 Market and supply chain issues

When considering how using the innovation might impact upon retailer/processor contracts and conditions, food assurance scheme requirements or the prices or market shares, for now, there are no prime or additional prices potentially available for the producers using this technology. Maybe, in the future, some retailers or processors can develop a value chain based on precision farming or sustainable production of processing tomato. This can be achieved by the use of this innovation and predicting model for pest and disease management. Some other processors such as Mutti SpA, that are not included in our stakeholders, demand upon their producers to use a web-based DSS to increase the level of sustainability of the production system.

With respect to whether the supply chain (and specific actors within the chain) support innovation by farmers/foresters and if not, unfortunately, the use of the innovation for this supply-chain is mostly related to the price of the agricultural product as said above. Nowadays, most of the Italian processors cannot offer a higher price to the farmers due to important competitors (Spain and Portugal), selling with lower prices, who are dominant in the European processing tomato market. This situation influences the trend of prices of the local processing tomato supply-chain where agricultural inputs costs increase and products price decrease. Therefore, the adoption of innovation can be difficult by the farmers and cooperatives with a good technical level.

11 Sustainable onion supply chains, Netherlands

11.1 Context

Onions are an important crop for arable farmers in the clay regions of The Netherlands: the South West of The Netherlands and the 'Flevo polders'. The total acreage of onions in The Netherlands is approximately 20,000 ha. Over the last few years the onion growers are facing serious problems concerning the quality of their product. It is a growing concern for the whole chain: approximately 85% of the Dutch produce (900,000 tons on average) is exported. The (international) market is asking for optimal product quality, grown in a sustainable way.

Over the years 2010-2013 the onion growers were facing serious problems concerning the quality of their product, due to 'neck rot', caused by *Botrytis* spp. Symptoms of neck rot show up sometimes during the storage period or during transport to export locations. Control of *Botrytis* spp. is not easy, there is no clear solution on how to tackle this problem. The neck rot problem is very unpredictable, in some years there are hardly any problems, in other years neck rot can cause significant losses: leading to quality problems in the store or during transport to export locations. The problem is that infection takes place in the field, but will only become visible in the store. There are several factors that have an influence on this fungal disease: onion waste management, fungicide applications, variety, infected seeds, N-rate, storage management and the method of harvesting play a role.

Neck rot is a problem for all partners in the onion value chain. These include the following stakeholder community convened for the VALERIE project:

- Onion growers
- Traders/buyers/exporters/packers
- Holland onion association
- Seed companies
- UiKC, onion innovation center
- DLV Plant
- Frugiventa, branch organisation for onion traders/exporters.

11.2 Methods

To assess the barriers and enablers to implementing these solutions the CSP provided his written answers to the prompts in the analytical framework. The CSP works as an expert agronomist with the Polish potato stakeholders and has many years' experience in this supply chain. His insights were supplemented by opinions of his expert colleagues and technical experts.

11.3 Innovation: not chopped onion leaves before harvesting

Measures to prevent infection of the onion bulb is the innovation issue being addressed in this case study. In The Netherlands growers chop the leaves, creating an infection route for the neck rot fungus, however from international literature the stakeholders learnt that in other countries the onion leaves are not chopped before harvesting. It is not known how important this infection route is for the Dutch circumstances. The stakeholders decided to trial this innovation assessing the effect of no leaf chopping, 'normal', 'short' and long leaf chopping on the stored onions.

11.4 Barriers and enablers onion value chain The Netherlands

11.4.1 Information

With respect to ease and cost of accessing relevant information, the only source of information is from other countries where they grow onions and have the neck rot problem. This is not easy to find, but through Valerie we found some literature documenting the effect of leaf chopping on neck rot infection.

Regarding the capacity to understand the potential value of the innovation, stakeholders understand well the potential value of the innovation, most of them are well educated, have a high level of agronomic expertise and have an extended world wide network. The Dutch onion sector is exporting 70% of the total produce to many foreign destinations.

Concerning the effectiveness of advisory/ extension services to support farmer with the innovation, if the innovation turns out to work well and has significant impact on neck rot control, the extension services can be very effective. Furthermore the whole value chain has an interest in solving the neck rot problem.

Regarding the ability to collect sufficient information on the innovation, and to try it out on the farm, the information available comes from abroad. As the consequences are significant, it is not so easy to try it out on the farm. Testing the innovation in applied research and agreement with the value chain partners is necessary before introduction into practice is possible.

11.4.2 Economic considerations

Regarding the costs versus the benefits of using the innovation, the costs of the innovation are not significant. The harvesters used can harvest onions without chopping the leaves. Also the loaders can operate. The extra costs come for chopping the leaves at another time. From the 2 options above the one with most potential is to remove the leaves during loading onions in the field, before transport to the store. The other option, remove leaves just before packing, leads to high costs, because of the extra waste in the packing stations. The benefits can be big, as growers don't have the risk of neck rot problems in the store where damage can be up to 1000€/ha. The guarantee of neck rot free onions has added value for national and international sales and therefore makes the growers/stakeholders more competitive.

With respect to economic risks involved in using the innovation, a later harvest brings the risk of more skin problems and bad weather during harvest. It is unknown if a longer field period for the onions increases the risk for neck rot infection thereby cancelling the positive effect of not chopping. Regarding incentives a better product quality represents a premium in the market. Growers, buyers/traders/exporters all have an interest in this.

11.4.3 Technical/ issues

With respect to whether the innovation is compatible with the bio-physical context/farming system, it can work in the context of the farm, but it requires changes in the traditional farm management. Regarding the need for extra skills, knowledge, education, training or advice, its thoughts that other value chain partners are capable enough to deal with it, if the innovation turns out to be effective farmers and stakeholders have sufficient levels of scientific understanding/ technical competence to make full use of the innovation.

11.4.4 Social

In the CSP's opinion the stakeholders' personal motivations and values do not prevent uptake of the innovation. Although it changes the traditional ways of doing things if it turns out to

effective, and it solves a problem, farmers have a direct interest and are willing to change. Concerning support networks, there is support through the value chain if stakeholders want to learn about or take up the innovation,. Many partners have direct contacts to farmers, and they all talk the same language. All the stakeholders have an interest to solve the problems and introduce practical solutions. There is no conflict of interest that could hamper the implementation.

11.4.5 Institutional drivers

There are no policy measures (subsidies, regulations, controls) that prevent or enable the use of the innovation and it is not expected that they will come, as it is a technical problem for the onion sector, with no direct link to the public agenda. The advisory/extension service (or supply chain support) are equipped to support stakeholders with new innovations.

11.4.6 Market and supply chain issues

Regarding the impact upon retailer/processor contracts and conditions, food assurance scheme requirements or the prices or market shares potentially available to producers, the innovation asks for another work routine elsewhere in the value chain, as the onion leaves have to be removed before they can be packed and transported. The consequences of the innovation are:

- Not chopping leaves leads to later harvesting, which represents a higher risk for bad weather during harvest in our frequently wet climate later in September
- Skin quality can become worse when harvesting later. Normal practice is to chop leaves when 30-40% of the plants still have green leaves.
- Leaves will have to be removed later, a few options here:
    - During loading the onions in the field. Loaders should be adapted for this purpose
    - Shortly before packing. But this leads to much more onion waste in the packing stations, which is not a very popular measure.
    - Unloading the store might become more difficult as the onions do not roll so easy when the leaves are still there.

The innovation would have a positive impact on the whole value chain as problems with quality of products is a disturbing factor in the (export) market. With respect to the supply chain supporting such innovations, there is no real conflict of interest, only the ‘waste’ problem could be a complicating factor, however this will be solved in the most efficient way if the innovation turns out to be effective.

12 Sustainable potato supply chains, Netherlands

12.1 Context

The French fry industry in Poland is quite new. The Farm Frites (FF) company involved produce French fries in the North of Poland, partly on their own farm, partly from 60 contract growers in the region. Production of high quality potatoes at a low cost price is crucial for this industry, with a lot of competition from other companies. The French fries supply chain as processors and retailers require blemish-free white flesh and long potatoes. Innovator is one of the varieties that meet these requirements, but this variety is susceptible to Tobacco Rattle Virus (TRV).

Internal brown spots in the tuber flesh caused by Tobacco Rattle Virus TRV, carried by nematodes, are a major problem for the growers in the region and the impact is felt across the whole value chain. The factory cannot process potatoes with a higher % brown spots than the norm, these are rejected and this represents a big loss for farmers but also a problem for the factory and the seed suppliers As there are no good alternative varieties for the specific market the whole value chain has a great interest to solve the problem.

The CS stakeholder community convened for the VALERIE project comprised:

- Farmers, growing potatoes for Farm Frites.
- FF Poland, the farm, growing potatoes for the factory.
- FF, the factory, located in Lembork, 50 km East of Slupsk.
- Agrico Poland, potato seed producer.

12.2 Innovation: potato varieties and nematode control strategy to control Tobacco Rattle Virus

These stakeholders met to discuss two solutions. As the Innovator variety is very susceptible to TRV, the easiest solution/innovation is to grow a TRV resistant variety. The other solution is nematode control strategy – growing potatoes on a TRV-free field i.e. without infestation with *Tricohorus* species, the vector of the virus. Trials were carried out by stakeholders on potential varieties to replace Innovator, thereby testing the first solution, but both innovations are discussed here.

12.3 Methods

To assess the barriers and enablers to implementing these solutions the CSP provided his written answers to a set of prompts. The CSP works as an expert agronomist with the Polish potato stakeholders and has many years' experience in this supply chain. His insights were supplemented by opinions of his expert colleagues and technical experts.

12.4 Barriers and Enablers

12.4.1 Information

With respect to awareness of the problem (innovation issue) and of the innovation solution the TRV problem is very clear to all the value chain partners, the easiest solution/innovation is to grow a TRV resistant variety or grow potatoes on a TRV-free field:

- All Innovator growers know the problem, they all face the 'tare' problem, i.e. price cuts because of bad potato quality. All growers know the differences between varieties and are open for 'innovation'.
- The infection rate with TRV is unpredictable and very variable from year to year. TRV is transmitted through nematodes, a few *Trichodorus* species are most important. Nematodes can only transmit the virus when infected. Nematodes

are active especially in wet springs, as they move up and down in the soil depending on soil moisture content. In dry springs nematodes stay rather deep in the soil and do not reach the upper soil layer where potato roots grow.

- The seed supplier, Dutch company HZPC, is the owner of the variety, they know, and every grower knows, that the Innovator variety is susceptible for TRV.
- In TRV free fields Innovator is a very good variety, however, information about the nematode situation in the different fields is mostly not available.

Considering the ease and cost of accessing relevant information there is reliable information on new and low susceptible varieties. The cost of a variety trial is not very high.

Innovator, as a susceptible variety, and can be grown on fields without infestation with *Tricohorus* species, the vector of the virus. The solution here is a nematode control strategy, however this is rather expensive and complicated as:

- Soil sampling for nematodes is necessary
- Control measures for *Trichodorus* can have an adverse effect on populations of other nematodes, like *Pratylenchus Penetrans*.
- All crops in the rotation, including cover crops, have an impact on the population dynamics of nematodes.

Regarding the capacity to understand the potential value of the innovation, stakeholders understand very well the value of innovations, most of them are well educated, have a high level of agronomic expertise and have an extended world wide network. The french fry industry works globally and there is exchange of knowledge, in the company and with external advisers. Employees visit potato events worldwide, looking for new information.
As example, the case study partner Farm Frites has french fry factories in several countries, such as: The Netherlands, Poland and other EU countries, Africa and South America. The teams of agronomists from all the countries gather at least once a year, to discuss all kinds of technical aspects about potatoes for french fries.

Concerning the ability to collect sufficient information on the innovation, and to try it out on the farm:

- With respect to varieties, there is sufficient information available on the susceptibility of the main varieties, see result of the Valerie field trial. There are a few resistant/little susceptible varieties available on the market, but they all have other negative properties (f.e. yield, french fry quality, storability)
- Nematode control strategy as a solution is a different story. In Poland growers have little information about the nematode situation in their fields. In the traditional crops, winter wheat and oil seed rape, nematodes are of little importance, and farmers are not aware of nematode problems. A rather small survey of fields under contract farmers a few years ago showed that many fields are infected with *Tricodurus spp* (mainly *T. primitivus and T. pachydermus*) and *Pratylenchus Penetrans*. Growers are now starting to realise that they have a nematode problem and starting to think about control measures. During the Valerie CS meetings there were 2 presentation from a WUR nematode specialist. Farmers know what farm management measures have an influence on nematode populations and the virus load of the nematodes. However the translation of this information into a TRV control strategy is costly and not so

easy. An example. On a field where TRV problems occurred we found a mix population of *P. penetrans* and *T. primitivus*. The crop rotation is winter wheat/cover crop-potato-winter wheat-oil seed rape. All crops multiply both nematodes and are a host for TRV. Tagetes is an effective control of P. penetrans, Raphanus sativus is a non host for TRV. It is therefore not so easy to develop an (cost) effective control strategy:

Multiplication of :			
Crop	P. penetrans	T. primitivus	TRV host
Winter wheat	yes	yes	yes
Cover crop*	yes	yes	no
Tagetes	no	yes	yes
Potato	yes	yes	yes
Winter wheat	yes	yes	yes
Oil seed rape	?	yes	yes

12.4.2 Economic considerations

With respect to the costs versus the benefits of using the innovation:

- *New variety.* The benefit of a resistant variety is clear, there is no risk for TRV quality problems. The financial risk of TRV can vary between 0 and 20% of the turn over on field level, 0-5% on farm level. The cost of the innovation is hard to estimate. When the variety meets the criteria from the industry, the financial risk is mainly in the potential yield loss per ha and storability. Compared to Innovator the potential yield decrease is about 5% average.
- *Nematode control strategy*. The basic element of a control strategy is information about the nematode populations in the field, this requires soil analysis. Based on this one can determine the measures to take and to monitor. For a large farm, as most of the farms in the North of Poland are, it takes quite a lot of money (10-50 k€), and no guarantee that the problems will be solved completely, definitely not on the short term. However both innovations may make the stakeholders more competitive in the longer term (3-5 years?).

Regarding costs preventing its uptake extra costs might occur because a new strategy for growing cover crops is necessary. Weeds and wheat plants emerging from non harvested seeds should be controlled, as they are host plants for nematodes and TRV. Ploughing and creating an optimal seed bed is necessary to guarantee a good cover crop. This causes extra labour and machine costs. When tagetes is considered for control of *P. penetrans* there are also extra costs (expensive seeds) involved.

Considering economic risks involved in using the innovation, for new varieties the risks are rather low, when the varieties are tested and accepted in the value chain there are no big risks, farmers can calculate the effect. For nematode control strategy there are risks involved, because the effect of the measures to take in order to control nematode populations is not

100% predictable, especially not when a mix of nematode populations is present in (some of) the fields.

Regarding how the risks relate to different groups of stakeholders, the factory is facing quality problems, leading to inefficient processes. McDonalds is in a way also a stakeholder, but at a distance; they demand good quality french fries, and only accept certain varieties, like Russet Burbank and Innovator, but they 'leave' the problems for the growers/production chain. There are no direct economic incentives, other than described above.

12.4.3 Technical issues

The innovation is compatible with the farming system, but it requires changes in the traditional farm management. Regard the need for extra skills, knowledge, education, training, control of nematode populations so far was is not a topic in the farming community in the North of Poland. It certainly requires extra knowledge, also a change in attitude. Good examples among colleagues can help to convince others. As there is no quick return on investment it is important to create such examples. The Farm Frites farm could be such an example and the agronomists of FF Poland could play a role in knowledge exchange as they have good relation with the contract growers. Some of the stakeholders have sufficient levels of scientific understanding/ technical competence to make full use of the innovation, but among (contract/other) growers in the region there is a lack of understanding to make use of the innovation without help from others.

12.4.4 Social pressures

Considering whether the stakeholders' personal motivations and values prevent uptake, Nematode control so far never was an issue in the minds of growers. Some growers see the necessity to work on solutions where others are more hesitant to take action. With respect to access to peer support, this could be the group of contract farmers. Agronomists of FF have good contacts with the growers. All the stakeholders have an interest to solve the problems and introduce practical solutions. There is no conflict of interest that could hamper the implementation.

12.4.5 Institutional drivers

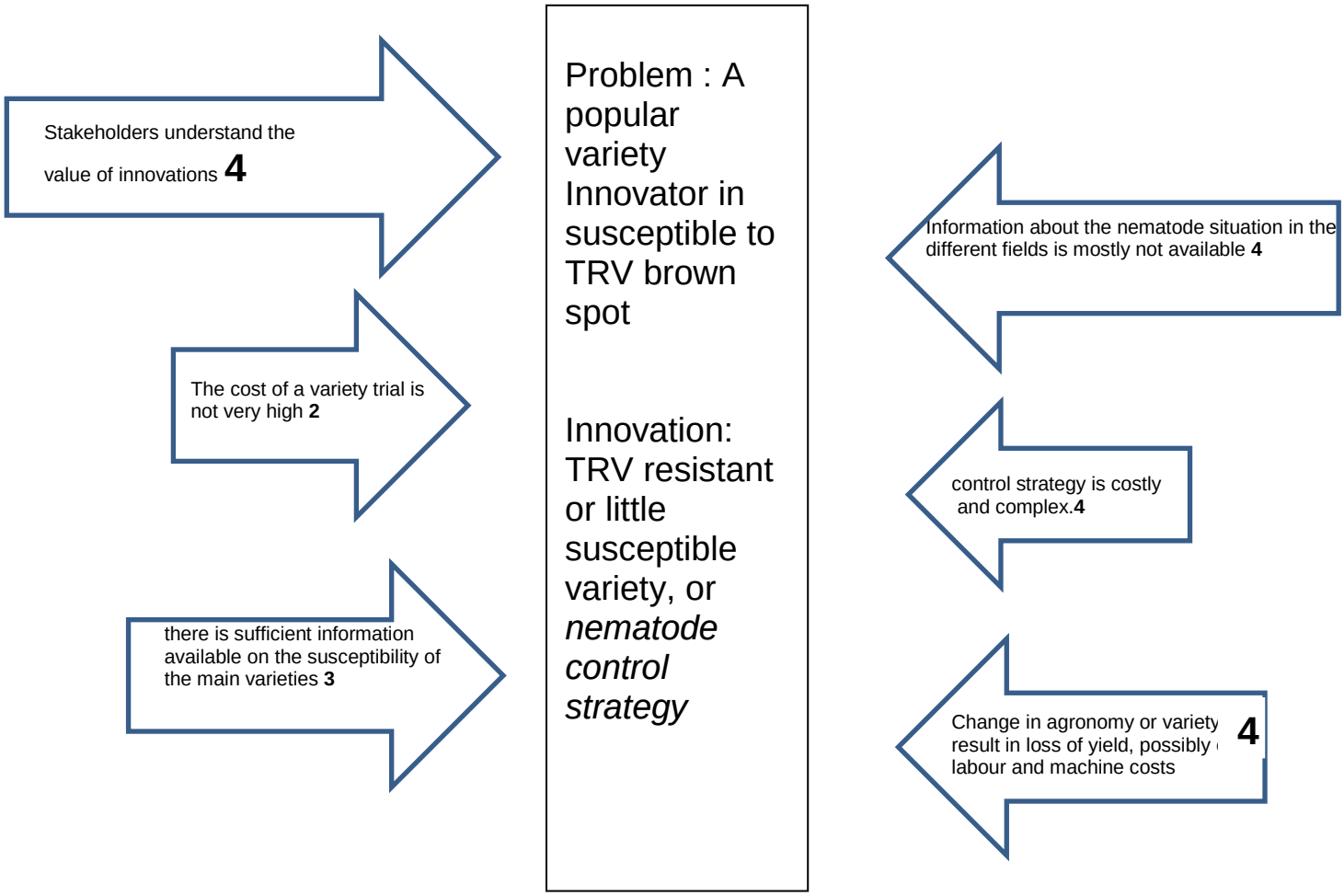
There are no policy measures (subsidies, regulations, controls) that prevent or enable the use of the innovation. It might be that the Polish EIP program offers opportunities, but so far this is not implemented in Poland (no operational groups so far). Regarding whether the advisory/extension service (or supply chain support) are equipped to support stakeholders with new innovations, the extension services are not very well developed in Poland. Government related advisory services mainly help farmers with the administrative aspects of EU policy, but in this specific case, the agronomists from FF are well trained and educated people and their activities are free for the farmers. Other stakeholders are not active in supporting growers in this aspect.

12.4.6 Market and supply chain issues

With respect to the way the innovation could impact upon retailer/processor contracts and conditions, food assurance scheme requirements or the prices or market shares the innovations would have a positive impact on the whole value chain. Problems with quality of

products is a disturbing factor in the contact between growers and processor. The supply chain (and specific actors within the chain) support innovation, FF Poland has an extended programme of supporting activities for their contract growers. On their own farm they do trials each year, fertiliser and variety trials are conducted on farm of contract growers, the results of these trials are shared with all the growers.

Force Field Analysis



13 Conclusions

The research team has been working together with the stakeholders to apply, test and refine screened research outputs in CS. As part of this they have also worked together to evaluate the research outputs' innovation potential in the local context, assessing the viability of solutions and exposing barriers and bottlenecks that limit their uptake**.** This report has examined the barriers and enablers to utilisation of innovations in CS, by collating and analysing the results from stakeholders and Case Study Partner assessments.

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It is evident that the utilisation of innovation derived from research is constrained or enabled by a number of factors, this is in line with Agricultural Innovation Systems thinking which situates farmers and foresters in a system where social, economic, ecological, market and institutional drivers influence innovation.

The analytical framework, derived with reference to previous studies on barriers to adoption and Agricultural Innovation Systems perspectives, provided six themes for the analysis in each case study. Although the CSs are diverse in nature some general conclusions can be discussed.

Lack of Information or awareness was rarely seen to be an important barrier to uptake of innovation. Most stakeholders understood or were aware of the benefits of the innovations being considered, although lack of knowledge about the innovation benefits was a significant obstacle in the case of wood ash utilisation, and in the potato CS where management strategies to control nematode populations are not that well known in the potato farming community in Poland. In Spain the potential of using LiDAR data was not well known and awareness of its use for forest management plans amongst all stakeholders was low. The French agroecology CS stakeholders mentioned that information might be accessible but there is a reliability problem. Whilst lack of information was not an important barrier, the appropriate delivery of information or facilitation of learning was suggested as an effective enabler in a number of CS, through the usual channels of advisers, farm demonstrations etc, and to farmers ,advisers and decision makers. A number of CS stakeholders stressed the importance of facilitation of group learning and knowledge exchange to enable uptake of the innovation.

Economic considerations are important, whether this is the extra cost of purchasing new tillage equipment or paying a contractor for spreading wood ash. As such, economic advantage needs to be demonstrated. Financial risk is always a potential factor preventing uptake, for example with nematode control strategy in potatoes, which can be expensive and complicated, there might be no guarantee that the approach is effective and therefore the grower must evaluate the cost and risks involved. There is also a question of who takes the risk, in the supply chain this is often transferred to the growers, for example, potato factories demand high quality crops and 'leave' the problems for the growers/production chain. In Italy for the weather sensor innovation the effect on the farms' competitiveness is key but unknown, it can be difficult to calculate precisely the benefits of the use of the innovation in terms of saved water and increase of quality. The transaction costs of setting up a forest management pan were noted in Spain, however the economic advantages to forest management plans and the use of LiDAR were a motivation for the forest owners to collaborate. This is line with views expressed by numerous scholars that new approaches will only be adopted to replace an existing system if the potential benefits of the new system outweigh the risk associated with change (Eastwood et al., 2012).

Technical feasibility and ability in implementing the innovation is important. In Finland, a lack of technically knowledgeable operators offering ash fertilization and spreading was seen to prevent ash usage amongst forest owners. Although some progressive farmers (potatoes and onions) have sufficient levels of scientific understanding, some activities are demanding, for example, a nematode control strategy in potatoes can be technically difficult (and in North Poland is new), so requires extra knowledge. Furthermore some field based

innovations (onions, potatoes) can result in other negative agronomic issues which demand attention. In Italy the sensor presented some technical problems for farmers to install, they need to have some basic knowledge about soil hydrology and water movement within the soil to optimise its use. In the case of the Spanish forest owners, they could not manage the raw data from LiDAR but expected the forest technicians to interpret this for them, these technicians therefore required additional training and skills. Learning required to implement an innovation can present barriers or what has been described as a 'competency trap' (Leeuwis 1993) which occurs around new technology where existing practices are maintained due to a lack of incentive to invest in learning how to 'do' the new practice (Eastwood et al., 2012).

Social pressure and cultural resistance to change was also noted in more traditional farmers, This is mostly the case where systemic changes are needed, for example, a change in tillage or cover cop usage in UK requires or a nematode control strategy requires change in attitude and approach. Other social factors include the tenure arrangements amongst pig owners in UK and the arable farmers whose fields they use; which mean that the herd owner must change practice to enable the innovation (cover crops) but will not benefit from this himself. In the agroecology CS in France, and in the tomato CS in Italy, the farmers also noted the lack of time to experiment and the complexity of change involved as barriers to practice change, this suggests that adaptation capacity is an important component of innovation. In the forestry CS the individual motivations of land owners were often strong, while in Spain absentee forest owners and the younger generation were described as having little connection to the forest or commitment to its management.

Institutional drivers including regulation, incentives, are thought to be important as enablers in all CS but were rarely suggested as barriers, although the amount of regulation related to ash fertilization in Finland was noted as a deterrent.

Markets and the role of the supply chain in promoting innovations as part of good practice was noted. For example in outdoor pug production demonstration of good husbandry could be used as part of a food/quality assurance for consumers. In the potatoes and onions supply chains, innovation, if proven, can be supported by a good network of agronomists and supply chain actors. This advice and support is often in place of public extension services which can be weak (Poland), also with respect to this, any technical problems are seen to be the responsibility of the commercial sector, as there is no direct link to the public agenda. There can also be negative effects of innovation on the supply chain, for example, the onion innovation (preventing neck rot by not cutting stems in field), if proven, requires a change in practice in the storage stage of the supply chain which can be expensive. In the Spanish forestry case the prospect of forest management plans was both an advantage to processors (biomass energy generators) as it secured a long term contract, while in some cases individual wood dealers potentially felt threatened.

In Italy using the innovation of the weather and soil humidity sensor is not incentivised by the supply chain. Although it provides better resource use for the grower, will not guarantee a price premium since the tomato processing supply chain is highly competitive and is limited in the prices it can offer growers.

In most CS, little differentiation was made between the stakeholders views, although in the French Innovative Arable Cropping CS farmers' and then advisers' views about barriers were sought and compared revealing some disparity.

14 Annex 1: Guidelines to CSP

Guidance for CSPs: collecting stakeholder views on barriers and enablers to innovation

Aims

These questions/points (see table 1) are about barriers and enablers to implementing the innovations and/or solutions identified by the stakeholders in your case study.

Background

We would like to identify and explore barriers and enablers for innovation in practice. Often, this is framed as 'barriers and enablers for the implementation of (technical) innovations developed by research'. The common hypothesis is that the 'end users' of such innovations just lack the knowledge (as a main barrier for uptake). From the WP3 perspective, we understand that the situation can be very different, and a range of e.g. economic, social and practical (and even legal) issues could be restricting innovation, individually or in combination with one another. This is of interest to VALERIE because we want to show that innovation is more than just using research outputs.

We would like to use examples from the WP3 case studies to understand what affects the uptake/acceptance of innovations because the cases contain a variety of 'innovations' (not only technical innovations provided by research, but also social and management innovations provided by peers or co-developed by stakeholders and advisors, for instance). As discussed in Toulouse, you could investigate this topic by having a discussion **in a meeting with a group of stakeholders, and/or also in interviews with individual stakeholders**. It will be important to have a range of views to avoid the risk of strong bias, if only a few people are included.

Instructions for CSPs

1. **Select one innovation per case and define it in general terms** (e.g. the use of wood ash for forest fertilization on mineral soils, or the use of cover crops in outdoor pig farming). The obvious choice is the innovation being trialled in your case, however you may want to broaden this to a more general set of innovations that might share the same sorts of barriers and opportunities (e.g. intercropping; field soil assessment). The WP3 team will talk to you before the meeting and/or interviews, about this choice.

   For group meetings, the selection/definition of which innovation to consider can be done with stakeholders as part of the meeting, whereas for interviews the CSPs will need to select and define the innovations in advance (in discussion with WP3 team). The key thing is that the **same innovation** is discussed with all the stakeholders consulted, in each CS.
2. **Identify the barriers and enablers for 'uptake' of the innovation.** The questions/issues (see table 1) are grouped into 6 key areas where we expect barriers and enablers to be identified. Please use these points under each area as a guide to your meetings/ interviews with stakeholders and technical experts.

   We suggest you:

Use a Force Field Analysis (FFA) (a very simple exercise) to structure a group discussion or interview. This is a way of identifying and scoring barriers and enablers (see guidelines and worked example below) and provides a consistent output for all CSs. After this, check that you have covered the 6 main issues in the table: are the barriers/enablers related to specific categories? If some categories were not mentioned, check if this is right or did we simply forget/neglect this?

If you do not want to do FFA there are other options for collecting this information:

a. Lead an open group discussion/interview based around the 6 categories and points in the table
b. Start the discussion in a very open way: 'imagine that farmers (or forest owners) should start doing this [example of innovation]: what would encourage them to do it, and what would hinder them?' It could be helpful to use sticky notes to write down on two charts everything they can think of, and then discuss these collectively in a group. After this, then check what you have covered against the questions in the 6 main categories: are the barriers/enablers related to specific categories? If some categories were not mentioned, check if this is right or did we simply forget/neglect this?

Make sure that you note down the different stakeholders' separate views (e.g. as expressed by research, advisory, farmers/forest owners, supply chain, customers, government, NGOs, society etc).

NB In a group session, the discussion may tend to converge towards a common understanding, while interviews can diverge into very different views. Interviews could therefore require more intensive analysis by the CS leader to draw balanced or common conclusions.

3. **Collect detailed information** from your stakeholders, in these discussions. It is important to make **good (extensive) notes**. Be as specific as possible e.g. instead of 'farmers' say 'elderly farmers with a small farm' or 'large intensive farmers'; or rather than 'advisers' say 'commercial advisers or government advisers', or 'technical agronomic advisers' or 'representatives from the fertilizer companies', etc.. It is strongly recommended that you assign somebody at the meeting to make detailed notes, so that you can concentrate on facilitating and encouraging the discussion. Better still, you could tape-record the session.

4. **Write a report** using the 6 issues as the main headings (around 400 words per sub section)

Provide as much detail and explanation as you can, preferably with quotations, not just noting comments as bullet points (though bullet point lists can be useful for summarizing issues to the participants, during the discussion).

- **Discussion points for case study stakeholders - barriers and enablers to implementing the innovations**

Table 1

Case study: **Innovation:** **Stakeholders/technical experts consulted (type and number; meeting/interview format):**
Information • *Awareness of the innovation* • *Ease and cost of accessing relevant information* • *Capacity to understand the potential value of the innovation* • *Effectiveness of advisory/ extension services to support farmer with the innovation* • *Ability to collect sufficient information on the innovation, and to try it out on the farm* • *How does this set of issues relate to the different positions/understandings of different groups of stakeholders?*
Economic considerations • *What are the costs versus the benefits of using the innovation?* • *Will the innovation make the SH more competitive?* • *Are there costs preventing its uptake*? *Explain what the costs are (e.g. new machinery, more labour) and how do they differ for different SHs?* • *Are there economic risks involved in using the innovation? Explain what the risks are (e.g. uncertain effect on yield/quality, volatile markets, loss of contract) and how they differ for different SHs(e.g. different levels of resilience between farms)* • *Are there any economic incentives for the innovation?* • *How do these economic incentives relate to different groups of stakeholders?*
Technical/ agronomic • *Does the innovation work in the bio-physical context/farming system? Is it compatible?* • *How difficult is the innovation? Are there agronomic/technical risks involved?* • *Does the innovation require extra skills, knowledge, education, training? For the advisors and/or for the farmers? Will farmers need to learn it from a trusted source? – consider whom* • *Do the SHs have sufficient levels of scientific understanding/ technical competence to make full use of the innovation?* • *How does this relate to different groups of stakeholders?*
Social • *Do SH personal motivations and values prevent uptake?* • *Do cultural aspects (e.g. traditional ways of doing things, accepted behaviours, habitual attitudes) prevent uptake? For example farmers say 'we've always done it this way – why change now?'*

• *Are there supportive social networks, peer support if SH want to learn about or uptake up the innovation?* • *How does this relate to different groups of stakeholders?*
Institutional • *Are there policy measures (subsidies, regulations, controls) that prevent or enable the use of the innovation? What are these?* • *Is the advisory/extension service (or supply chain support) equipped to support SHs with new innovations? For example are they well trained, component, innovative, well resourced, reasonability priced or the opposite?* • *How does this relate to different groups of stakeholders?*
Market/supply chain issues • *In what way will using the innovation impact upon retailer/processor contracts and conditions, food assurance scheme requirements or the prices or market shares potentially available to producers?* • *Does the supply chain (and specific actors within the chain) support innovation by farmers/foresters and if not, how does it discourage innovation and why?* • *How do these aspects relate to different actors in specific supply chains?*

Force Field Analysis (FFA)

FFA helps you think about barriers and enablers for implementing an innovation.

- To carry out a FFA describe you innovation in the middle of a piece of paper or whiteboard
- Then list all the enablers (opportunities) on the left side and all the barriers in a column on the right side
- Score each factor on a 1-4 scale (with 1 being not so significant and 4 being very significant) and add up the scores for each column.
- Draw this as an output diagram (see example below)
- You can then evaluate the most significant enablers and barriers and think about how these can be supported or overcome
- Check that you have covered against the points in the 6 main categories (in table): are the barriers/enablers related to specific categories? If some categories were not mentioned, check if this is right or did we simply forget/neglect this?

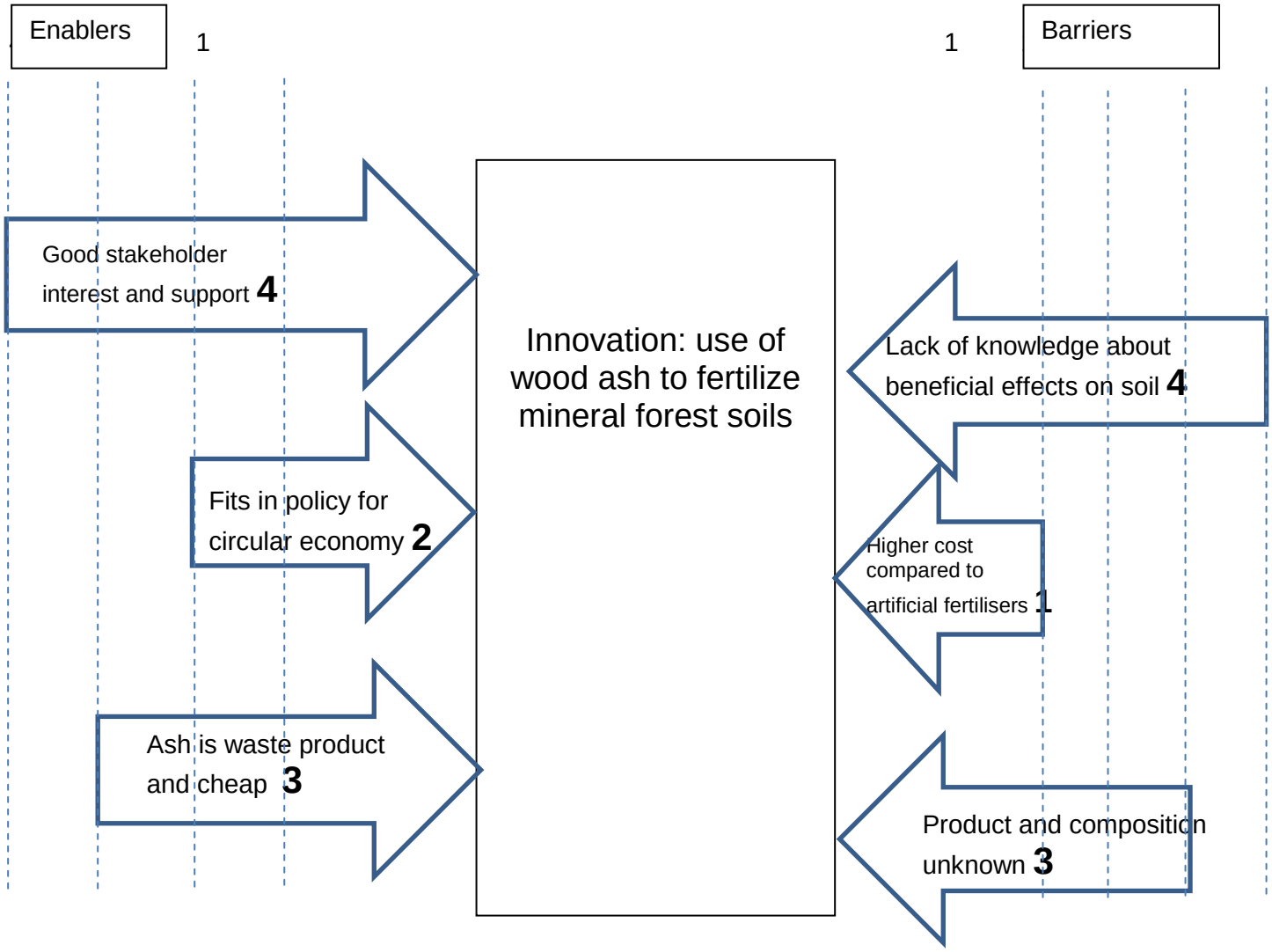
Force Field analysis worksheet

Enabler	Score

Innovation

Barrier	Score

Force Field Analysis output diagram for Finland ash fertilizer use: Worked Example



15 References

EIP 2017 What is innovation? https://ec.europa.eu/eip/agriculture/en/what-innovation

EASTWOOD, C., CHAPMAN, D. & PAINE, M. 2012. Networks of practice for co-construction of agricultural decision support systems: case studies of precision dairy farms in Australia. *Agricultural Systems,* 108**,** 10-18.

EU 2013. Agricultural knowledge and innovation systems towards 2020–an orientation paper on linking innovation and research. *European Commission, Brussels*.

FEDER, G. & UMALI, D. L. 1993. The adoption of agricultural innovations: a review. *Technological forecasting and social change,* 43**,** 215-239.

FELICIANO, D., HUNTER, C., SLEE, B. & SMITH, P. 2014. Climate change mitigation options in the rural land use sector: Stakeholders' perspectives on barriers, enablers and the role of policy in North East Scotland. *Environmental Science & Policy,* 44**,** 26-38.

HALL, A., BOCKETT, G., TAYLOR, S., SIVAMOHAN, M. & CLARK, N. 2001. Why research partnerships really matter: innovation theory, institutional arrangements and implications for developing new technology for the poor. *World development,* 29**,** 783-797.

HALL, A., MYTELKA, L. & OYEYINKA, B. 2006. *Concepts and guidelines for diagnostic assessments of agricultural innovation capacity*, UNU-MERIT, Maastricht Economic and social Research and training centre on Innovation and Technology.

KLERKX, L., AARTS, N. & LEEUWIS, C. 2010. Adaptive management in agricultural innovation systems: the interactions between innovation networks and their environment. *Agricultural systems,* 103**,** 390-400.

KNICKEL, K., BRUNORI, G., RAND, S. & PROOST, J. 2009. Towards a better conceptual framework for innovation processes in agriculture and rural development: from linear models to systemic approaches. *Journal of Agricultural Education and Extension,* 15**,** 131-146.

KNOWLER, D. & BRADSHAW, B. 2007. Farmers' adoption of conservation agriculture: A review and synthesis of recent research. *Food policy,* 32**,** 25-48.

LONG, T. B., BLOK, V. & CONINX, I. 2016. Barriers to the adoption and diffusion of technological innovations for climate-smart agriculture in Europe: evidence from the Netherlands, France, Switzerland and Italy. *Journal of Cleaner Production,* 112**,** 9-21.

MILLS, J., GASKELL, P., INGRAM, J., DWYER, J., REED, M. & SHORT, C. 2016. Engaging farmers in environmental management through a better understanding of behaviour. *Agriculture and Human Values***,** 1-17.

PANNELL, D. J., MARSHALL, G. R., BARR, N., CURTIS, A., VANCLAY, F. & WILKINSON, R. 2006. Understanding and promoting adoption of conservation practices by rural landholders. *Animal Production Science,* 46**,** 1407-1424.

PROKOPY, L. S., FLORESS, K., KLOTTHOR-WEINKAUF, D. & BAUMGART-GETZ, A. 2008. Determinants of agricultural best management practice adoption: evidence from the literature. *Journal of Soil and Water Conservation,* 63**,** 300-311.

REDDY, S. & PAINULY, J. P. 2004. Diffusion of renewable energy technologies—barriers and stakeholders' perspectives. *Renewable Energy,* 29**,** 1431-1447.

ROGERS, E. 1995. Diffusion of Innovations fourth edition The Free Press. *New York*.

SEWELL, A., GRAY, D., BLAIR, H., KEMP, P., KENYON, P., MORRIS, S. & WOOD, B. 2014. Hatching new ideas about herb pastures: Learning together in a community of New Zealand farmers and agricultural scientists. *Agricultural Systems,* 125**,** 63-73.

SPIELMAN, D. J., EKBOIR, J. & DAVIS, K. 2009. The art and science of innovation systems inquiry: Applications to Sub-Saharan African agriculture. *Technology in Society,* 31**,** 399-405.

VANCLAY, F. M., RUSSELL, A. W. & KIMBER, J. 2013. Enhancing innovation in agriculture at the policy level: The potential contribution of Technology Assessment. *Land Use Policy,* 31**,** 406-411.

Further reading
Finland CS

A thesis titled *The effect of circulating nutrients of ash to the cost structure of distributed energy production* will be prepared during 2017 by one of the cooperators in Puutuhka -project (Mervi Matilainen, Apila Group Ltd.).