



PERENNIAL BIOMASS CROPS

PBC4GGR

GREENHOUSE GAS REMOVAL

Growing and upscaling the production of Miscanthus and SRC willow: understanding the barriers and enablers

INTERVIEW AND WORKSHOP ANALYSIS REPORT DECEMBER 2022



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Authors:

Julie Ingram, Jane Mills,

Honor Mackley-Ward, Fred

Dunwoodie Stirton

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1. Introduction

This report contributes to Work Package 4 (WP4) of the project Perennial Biomass Crops for Greenhouse Gas Removal (PBC4GGR). It addresses the high-level project objective: De-risk the future roll-out of GGR via perennial biomass crops (PBC) by establishing the conditions required for farmer uptake and wider social acceptance. Specifically, the WP4 objectives are:

- to understand from past and current examples a) what motivates and enables/ constrains farmers to grow PBC and b) the extent of social acceptance in the local community of such PBC and associated infrastructure
- to understand how different groups (farmers, local organisations, citizens) in selected catchments value ecosystem services provided by PBC

The research is conducted in two phases. Phase 1 aimed to collect the current grower and stakeholder experiences and identify enablers and barriers to growing Miscanthus and SRC willow. Drawing on experiences of existing growers, industry specialists and a range of interested stakeholders we collected and analysed qualitative data relevant to farm, industry and policy domains, using interviews and workshops. Analysis of this data allowed us to map out the enabling environment of biomass cropping (policy, institutions, economic, socio-economic context), identifying potential enablers and barriers to upscaling. This report presents Phase 1 analysis. Phase 2 builds and extends this analysis with stakeholder regional workshops focusing on opportunities for PBC co-benefits, as reported in this paper <https://doi.org/10.1016/j.erss.2025.103936>.

2. Methods

An analytical framework was developed based on a) a literature review of empirical research on barriers and enablers to bioenergy/biomass cropping in UK and Europe, b) key concepts relevant to this topic (Appendix Figs A1 and A2). This informed the interview design which sought to understand socio-cultural, economic and risk aspects of growers' decision-making, policy and industry supply chain contexts and social acceptability aspects (impacts on roads, landscape, pollution, rural economy). Specifically, it combined an innovation systems functions perspective (policy, institutional, network, market and technological dynamics) with behavioural aspects (attitudes, values, social norms and motivations) (Breukers et al., 2014)¹.

Interviews and workshops were conducted with existing Miscanthus and SRC willow growers and associated stakeholders.

A stakeholder analysis was first conducted drawing on the literature, other research projects, and discussions with projects partners and the advisory board. This identified the following categories:

- Power station/energy plants (also called end users)
- Land agents, agronomists, crop consultants, countryside stewardship facilitators
- Forestry sector representatives
- Specialist biomass consultants and contract organisers (called intermediaries here)
- Knowledge exchange (e.g. AHDB, Innovative Farmers)
- Upstream suppliers- nurseries, machinery

¹ Breukers, S., Hisschemöller, M., Cuppen, E. and Suurs, R., 2014. Analysing the past and exploring the future of sustainable biomass. Participatory stakeholder dialogue and technological innovation systems research. *Technological Forecasting and Social Change*, 81, pp.227-235.

- Researchers- variety breeders
- Growers (current, ex, potential) and their groups and networks
- Contractors (specialist planters and harvesters)
- Policy makers and decisions makers (local, regional, national- BEIS and Defra)
- Planning authorities
- Rural interest organisations (community groups, transition groups, parish councils)
- Environmental groups (e.g. WLTs, Facilitation Fund/ELMS T&T) and citizen organisations (e.g. RSPB)
- Academics

Following this a combination of purposeful sampling, steered by industry stakeholders, and snowballing, was used to identify and select participants.

Interviews

Semi-structured interviews (10 for *Miscanthus* and 10 for willow) were conducted with growers, supply chain actors and associated stakeholders. Based on the stakeholder analysis, interviewees were identified. The interview schedule was based on the analytical framework.

- *Miscanthus* – five growers representing four farms covered a range of farming systems (arable, mixed, livestock, hobby), sizes and tenure were interviewed. All had planted the crop in the early 2000s often with establishment grants and BICAL contracts and support (later replaced by Terravesta). The farms were located across England (Oxfordshire to N Yorkshire). Five stakeholders were interviewed, representatives from: agricultural banks, energy plants, intermediaries in the supply chain, Wildlife Trusts) (Table 1).
- *Willow* – seven growers and three stakeholders were interviewed. A range of farm types and farmers were presented: livestock, grass (ex-livestock), arable/horticulture enterprises with size ranging from 20->300ha. Willow planting dates were between 2001-2009. Contracts had been arranged through one intermediary with Iggesund (a paper mill in Cumbria which runs a biomass-fuelled power plant). Most farms were in the north. Stakeholders were representatives from: intermediaries in the supply chain, power plants, and Wildlife Trusts (Table 2).

Table 1 *Miscanthus* Interview participants

Participant number	Farming system	Farm size	Tenure	Area and age of <i>Miscanthus</i>
Grower				
G1	Extensive beef	400ha	owner	26 ha planted in 2007, previously set aside
G2 and 3	Lifestyle	10ha	owner	10ha planted in early 2000s with BICAL contract, now Terravesta
G4	Mixed	TBC	tenant	30ha planted in mid 2000s on wet winter pasture
G5	Arable	500ha	owner	20ha unproductive land planted in early 2000s with BICAL contract, now Terravesta
Stakeholder	Stakeholder type			
SH1	Bank			
SH2	Power plant			
SH3	Wildlife Trust			
SH4	Intermediary/promoter			

SH5	Power plant			
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Table 2: Willow interview participants

Participant number	Farming system	Farm size	Tenure	Area and age of willow
Grower				
G1	Mainly cereal	102ha	owner - land rented out	28ha planted on grassland prone to flooding. Iggesund contract
G2	Upland livestock	1200ha	owner - land rented out	26ha planted in 2016. Iggesund contract
G3	Livestock	160ha	owner - land rented out	22ha planted in 2015. Iggesund contract
G4	Livestock	99ha	mixed tenure	Planted in 2019. Iggesund contract
G5	Arable/Vegetables	4500ha	Owner (farm manager interviewed)	325ha first planted in 2001. Iggesund contract and on-farm boilers. Contractor as well
G6	Ex livestock, grassland	20ha	owner	15ha planted in 2015
G7	Ex livestock, grassland	65ha	owner (digger contractor)	30ha planted in 2019
Stakeholder	Stakeholder type			
SH1	Intermediary/promoter			
SH2	Wildlife Trust			
SH3	Power Plant			

In the analysis, themes were identified and coded using NVivo12, these included the themes from the literature used to design the interview schedule, as well as newly emerging ones. Whilst this is a small number to draw on, the in-depth qualitative nature of the interviews and the breadth of stakeholders' interests provided useful insights. Analysis was used to map out the barriers and enabling environment of PBC (policy, institutions, industry, economic, socio-economic context) and informed the design of workshops which followed.

Workshops

Two participatory workshops presented analysis from grower and stakeholder interviews and asked for validation and feedback and further views. Based on the stakeholder analysis, participants were identified as follows (see table 3).

- *Miscanthus*- thirteen participants attended representing a range of organisations
- *Willow*- nine participants attended representing a range of organisations. No farmers were able to attend on the day, however, the stakeholders who participated work closely with the farming community and were able to comment on farmer views.

Table 3 Workshop participants

Miscanthus
3 x Farmers (Miscanthus growers)
Farmer (non- Miscanthus grower)
Farmer / Business Consultant
2 x Supply chain intermediary
Defra Policy Advisor
Commercial Manager at Research Institute
2 x Biomass Researchers
Renewables Manager
Fuel Supply Chain Manager
Willow
Agronomist/breeder Rothamsted Research
National Farmers Union -policy representative
Policy maker- Natural England
Supply chain/willow contractor
3 x Consultants for energy crops
Agricultural College field trials representative
Biodiversity Manager for a large brick making company

A presentation of the interview analysis was given for the respective crop showing the barriers ‘map’ developed from the interview data analysis. This was used as a visual tool at the workshop to validate and extend the findings. Participants were asked to discuss, prioritise and add barriers, and to rank the top three barriers. They also proposed and discussed enablers.

Participants were also presented with different visualisations of the impact of growing Miscanthus and willow on the farmed landscape (still images and videos created from GIS software, and 3D virtual reality created with CEH’s E-Viewer). They provided feedback on the potential value for these in assessing farmer and societal acceptance of the crops. This exercise also prompted discussions about landscape impacts. A tour of the field demonstration and agronomy trial plots that followed gave participants a chance to ask questions from local and national experts.

3. Results

3.1. Growing Miscanthus and SRC willow: motivations and attitudes

3.1.1. *Motivations for growing*

Farmers

The main reason for growing the Miscanthus was the opportunity to provide a return on unproductive land. It is regarded as a low maintenance crop, with low time and labour demands, and attractive for those heading into retirement. All farmers also cited the existence of grants (at the time of planting) for growing Miscanthus and/or a fixed market price as part of the motivation. Alternative markets available for Miscanthus, e.g. horse bedding was also a motivating factor.

For willow, there was a broad spectrum of motivations. Seeking to diversify or leave the livestock sector due to current challenges was one motivation. Willow was described as an appealing low maintenance option to improve income, help diversify and increase farm resilience in the face of uncertainty, and reduce costly inputs of fertiliser and labour. A couple of farmers described how growing willow had freed up time for other responsibilities, whilst others explained that it is less physically demanding. The specific nature of willow's tolerance of wet or flood-prone land was a factor in the decision to grow it on wetter land, as was the ability to spread sewage sludge on it, and its perceived environmental benefits. Willow is also regarded as less permanent than trees.

Stakeholders

Recent uptake of Miscanthus crop has been lower than expected, particularly now that loans are available, and some stakeholders find this hard to understand, arguing that the crop compares well with the average combinable crop, even with higher costs for plant establishment, and makes financial sense when planted on unproductive land. The loss of the BPS was seen as a strong driver for farmers to rethink land use when planning the future direction of the business. For willow, stakeholders agreed diversification and spreading risk were motivations for growers, large estates or the more innovative farmer. They agreed that willow appeals to those farmers looking for a relatively secure and stable income stream.

3.1.2. *Attitudes and values*

Farmers

The reasons growers gave for planting Miscanthus crop were not environmental, although they had come to value the benefits to biodiversity and climate change mitigation once the crop was planted. At the time of planting, carbon capture was not a priority or a motivation for farmers. Growers considered the crop to be carbon neutral, and a better alternative than other biofuels which require more inputs. Some argued that this was a good reason why the government should bring back planting grants. Regarding whether it was compatible with their goals for farming, farmers noted that growing Miscanthus required a substantial change in the way of thinking. For some, the food versus fuel debate was salient, they justified producing fuel as it was an essential resource. In this way it was deemed an acceptable way to diversify incomes.

Willow growers' views were mixed about whether willow grown for energy was capturing carbon. While some recognised its carbon storage value, there was uncertainty from others and concerns that the transport emissions associated with the crop haulage might eliminate any benefit. Concerns around being able to make a profit overrode any sense of willow being misaligned with their traditional role or identity as a food producer.

Stakeholders

For Miscanthus, stakeholders' attitudes reflect their professional roles and sectors. Some agreed that

while the crop may benefit carbon, the most important factor for farmers was that it had to make sense economically. They were cautious about promoting the mitigation effects, arguing for a focus on other benefits. For the wildlife stakeholder, the concern was more about competition PBC represents for some unproductive but potentially biodiverse sites. This stakeholder acknowledged that *Miscanthus* might achieve both carbon capture, through locking up carbon in the soil organic matter, and biodiversity gains. They also saw the potential of the crop being an intermediate step even towards restoring impoverished arable soil and then continuing on a pathway towards a semi-natural habitat. However, they strongly argued that more information/evidence was needed, particularly about what happens to the soil after *Miscanthus* is removed.

For willow, the stakeholders' views on the value of the crop for capturing carbon and mitigating climate change were notably varied, and depended on haulage costs and progress with carbon capture and storage technology. Willow for local, small-scale, district heating biomass plants is regarded as the most sustainable option.

Workshop

In the *Miscanthus* workshop there was some disagreement around attitudes to land use, some stakeholders seeing a conflict between growing biomass and other priorities like food or biodiversity. Some voiced concerns that biomass crops may accentuate a perceived lack of government interest in producing food domestically. Others saw the food/fuel/biodiversity competition for land argument as misplaced and ultimately a communication issue, especially as *Miscanthus* is grown on non-productive land. This was described as a failure of the promotion of the whole bioeconomic/ environmental vision by one participant. However, they agreed that for the farmer, the decision to use the land for one purpose or another is also linked to the farm business economics and the mind set about income. Although it grows on non-productive land, it grows better on good land therefore growers will always be balancing yield against alternative land uses.

For willow, in line with the interview analysis, farmer 'mindset' was thought to be an important barrier to growing willow. These mindsets differ depending on many factors such as sector, geographical area, tradition and social norms, however the unfamiliarity of perennial cropping compared to familiar annual cropping cycles was considered a drawback. Long-term offtake contracts are also unfamiliar to most farmers although they may have become more common with AD. Another perception held by farmers is willow's negative impact on land values. The negative views and experiences expressed in the interviews with existing growers were felt to be historic by some workshop industry stakeholders, reflecting the limited information and support 20 years ago.

3.1.3. Identifying farm(er) types

Stakeholders

Stakeholder suggested that *Miscanthus* growers have typically been arable, however there has been interest from grassland areas, as in Wales, where some farmers are leaving livestock farming. Geographically, proximity to the power stations is important, due to the cost of haulage. Stakeholders found it hard to characterise a typical farmer, farm type or sector, but agreed the farmers were generally forward thinking, although motivations varied, for example, one dairy farmer put all of his farm down to *Miscanthus*, and then 'treated it as a pension'. In terms of marketing, many farmers are seen as eligible in that they often have parcels of non-productive land which is too wet or too dry or inefficient to manage, or a long way from the farm. Also, more recently, bigger landowners or more institutional and corporate entities that own land who want to do something environmental or have a fuel requirement, are a new cohort of potential growers.

Three categories of farmers likely to grow willow were described by one participant: older as part of a retirement plan, younger to release more time for family life, and diversifiers. Regarding farm type sector, whilst livestock farmers in the west may engage more due to uncertainty in the livestock sector, there is also interest in the eastern arable areas. Stakeholders suggested that large estates tend to grow willow often for biomass boilers, usually recommended by a consultant.

3.1.4. Advice and knowledge sources that affected the decision to grow

Farmers

Participants described organisations such as Terravesta (and historically BICAL) as providing knowledge and advice that affected their decision to grow Miscanthus. Several described extensive support packages put in place, including help with grant applications, advice, planting, accessing machinery, haulage and rolling 5-year index linked purchasing contracts. With the absence of other specialist knowledge or advisers available at the time of planting, some farmers felt they had to rely on information from this one source. There was not much sense of a network of farmers sharing knowledge or support. Nor was there any indication of local farmers being encouraged by their peers. Only one farmer mentioned that a neighbouring farmer had introduced him to Miscanthus.

Conversely, other farmers already growing willow were described as influential, while reading about willow in the farming press or on the internet was also important. Most growers also highlighted a single person working in biomass procurement who was described as supportive and helpful, although in some cases the grower's experience of growing willow had not matched the expectations.

3.1.5. Societal views about the crops in the landscape

Farmers

In general, the public had been curious about Miscanthus but farmers have not experienced any negative feedback. One farmer had received some complaints about the height of Miscanthus, but there is generally less objection than there is to maize. Miscanthus was described as aesthetically 'alien' in the landscape by one farmer, and all agreed that smaller patches are preferable. Similarly, for willow, participants generally perceived ambivalence, curiosity or enthusiasm about their willow in the wider local community. The benefits of shelter were appreciated by the community although there were some fears of blocking views.

Stakeholders

Most stakeholders favoured planting Miscanthus in the landscape to create a mosaic effect, and existing planting is in small parcels reflecting the scattered nature of non-productive land. However, they acknowledge that with scaling up, there may be issues in the community if large blocks are planted. For the wildlife stakeholder, creating a mosaic is important, and, as with any tree planting, they argue that Miscanthus should not be planted in the 'wrong place'. Stakeholders felt that complaints stemmed more from perceptions and are often down to a lack of knowledge about the crop and the different varieties planted. The level of resistance to growing willow can depend on the setting, for example there is more resistance in National Parks.

Workshop

Miscanthus is not regarded as problematic for the landscape and it is not necessary to gain any permissions to grow the crop. Only where sites are sensitive or very large in scale is it anticipated there might be issues with societal acceptability. Some participants (notably growers) were concerned about widespread negative public opinion on burning biomass crops for energy.

3.2. Experiences of growing Miscanthus and SRC willow

3.2.1. Farmer growing experiences

Farmers

There were mixed feelings about how easy or difficult it was to get Miscanthus established, with access to specialist machinery for planting, drying out rhizomes and wireworm cited as difficulties. The consensus was that it was very easy to care for once established, although there were some challenges around replanting patches where they will be out-shadowed by the surrounding crop. Reliance on contractors was an issue for most participants. One begrudged having to employ contractors with specialist machinery to harvest Miscanthus, particularly given that there are few available, and therefore may not be able to travel the distance required in the weather window. The hope was that as the technology matures, costs will come down.

Regarding fitting in with the farming system, most participants considered Miscanthus to fit well in their annual farming cycle and farm labour profile, with planting (late spring) and harvesting (late winter) falling in quieter times. They also described the crop as low maintenance, and ideal when they or their staff were beginning to retire. With respect to the impact on the business, farmers in the study were consistently happy, and would recommend it to other farmers, and consider planting more.

Generally, willow was also described as fitting in well with the farming system and fulfilled objectives such as lowering labour requirements, good yields and being financially better off. Some of the growers had experienced issues with the establishment of the willow due to browse damage, and *Phytophthora* disease was mentioned by one. Issues with harvesting had been experienced by some with flooding preventing access to land and some issues of regrowth post-harvest, although others like the flood and drought tolerance of the crop. None of the growers had experience of willow affecting their drains but concerns by non-growers remain prevalent.

3.2.2. Impact on the environment

Farmers

Most participants observed that Miscanthus led to improved soil health. Not disturbing or compacting the soil, and not using many agrichemical inputs were considered central in this, as well as the fact that rhizomes mat together to prevent erosion in wet conditions. One grower had monitored change and reported increased nutrient levels. Biodiversity was also widely perceived as having increased, with Miscanthus, providing shelter to birds and deer, although not necessarily food. Most growers reported an increase in insects which they attributed to reduced pesticide use.

Most willow growers also observed improved biodiversity, particularly birds and insects. They highlighted the fact that willow was very flood tolerant, and that it prevented soil erosion in extreme weather. However, some participants described having ploughed up permanent grassland to plant their willow, raising important questions around soil carbon and the impacts on biodiversity at different scales.

Stakeholders

Contrasting views were expressed by stakeholders, an advocate of willow argued that it is a haven for wildlife, while a wildlife NGO representative described a (unharvested) block as ecologically dead. Concerns were raised about growing these crops on non-productive land which is often relatively species rich. Also one person considered willow likely to be better for biodiversity than non-native Miscanthus.

3.3. Barriers to upscaling Miscanthus and SRC willow

For Miscanthus and willow the interviews and workshop discussions identified a combination of industry, policy, and farm-level barriers to upscaling.

3.3.1. Long-term commitment

Farmers

For Miscanthus, concerns around the long-term commitment when deciding to grow the crop were largely centred on uncertainty around a shift from annual crops (and a change in mind set). However, for some current growers, the long-term commitment was part of the appeal of the crop, providing a low-maintenance, long-term alternative to current use.

For willow, the long-term commitment required to grow and make a financial return was regarded as a moderate barrier. This was in part related to these considerations: for older farmers, the perceived negative impact of willow on land value over time; tenant farmers may not recoup the cost of investment within the length of their tenancy; the long commitment amplifies concerns around limited markets; and concerns around getting 'stuck with' the crop for various reasons, including anxieties around the difficulty of removing it.

Stakeholders

For Miscanthus, stakeholders agreed that farmers regard the long-term commitment as a barrier, especially with changing contexts and particularly the volatility (and, at the time of interviews, rising) of cereals prices and input costs. The risk of effectively 'writing that area of your farm off' for 15 years with Miscanthus was mentioned by one stakeholder.

For willow, stakeholders recognised this concern but suggested that on wet land in particular, the value of willow outweighed any other crop, and so there was a financial advantage. They identified a lack of knowledge about the impact of willow on land values, noting that land agents have been known to advise farmers who are selling their land to remove willow first to increase the land value. Interestingly, a comment was made that perspectives will differ for the two PCBs; farmers may identify willow as 'forestry' rather than 'farming' and more likely to perceive shifting to this to be non-reversible.

3.3.2. Establishment costs and cash flow

Farmers

The Miscanthus farmers interviewed had mostly received energy crop grants and these were unanimously described as essential to farmers' decisions to plant the crop, due to the high up-front costs. Establishment of Miscanthus is regarded as a bigger commitment both in time and finances compared to an annual crop. Cash flow difficulties of not getting a return during the first years compounds the already high initial investment, as well as having to trust the intermediary's financial figures. Some growers described improvements in machinery, techniques and breeds bringing these costs down.

For willow, similarly the upfront cost of planting and establishing willow was a concern although most interviewed had not borrowed to plant the willow but used their own savings. Cost of harvesting and a small pool of contractors with specialist equipment were raised as issues and this is complicated by the fact that different buyers require the willow in different forms (each requires specialised equipment). Whilst the industry remains small and the buyers few, the costs of contracting is thought to remain high, and buying equipment potentially prohibitive for those without a contract.

Growers in the interviews were asked to rank concerns/barriers that affected their decision to plant the PBCs. There were a range of rankings showing that this is often an individual decision, although establishment costs and long term commitments generally scored higher.

Stakeholders

Stakeholders agreed that cash flow was the key barrier to farmers planting Miscanthus, with £1500 per hectare costs and two or three years before farmers get any return. However, they argued that it is not the cost per se, but the cash flow (since there is no immediate annual return). Similarly, for willow, stakeholders agreed that the upfront cost of planting, combined with the lack of a return on the investment for 2-4 years can act as a significant barrier. Furthermore, they noted that where haulage costs are high this can reduce the contract price.

Workshop

Participants agreed that the loss of establishment grants which previously countered cash flow concerns was a significant barrier to growing PBCs.

3.3.3. Uncertainty about support grants and measures

Farmers

For Miscanthus, uncertainty surrounding future policy support measures was described as leading to hesitancy in all aspects of farm planning, and some current growers were delaying their decision to replant or expand their current crop, or extend their contracts. Farmers are awaiting confirmation about any support for biomass crops in terms of new planting grants, while also monitoring ELMS, tree planting grants and carbon markets for opportunities there. For willow, farmers also highlighted a lack of clarity around how the crop fits into existing stewardship agreements, with some describing current difficulties getting authorisation from the Rural Payments Agency and/or the Forestry Commission.

Stakeholders

Miscanthus stakeholders also highlighted the uncertainty underpinned by the current policy landscape. Carbon accounting was another potential future option mentioned although all agreed that the appropriate mechanisms for this are not yet established. They highlighted the direct competition between Miscanthus and other incentives and schemes, noting that in some cases land agents are advising land owners to take land back in-hand and plant conservation clover mixes which they consider will make more money. Similarly, for willow, stakeholder agreed that farmers are holding off planting currently due to uncertainty around what funding may emerge in the near future.

Workshop

Participants concurred about the ongoing uncertainty around the place of Miscanthus in future grants. The removal of the energy planting scheme grant has had a negative impact. Although specialists claim that currently the farm economics work for Miscanthus without the grant. Grants have been shown to offer confidence, giving the crop the legitimacy and security of government backing. Conversely, the current lack of a grant acts as a disincentive.

The participants recognised that there are also a number of competing schemes/opportunities, and weighing up and making sense of all the available information and options is difficult for farmers. Forestry and tree planting were identified as being in competition with Miscanthus and it was felt that adequate subsidies were needed to level the playing field. The absence of support for Miscanthus in ELMS was highlighted as a barrier and the crop was seen as being at a disadvantage to other opportunities under ELMS which fit in with standard annual farm rotation compared to Miscanthus, which requires a land commitment of 10-20 years. One concern was raised from a potential grower

around the possibility of getting 'locked in' to Miscanthus, as with permanent pasture, where after a certain amount of time farmers may not be able to remove the crop if soil carbon gains are found to be significant, or if Miscanthus was rescheduled as a permanent crop by RPA after 5 years, potentially making it ineligible for payments.

For willow there was a similar consensus that policy uncertainty on environmental schemes and specifically about whether they might support PBCs are impacting farmers' decisions. As with Miscanthus, participants agreed that rather than incorporating PBC into ELMS or tree planting support, there will more likely be competition between available schemes/grants and PBC. Participants highlighted the evidence of biodiversity benefits of willow. They acknowledged that the impact depended on the starting point, arguing that with a very intensive landscape of monoculture crops, growing PBC can increase the structural heterogeneity within that landscape and provide resources for species that would not normally be there, however, they agreed that the impact of cultivating and planting PBC in a nature rich landscape, with natural habitats would clearly be negative. They also agreed that there is uncertainty about willow's role in carbon storage as well as any potential income from carbon credits (and concern about some industry and marketing claims), and it was felt that robust evidence is needed. Flood mitigation was another recognised benefit discussed. The Forestry Commission was described as conservative and constrained by motivations to get trees rather than willow planted.

3.3.4. Lack of strategic policy direction on biomass crops

Farmers

Participants pointed to the absence of a long-term policy strategy, or vision, which are a fundamental barrier for upscaling PBCs. Historically, limited political commitment is considered to undermine grower confidence, particularly where they or their peers had experienced broken contracts. For some, the feeling was that Defra regards the crops as niche, and outside their influence and experience. Current growers consistently agreed that Miscanthus and willow made sense as biofuel crops in the current climate, but that this enthusiasm was not matched by policymakers.

Stakeholders

There was also a consensus amongst the stakeholders for both crops that there is no long-term strategic direction for biomass crops from government departments and that as a result the industry is 'doing it for itself'.

Workshop

In line with farmer and stakeholder views, participants agreed that for both crops, absence of a strategic policy or direction underpinned by a lack of coherence between BEIS and Defra policies was an overarching barrier. This is compounded by poor communication of policy (e.g. an out of date Biomass Strategy) to stakeholders and growers. This lack of clarity leads to a sense of uncertainty around strategic policy direction with respect to food, biomass, or biodiversity (which are perceived to be directly competing for space), which in turn leads to some Industry hesitancy and undermines confidence in PBCs amongst growers. There is frustration that despite lobbying, Defra has not taken the opportunity to promote biomass crops as a way for farmers to become carbon neutral. Lack of direction with respect to land use overall was highlighted, particularly with domestic food security emerging as an issue at the time of the workshop (when impacts of the war in Ukraine were first being experienced). For some ecologically minded stakeholders, however, concerns were raised around government policy supporting biomass crops to the detriment of biodiversity and the lack of evidence about the long-term biodiversity impacts of growing Miscanthus at the field scale.

3.3.5. Risks and economic viability assessment

Farmers

For Miscanthus, figures (yields and finances) provided by BICAL (previously) and Terravesta were cited as important for farmers when assessing the economic viability of the crop. The fixed price in the contract allowed them to budget and work out its profitability for an anticipated yield compared to other crops. Linked to the Retail Price Index, secure contracts were largely seen as reducing risks, but also as excluding farmers from potentially lucrative markets. Lack of competition in the sector and the risk inherent in this market monopoly were raised as issues, although, farmers recognised the organisations had 'their interests at heart'.

With the loss of BPS, willow was judged by growers to be more economically viable than livestock farming, as it required less labour and fewer costly inputs, although cost-benefit analysis is often based on rough figures. Most participants had a 20-35 year contract with a buyer, which covered the costs of harvesting with specialist machinery. This significantly reduced the risks, and contracts were considered essential especially where there were few larger buyers; those without such contracts were left in a more precarious position. Inflation indexed contracts gave farmers security, but some voiced concerns that being locked into these, potentially meant they may not receive the benefits of higher prices.

3.3.6. Confidence in market and demand

Farmers

The risk of termination of contracts was not a concern at the time of planting for any of the Miscanthus growers interviewed, although some had experienced the shock of Drax terminating their contracts shortly after their crop had become established. This risk has been mitigated to some extent by more local power plants being built and alternative markets, such as horse bedding, becoming available. For willow, while some had significant concerns around possible plant shut-down, and the strength of the market, others were reassured by having a contract with a business they perceived as well-established. Growers did, however, feel they were at the mercy of their buyers and their timetables and the different specifications and complications of different willow markets.

Stakeholders

For Miscanthus, stakeholders strongly agree that farmers are risk averse and need some assurance about the markets, often perceived to be insecure. Distance from market also presents a barrier for many farmers in terms of haulage costs and general awareness, but new markets may help to overcome this. For willow, stakeholders agreed that some delays in harvest (and payment for it) could occur due to temporary power plant shutdown, and extended unfavourable weather. Competition from Scandinavia and the abundance of wood from storm damage and ash die back also can act to reduce the demand. It was acknowledged that there is some hesitancy around contracts in segments of the willow growing community, due to past experiences and the difficulties of finding alternative markets for growers if power station markets stopped.

Workshop

For willow, some participants made a clear link between limited policy support, confidence in the industry and slow growth in the market. It was felt that the government has not done very much to help create a market, that markets had been left to emerge by themselves. Some stakeholders in the industry, however, contradicted this view, observing that there is plenty of end markets now and they were confident that the market will grow. Poor farmer confidence in markets described in the interviews was ascribed to a legacy of times when markets were not so secure, however, they acknowledged that there are peaks and troughs in supply and demand.

3.3.7. Industry capacity

Workshop

Most workshop participants considered upscaling Miscanthus to be limited by industry hesitancy or lack of capacity, with this outweighing (and sometimes fuelling) poor farmer confidence. The participants recognised that without an established industry (and mature market) farmers would be hesitant to grow the crop, yet without a critical mass of growers in an area, industry will not be attracted to increase capacity. For the participants, these issues were directly related to a lack of strategic government policy in two key ways. Firstly, by causing a wider lack of understanding or vision of the diverse uses of Miscanthus, beyond fuel. Secondly, absence of policy around the development and siting of small-medium sized (40MW) power stations so that they can be located in key, accessible locations.

Compared to Miscanthus, willow is described as a slow growing industry with a few supply chain intermediaries, and less promotional activity overall compared to the relatively harder sell approach of the main Miscanthus promoter. Furthermore, Miscanthus is considered to be an easier crop to market to arable farmers as it looks more like an arable crop and quite conventional agricultural equipment can be used to harvest it. As with Miscanthus, the point was made that capacity would need to grow throughout the willow supply chain in line with any increasing demand or policy incentives that emerged. Being prepared for any new targets or market stimulus was considered essential and positive signals are needed. However, the risk of inexperienced opportunists entering the supply chain in response to any incentives was highlighted. Regarding the industry capacity to lobby governments, one participant noted that it was more complicated than simply increasing lobbying since policy is made in departments that have 'rotating doors'.

3.3.8. Uncertainty about the agronomy

Farmers

Agronomic skills required for growing Miscanthus were not regarded as a barrier to planting, and largely alleviated by organisations supporting the growers (like BICAL in the past and Terravesta now), and knowing other growers nearby. Overall it was considered by growers to be a very low-maintenance crop, with little attention needed beyond weed control during the establishment phase. For willow, however, growers had some establishment concerns, and some lack of knowledge about dealing with rabbit/deer pests and how different varieties are suited to different conditions. They agreed that evidence about the impact on drains is needed and procedures for removing willow clarified.

Stakeholders

Stakeholders agreed that agronomic issues did not appear to be a particular issue or barrier for farmers when growing Miscanthus, describing it as similar to other crops. For willow, they suggested that, although there are competent specialist advisers to support growers, there is a lack of knowledge and understanding amongst regular farm advisers and agronomists.

Workshop

In the Miscanthus workshop, perceived issues with agronomy were highlighted as a more prominent barrier than in the interviews. Potential growers were described also as having 'closed minds' to growing a new crop. It was felt that a lack of information or support for Miscanthus is a particular barrier for farmers newly growing the crop, especially when there are no local growers. Participants also highlighted a lack of understanding of what land is most suitable for growing Miscanthus, and how to successfully remove it if it does not go well. Access to agricultural labour, problematic for several years now, was highlighted as an issue, as particular phases in the crop life cycle are seen as labour intensive, although this comment contradicts growers' experiences. As growing Miscanthus is

a long-term venture, the unknown impacts of climate change on the *Miscanthus* growth cycle or emerging pests were also raised as possible issues of concern.

For willow, participants also highlighted a lack of understanding of what land is most suitable for growing willow. Topography and a short harvest window in wet areas were considered to limit growth. They agreed that some perceptions (and misconceptions) about growing willow are enduring, such as the impact on drains.

3.3.9. Awareness and access to information and advice

Workshop

For willow, the lack of independent, best practice advice for growers was flagged up as a barrier by a number of participants. Whilst it was acknowledged that there were knowledgeable experts in the industry, it was felt that there may be scope for a 'level of government' to advise people on standards and offer impartial advice like best practice guides. Knowledge and technical expertise were seen to exist in pockets and not within reach of everyone around the country. For those in the supply chain, they see the need for farmer education and advice, but emphasise the importance of building trust with their clients as well.

It was also noted that farmers get advice from other influential people on farm. An agronomist, for example, who gets commission on inputs sales or clover mixes, would not be incentivised to advise planting PBC. Land agents were also described as conservative and one of the reasons that the PBC have been slow to upscale. Furthermore, one participant suggested that the message is not reaching farmers about the scale of the GGR challenge. Some participants also referred to negative narratives, for example, from environmental NGOs, that might influence some grower decisions notably the campaign that the RSPB backed, called 'dirtier than coal'.

3.3.10. Land tenure

Farmers

For *Miscanthus*, land tenure affects the perceived feasibility of growing the crop. The high initial outlay and delayed financial return was described as hard to justify, or secure loans for, when growing on rented land. Tenants described apprehension about what the landlord would think of this long-term, unconventional crop, and sometimes intermediaries are involved in convincing them. Owning the land outright and having available capital to use in establishment were described as definite advantages.

Workshop

Land tenure was also raised as a potentially significant barrier at the farmer level to upscaling *Miscanthus*. Owner-occupier farmers with 'the control to make decisions', were considered ideally placed for growing *Miscanthus*. Tenant farmers are restricted in what they can do with their land and often the landlord is not supportive of perennial crops. Farm business tenancies are usually less restrictive, but typically at 3 years in length, too short to establish and get a return on *Miscanthus*. Arrangements where power stations rent land or enter into joint ventures with farmers to grow *Miscanthus* are perceived risky and complicated, potentially unfavourably impacting farmers' trading and tax status. There is also the question of whether *Miscanthus* qualifies as a crop, and the impact of this on land inheritance tax status may be off-putting, particularly for older farmers.

For willow, participants regarded tenure as less of a problem, as some large estates/landowners often have biomass boilers and therefore encourage tenants to grow biomass for these boilers. From the landlord's point of view, a mismatch of tenancy and length of the willow life was raised as an issue, in case the tenant left.

3.3.11. Societal level barriers

Workshop

Landscape impact of these crops was not considered a particular issue. Miscanthus is often regarded as another crop (looking like maize) and attracts few comments from the community, especially when grown in small blocks. Regarding the size of planting blocks, most are limited in size (since farmers do not want to risk large tracts of good quality land) according to participants, with farmers typically planting 30 hectares. However, there have been concern voiced about the impact of willow in National Parks and protected landscapes, although some stakeholders argue these concerns are misplaced/ due to a lack of understanding.

3.4. Enablers to upscaling Miscanthus and SRC willow

3.4.1. Provide clarity on future grants and measures

Farmers and stakeholders

There was consensus amongst both farmers and stakeholders that more clarity on all support payments (planting grants, possible inclusion in ELMS) is needed so that farmers can make well informed decisions. It was argued that PBCs have got to be more obviously, and actively supported and that the government needs to develop a policy framework that makes them economically attractive to early adopters.

Workshop

Participants also consistently highlighted the need for clarity on grants and scheme funding, and for these to be developed and co-ordinated across Defra and BEIS. They considered that resolving the ongoing uncertainty around ELMS, and providing clarity about the status of PBC as semi-permanent biomass crops as important to upscaling. In addition, addressing the (perceived) complexity and time-consuming nature of grant and scheme application was highlighted. Currently these are seen as only accessible for larger farmers who have specialist advisers; or for land agents on larger estates. They anticipate that this situation will continue under ELMS and needs to be rectified to enable all farmers to access this support.

Clarity about the status of willow as a semi-permanent commercial crop with regard to its potential for ELMS support was also identified as important. Suggestions were made for incorporating willow options into agreements (forestry or biodiversity schemes) building on its biodiversity potential. For example, they suggested that willow needs to be on the menu list as an agroforestry, or buffer strip option, or that flower mixes should be allowed on willow headlands. Opportunities for complementary and synergistic approaches to incorporate PBC with biodiversity schemes were regarded as the most promising to counter competition for land. This would require rethinking of willow as an integrated part of a dynamic set of interacting habitats, rather than as an isolated plantation block. They agreed that discussion between the supply chain, farmers and Natural England should be encouraged to allow willow to be grown in the right places and at the right scale, and to speed up permissions. All agreed that robust evidence to demonstrate biodiversity and carbon storage benefits would enable and incentivise growers. Speeding up the permissions process from Forestry Commission and /or the Rural Payments Agency (due to issues with existing agri-environment schemes) may enable more farmers to grow it.

3.4.2. Provide financial support

Farmers

The major factor in enabling more farmers to grow Miscanthus was consistently identified as reinstating adequate grants to cover planting costs and to reduce the cash flow issues during the establishment phase. Different funding streams were raised as potential enablers of growing willow with possible support routes including: carbon markets (with a focus on opening these to smaller

producers), planting grants, or interest free loans to help with establishment. Participants described needing more support from planting through to harvesting, in the context of the immature market.

Stakeholders

Stakeholders agreed that support to bring down the cost of establishment was important. There was general agreement that the establishment grant worked very well before and it would also help to 'make people think differently'. A newly established agricultural bank, a specialist in agriculture and in Miscanthus, working with Terravesta, offers short-term working capital and long-term loans and as such offers to 'de-risk the growing of Miscanthus'. Some considered this is an area where private enterprise is better than government, and that there is no shortage of innovators, entrepreneurs, nor people to make and take risks. These are offering options for diversification after Brexit and mitigation to climate change, for example it was suggested that carbon markets could possibly help to pay for the planting costs. However, some policy signalling within the sector to back Miscanthus is needed for early adopters, according to some stakeholders. One participant pointed out that while the main Miscanthus promoter offered financial support with loans and advice for farmers, there is not an equivalent organisation for potential willow growers.

Workshop

Participants concurred that financial support to cover establishment costs and cash flow issues through planting grants would act as an immediate enabler for both crops. This would also provide reassurance to farmers, and shift the mindset, demonstrating that the crop is valued and supported by policy makers.

3.4.3. Develop a policy strategy

Farmers and Stakeholders

As well as some immediate clarity about grants and schemes, a long-term strategy for biomass crops is required to give confidence to the industry and to farmers, according to most participants. Stakeholders agreed that stability in policy was vital for farmers and growers. In the same way that businesses are looking ahead with respect to how timber and willow will be perceived in the longer term, they argued that government policy needs to be equally strategic.

Workshop

Participants described the reassurance, depth of support and validity that a clear policy on biomass would lend the Miscanthus crop and the industry surrounding it, as an important enabler. A coherent strategy, requiring joined-up thinking between key industry organisations and government departments (Defra and BEIS) is regarded as necessary for this. Participants argued that the policy would need to address the following key elements:

- Comprehensive evidence and accounting of the perceived biodiversity and climate benefits of Miscanthus
- Support (especially in planning regulations) for the development of new power stations to stimulate local markets

Participants at the willow workshop concurred that a coherent and strategic policy is important to supporting biomass, above and beyond any accompanying grants, for the reassurance that it offers. As for Miscanthus, participants agreed that a government strategy for willow with coherence between Defra and BEIS was needed to provide a long-term vision, and to signal to the industry that there is support. This could include government backing for both the large industrial scale power plants and the smaller biomass plants for biomass grown locally. As part of this, participants also argued that the policy would need to address the perceived conflict with domestic food production since this is emerging as a key narrative against growing biomass crops. In this respect, the need for a land use framework to help balance targets for food, fuel, net zero and biodiversity was identified. They also

argued that, in line with raising awareness, evidence, and impartial advice, the government should have a role in commissioning and updating research and communicating evidence on all PBC benefit claims: carbon, biodiversity, flood mitigation.

3.4.4. Increase confidence in markets

Stakeholders

Although planting grants are important, farmers need some assurance about a secure market. There is reportedly a lot of interest in Miscanthus, however a critical mass of growers is needed (incentivised by establishment grants). Continued market development with alternatives to power generation are also needed, to show the crop's versatility.

Workshop

Developing alternative markets for willow and raising awareness about these was seen to be an important enabler for upscaling. Biomass boilers at appropriate scales could be promoted as a green option for a number of energy intensive industries. Opportunities for adding value, and finding other (non-energy) markets were discussed, some of these other uses might operate on an annual cycle so remove the cash flow issues and the uncertainty about being able to sell the crop in the future. Diversifying the markets for farmers would help build their resilience.

3.4.5. Build industry capacity

Stakeholders

There were some contradictory comments about power station demand and straw availability (where straw can't meet demand this creates a need for Miscanthus). It was, however, agreed that weather negatively impacts on cereal harvests and this has created volatility in straw supply, giving an opportunity for PBCs. Another area to consider is improvement in product quality, an issue currently experienced for straw. This would require more communication between the end user and the farmer, and more strategic thinking.

In terms of lobbying power, the industry community has been trying to build a bioenergy crop alliance as they understand that a collective enterprise can be more powerful. The industry has got some advocates and support: NFU and Drax have been working together to present the PBC case, and the recent CCC report targets are seen as promising. Now is regarded as the time for strong lobbying.

In terms of skills capacity, some thought skills will develop in parallel with the market and that now they are proportionately fine. However, it was also considered that if the market increases dramatically, the skills base might struggle to keep up and there is a need to ensure stock and skills are in place, ready for upscaling to happen. Progressing technical developments was also considered important including, developing more reliable rhizome material for planting and high yielding varieties. This is one area it was felt the government could support. There was also hope that as the technology matures and varieties improve, planting costs will come down.

Workshop

Participants noted that capacity was directly linked to industry confidence. Stakeholders described a 'chicken or egg' situation, where farmers are reluctant to grow Miscanthus without secure local markets for it, but industry are unlikely to establish plants without a critical concentration of growers in the area, suggesting that a policy nudge would break this inertia.

Building industry capacity for willow was considered to need government support. They need to improve willow cost-effectiveness through current efforts to develop new machinery, also develop and improve the burning abilities of willow with respect to different types of boiler. The slow growing

nature of the willow industry in particular was thought to require stimulus and confidence building at every level.

3.4.6. Raise awareness and build knowledge

Farmers

Awareness raising between farmers in the local community was perceived as a potential enabler for Miscanthus. Conversations with other growers were regarded as an important way to exchange advice on growing, and assess crop's suitability to the field conditions, and importantly to verify the figures given by intermediaries on predicted yield and financial returns. Several growers suggested that there was a lack of independent advice, and that better knowledge was needed in the place of 'hearsay' on willow. Improved clarity and knowledge dissemination on incentives, permissions and agronomy may therefore be key enablers.

Stakeholders

Some stakeholders observed that there is good knowledge and expertise across the Miscanthus industry already, and a number of consultants and firms capable of giving advice, which is considered preferable to the government giving advice. This also extends to the new agricultural bank as well which is a specialist. There is thought to be interest in the crop and a good response to recent publicity.

However, other stakeholders pointed to poor advice that had been provided to growers in the past both for willow and boilers resulting in unharvested willow. Although there are sufficiently competent advisers who can guide potential growers through the agronomy of willow, some suggested that availability of advisers and access to technical knowledge may in fact be limited. Perceived lack of awareness amongst farmers about the crop and market opportunities was highlighted, but also amongst the land agents they get their advice from. Stakeholders highlighted the direct competition between willow and other incentives and schemes, noting that in some cases land agents are advising land owners to take land back in-hand. They identified the need for a platform or network aimed at farmers and advisers to raise awareness on the potential benefits to them of growing willow, for example, in the restoration of depleted arable farmland.

Workshop

Participants agreed that better access to information and guidance on the value of the Miscanthus, its uses and agronomy was considered important, alongside support for adjusting to the long-term commitment of the crop. Better information on how the crop or potential pests might respond to climate change was also highlighted as important in the context of it being a long-term commitment. Including biomass agronomy in agricultural colleges curricula, and training farm advisers were seen to be fundamental to addressing the poor agronomy and awareness. Working through the advisory community, including agronomists, water boards and Defra, would be important to improving farmer awareness of Miscanthus. Participants regarded Miscanthus as easier to promote than trees and willow, as they see it as reversible. Its value in resting the land to improve the soil for extended periods (around 10 years) before returning it to cropping (as experienced by current growers) could be better communicated.

3.4.7. Increase access to markets and contracts

Farmer and Stakeholders

For several growers, having a secure contract and a guaranteed market for their willow with a business they perceived as well-established was a key enabler. There was a suggestion for fostering a network of small(er)-scale biomass power plants powering district-scale heating, as well as feeding into the grid. This was considered preferable to developing more larger-scale plants and increasing the carbon footprint of biomass willow, and decreasing its profitability for farmers, through extended haulage.

3.4.8. Societal- tell positive stories

Workshops

Opinions on the wider societal acceptance of PBCs were mixed. Some considered the environmental agenda having reached the political mainstream, and renewed concerns about energy prices, would potentially enhance public support of the crop. However, others described strong resistance to biofuels and the burning of crops as still having an 'image' challenge. Raising awareness and creating a positive image were recognised as enablers, whether this was more generally by addressing emerging concerns about domestic food security, negative media headlines, or telling positive stories in the farming community.

3.5. Mapping barriers and enablers

The barriers and enablers were mapped iteratively amongst the research team and participants (Figs 1-4). The maps were used as visual tools at the workshops to validate and extend the findings. These depict the main themes that emerged at: the farm level (green), the government and policy level (yellow), the industry level; (blue) and societal level (pink). The purple numbers on the barrier maps are the cumulative ranking scores (each participant ranked the top 3). The faint yellow boxes were added in an expert project advisory board discussion. The cross-cutting themes shown in Fig A1: social, policy, technical, economic are relevant to all barriers and enablers shown here.

The farm level (green) barriers are interconnected with many barriers working together: farmers' socio-cultural factors (attitudes, values, perceptions, mind-sets), the perceived policy uncertainty and lack of support, together with the need for assurance and confidence in the market; as well as the economics, capacity, risk and knowledge associated with a new perennial crop.

Policy (yellow) barriers included the absence of both a cohesive policy framework for supporting and incentivising farmers (no establishment grants or provision in ELMS), and a long-term strategic direction, both linked to farmers' perceived policy uncertainty and industry confidence.

Industry barriers included limited capacity to collectively lobby and influence government, together with a small number of intermediaries (less developed in the case of willow), some technical limitations which can increase costs (varieties and machinery), as well as some limitations in advice and support outside of the immediate supply chain. These are indicative of an immature market and linked to a perceived lack of direction from government, and reinforce confidence issues at farm level.

Societal acceptance (pink), gauged by comments about potential landscape impacts, was not seen as a significant barrier currently, although a few concerns were expressed about the willow blocking views. There are potentially wider societal issues about competing land use (competition for food and biodiverse land), carbon storage and claims about the crops being carbon neutral or negative.

A similar enablers map was generated for each crop in the workshops with participants. They capture the discussions set out in the previous sections highlighting the importance of building confidence and capacity in the industry through: policy support, lobbying (through collective organising or through existing representative groups), advice and support on crop agronomy, as well as raising awareness.

4. Conclusion

In summary 20 interviews were undertaken with Miscanthus and SRC willow existing growers and selected stakeholders. Analysis of these was validated and extended in the participatory workshops that followed. Results shows a concurrence of views between growers and stakeholders with respect to the main barriers and enablers, however, some differences between industry stakeholders, and between industry and NGO stakeholders, were noted. The main barriers are in line with other observations and current commentaries by industry specialists and researchers.

For Miscanthus, whilst the interviews prioritised barriers of long-term commitment and cash flow/high establishment costs, the workshop discussions centred more on policy, specifically a lack of clarity or strategic direction, and ambiguity about the place of Miscanthus in current and future funding. The impacts of government support (or its absence) were relevant in most barriers, including industry capacity. However, other core issues were raised in the workshop, including perceptions held by many farmers that the agronomy was difficult, challenges for tenant farmers, and the business tax implications of using land for perennial cropping.

In the case of willow, a lack of clarity or strategic direction for PBC was also identified as a central policy point and the overriding barrier. However, conservative mindsets and poor awareness amongst the farming and wider community about the market opportunities, agronomy and the potential benefits, were also raised, as were establishment costs and the need for more impartial advice and evidence. Perceptions of competing land use demands especially for food were also raised. There was general agreement with the interview analysis about the main barriers and enablers to upscaling willow production, although it was noted that some of growers' past experiences did not necessarily reflect cotemporary conditions.

Based on this analysis, societal acceptance has not been a particular issue with respect to landscape impacts, although other environmental and land use concerns were raised. The interviews can only be illustrative of experiences and viewpoints of current growers and associated stakeholders, however they were validated and extended in the workshops. This analysis provides the basis for more extensive (working with non-growers) examination of how to upscale PBC in Phase 2 of the project.

Fig 1 Map of Miscanthus barriers

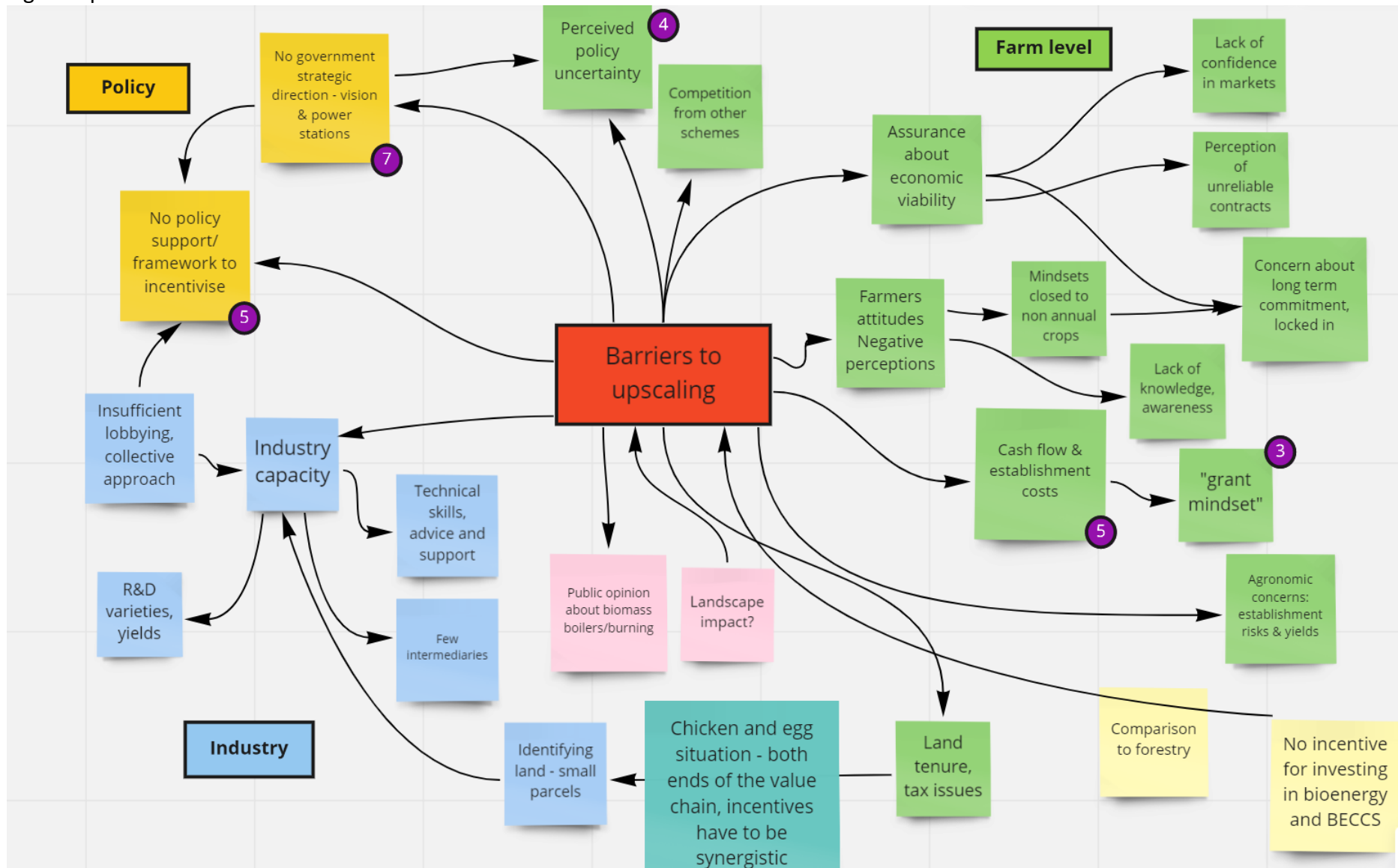


Fig 2 Map of Miscanthus enablers

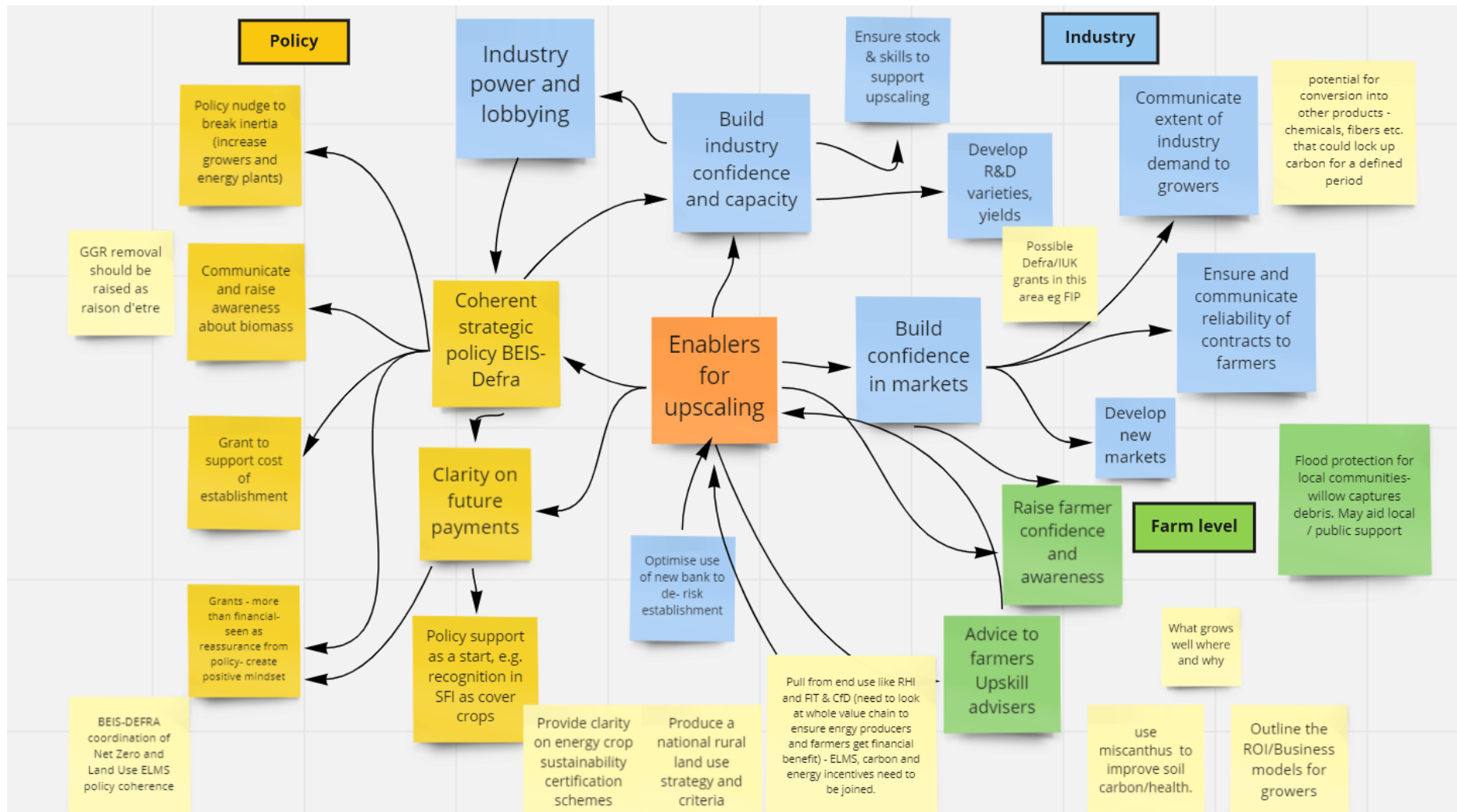


Fig 3 Map of willow barriers

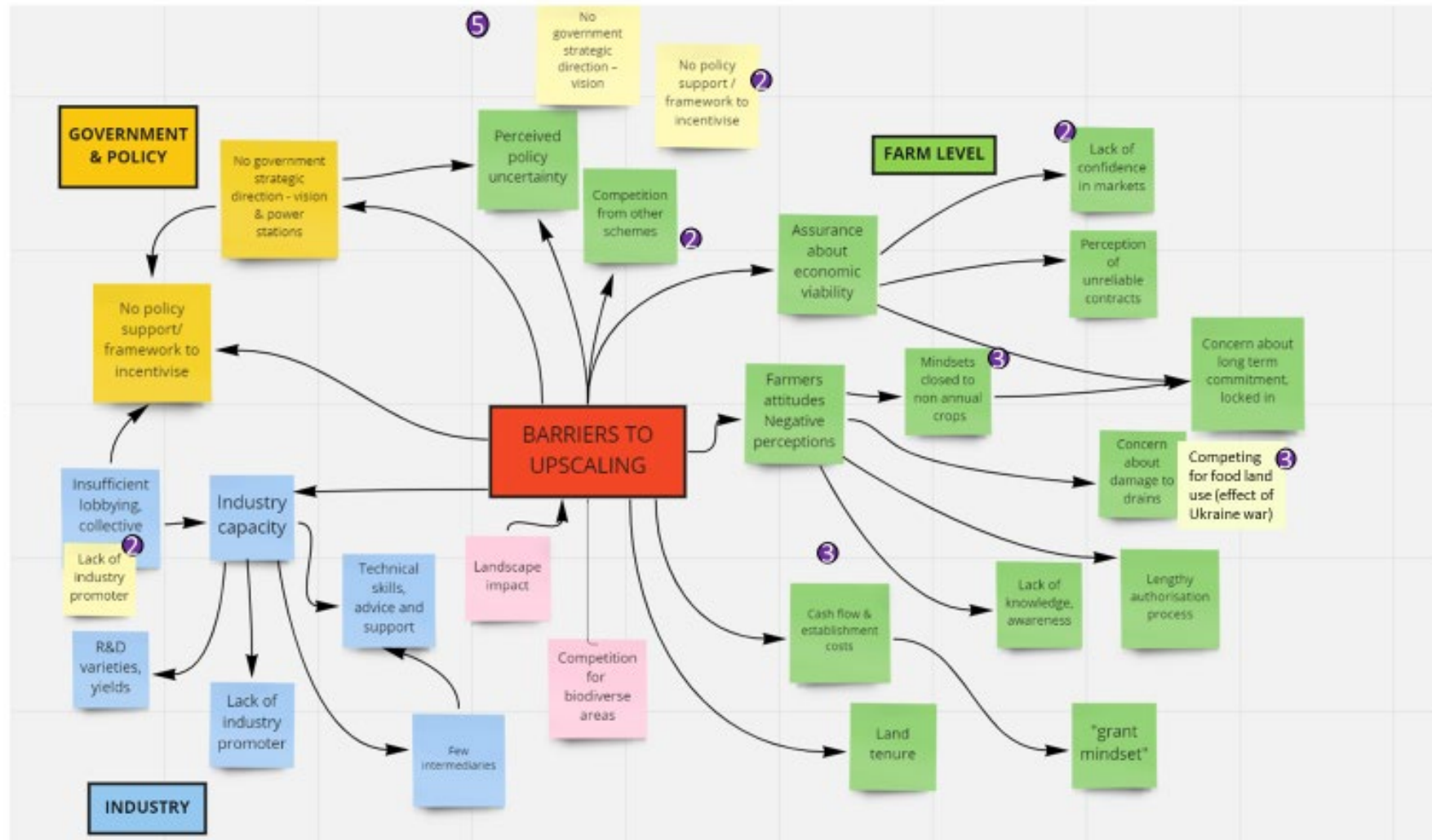
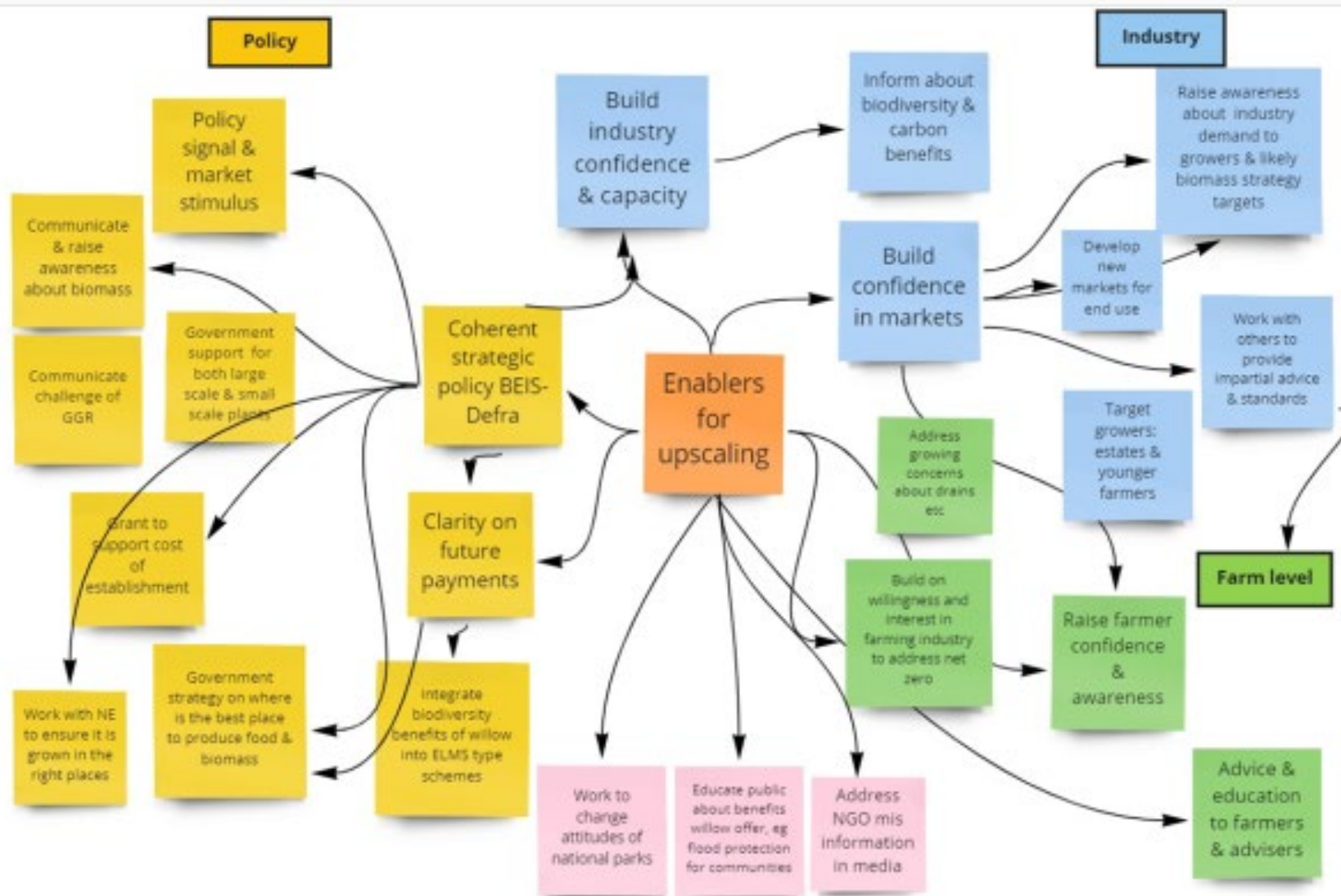


Fig 4 Map of willow enablers



APPENDIX

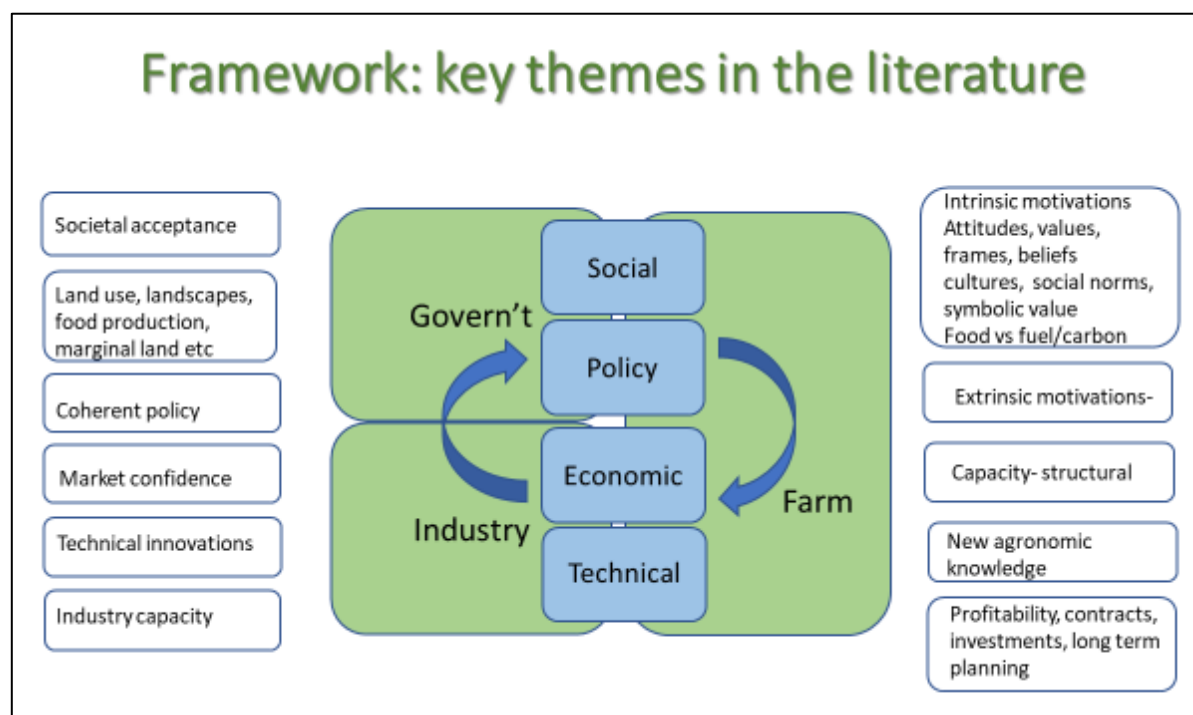


Fig A1 Key themes in the literature

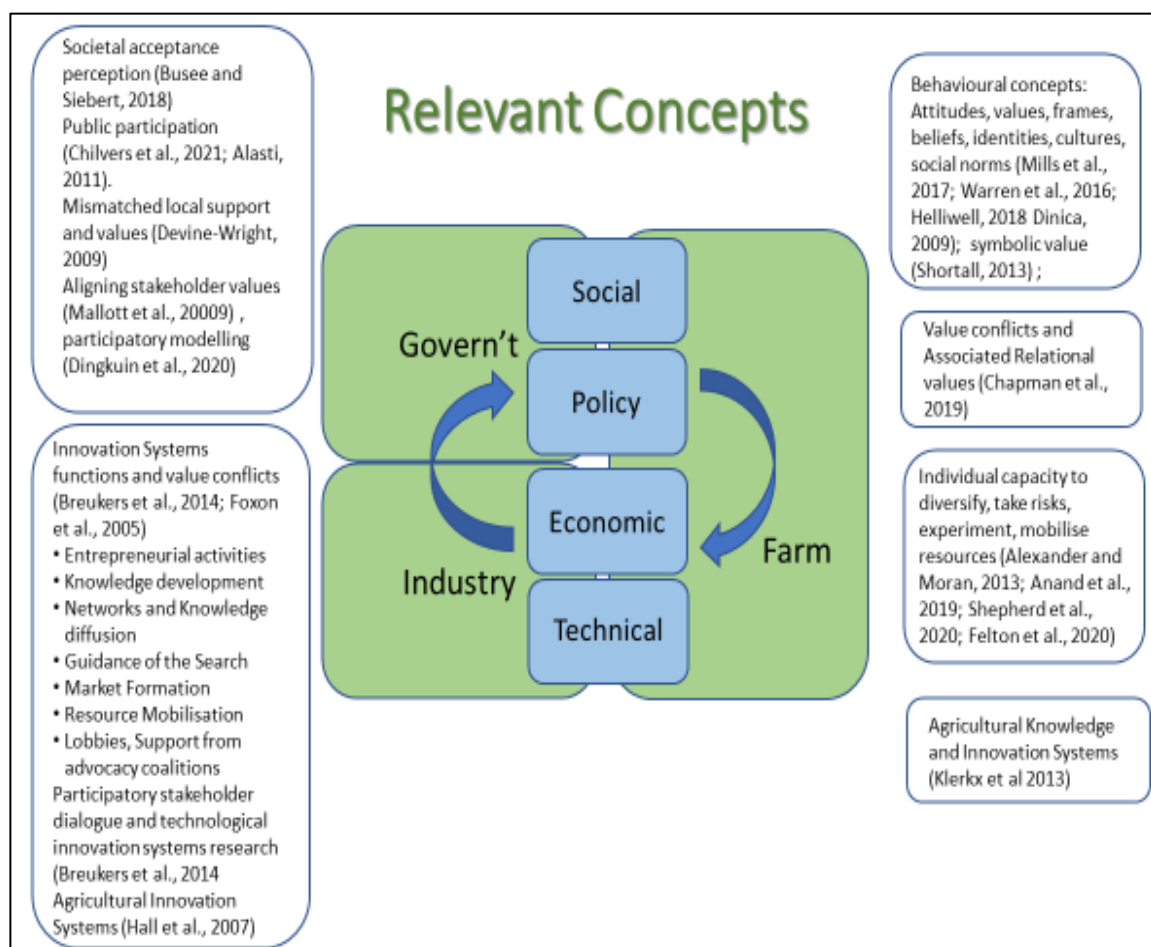


Fig A2 Key relevant concepts

