

Influencing behaviour for resilient treescapes: Rapid Evidence Assessment

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Influencing behaviour for resilient treescapes: Rapid Evidence Assessment

1. Introduction

1.1. Objectives

The purpose of this Rapid Evidence Assessment (REA) is to provide a summary of the available evidence and what it tells us about the uptake of grants and other support measures and how this influences land manager behaviours. The specific interest is to uncover more about how these relate to the response and management of tree pests and diseases. The Government Social Research (GSR) Guidelines for Rapid Evidence Assessment¹, suggests that a literature and evidence search needs to be focused answering explicit questions. Those guiding this piece of work were:

- 1 Do policy tools (e.g. grants) influence land manager responses to tree pests and diseases (P&D)?
- 2 Do policy tools (e.g. grants) influence land manager decision making for management, woodland creation or restocking?
- 3 Do policy tools (e.g. grants) influence land manager decision making for more diverse planting?
- 4 Do landscape scale partnerships influence land manager decision making?
- 5 Do landscape scale networks influence land manager decision making around more diverse planting, uptake novel/resilient species, or responding to tree P&D?

1.2. Method

The published research literature on policy measures, decision making, and behaviour change across a range of land managers (i.e. farmers, foresters, other land management stakeholders) is substantial. These topics have been a focus of economic and social research for many years. There is also a large but difficult to access pool of project and programme-based documentation, including evaluations and other consultancy reports,

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<http://webarchive.nationalarchives.gov.uk/20140402164155/http://www.civilservice.gov.uk/networks/gsr/resources-and-guidance/rapid-evidence-assessment>

looking at the impacts and achievements of particular policy instruments. The search parameters were narrowed down to focus the evidence assessment on:

- Stakeholders of interest – land managers with an interest in trees and forestry in rural and urban areas
- The domain of interest – decision making about actions that support tree health
- Empirical work looking at decision making AND actual action (i.e. behaviour)
- Work with a clear link to specific policy approaches and tools
- Work with a clear link to social learning and action: networks, partnerships.

The SPICE framework was used to organise the key words for the evidence search and assessment as shown in Table 1. The evidence search was confined to peer reviewed literature available through Science Direct, Scopus and Web of Science, and easily available grey literature available via Research Gate and Google scholar.

A total of 25 days staff time was spent on the REA during September-November 2018.

Table 1. Evidence review key words using SPICE framework

Setting	Population /Perspective	Interest	Comparison	Evaluation (measure)
forest* (i.e. to cover forest, forests, forestry)	farm* (to cover farmer, farmland, farm, farming)	policy OR policy measure	Pest*	management
wood* (i.e. to cover wood, woods, woodland)	owner OR landowner	incentive OR subsidy OR grant	Disease*	fell*
silvicultur* (to cover silviculture, silvicultural)	manager	regulation	invasive species	planting OR creation OR restocking
forest restoration	business	cost-share	beetle	species choice
tree*	estate	assistance OR support	forest disturbance	regeneration
	urban	decision making		
	network* OR stakeholder network	behaviour		
	partnerships	social learning		
	collaboration	adaptation		
	all lands management			

1.3. The evidence considered

1.3.1. Treatment, felling, restocking evidence

The searches resulted in 159 studies (reviews and empirical work) that were assessed to identify findings about the specific behaviours exhibited by land managers with respect to P&D and policy support mechanisms.

Of the 159 studies 16 were specifically focused on tree P&D rather than studies about policy tools to nudge other desired behaviours (i.e. woodland management, woodland creation). This social and human dimension of tree P&D research is only just beginning with the UK, specifically Forest Research being the world leader in terms of published output.

The country coverage of the papers considered was: UK, Europe, North America and Antipodes.

1.3.2. Networks evidence

Scopus and Google Scholar were searched using keywords including network, partnership, group, alliance, association, collective, facilitation, collaboration, and land manager, pest, disease, tree health, invasive species, woodland management, forest management. Accessible grey literature was sourced from key government and organisational websites.

The searches resulted in 17 relevant academic papers, 12 grey literature reports, 1 conference paper, a book and a book chapter. Only land management papers, and papers written in English were included. Eleven papers and reports related specifically to forests, with 3 focused on trees rather than forests, and 5 were focused on specific tree pest and diseases.

All 32 references were assessed to identify conditions for the formation of a network, any actions undertaken, success factors, barriers to success or taking action, location, scale of study and environmental resource focus. All details were added to a spreadsheet for analysis.

2. Findings

2.1. Overview of the evidence about land manager behaviour

Understanding the decisions and behaviour of private non-industrial landowners constitutes the second most widely studied area of forest economics and associated social sciences (Amacher et al., 2003, Quiroga et al., 2018). Evidence assessment shows is that since the 1980's research has moved from trying to determine the variables affecting reforestation or harvesting decisions, to considering decision making



and behaviour around a much broader set of land manager objectives and a broader suite of private and public goods and services. This research interest has seen a recent increase, which is related in part to policy maker and sectoral interest in developing and changing forestry and woodland management practices to increase resilience to threats and risks such as those brought about by climate change and globalisation (Thomas et al., 2015).

2.1.1. Specific tree health evidence is growing but insights are general

However, within this research literature, investigations of land manager responses to tree pest and disease issues is an emerging topic. The number of published and easily available studies is significantly smaller than that for other areas of land manager decision making. Those countries where research into the social science dimensions of tree health is being investigated are the UK, the United States (US), Australasia and some parts of Europe. From their review of the literature Tomlinson et al. (2015) confirm that:

- Although analyses of specific pest outbreaks have been published these have tended to **focus on the biological and epidemiological aspects** of outbreaks, with few published studies focused on governance, management or land manager responses.
- **Exceptions in the UK include Dutch elm disease**, which was the subject of recent work examining outbreak management over a 40-year period (Potter et al., 2011, Tomlinson and Potter, 2010, Harwood et al., 2011), and the current and on-going outbreaks of *Phytophthora ramorum* and *Phytophthora kernoviae* in the UK, which has also been examined through a plant health governance lens (Potter et al., 2011, Tomlinson et al., 2009).
- Other social science contributions have **focussed on the legislative framework, policy protocols and risk assessment techniques** surrounding the regulation of plant and tree pest and disease risks locally and globally.
- **Peer-reviewed research on the governance and management of a tree pest outbreak in a specifically urban context is lacking.**

Marzano et al (2017) in their global review of the social dimensions of tree health recognise that in general terms there are a number of factors which affect the actions of stakeholders including land managers. They suggest that stakeholder values and motivations, risk perceptions, and their ability to act, as well as the existing regulatory and economic environment all combine to influence land manager responses to tree pests and diseases (P&D). Their findings reflect similar insights into land manager behaviour (see below) and suggest that:

- **Awareness of tree P&D and their impacts is likely to influence biosecure behaviours** and attitudes towards management measures. However, awareness is



generally low across a broad range of stakeholders, including key groups such as woodland managers or tree professionals.

- **Raising awareness of tree pests amongst stakeholders can facilitate early detection** and the effectiveness of management responses.
- **Targeting trusted intermediaries able to demonstrate the benefits of biosecure behaviours is likely to be an effective strategy.** Communication regarding tree pest risk is more readily received if it comes from a trusted source.
- **There is an underlying demand for action against tree pests, but acceptability of various responses measures varies.** Levels of trust are influenced by where the information about measures comes from, what the measures are and how those fit in with management objectives (i.e. spraying with chemical pesticides versus biological control), and land managers' past experiences and their perceived effectiveness of the measures.
- **While there is a stated willingness to engage in biosecure behaviours, people may not be prepared to incur extra costs in doing so.** There may therefore be a role for policy tools to fill the gap, but the evidence suggests that management of tree pests is constrained by current governance contexts and external vested interests.
- **There is still a level of confusion and lack of clarity over responsibility for aspects of tree pest management which can act as a barrier to action** and hinder effective responses.
- **Evidence suggests that traditional media (e.g., newspapers, TV) are still the most popular** sources of information on tree pests. Mainstream media and public attention can push tree health issues up the political agenda.
- Characterisations and segmentation studies connected with tree P&D in the US have shown that:
 - **Active rural and active urban amenity forest managers had some knowledge and awareness of red oak borer (*Enaphalodes rufulus*), but rural land managers were more aware compared to urban counterparts** perhaps because their management objectives included timber revenue as well as amenity. However, there was a low level of response action across manager types with just 12-15% of active amenity managers in urban and rural areas respectively, taking steps to manage red oak borer. The authors conclude that educational and incentive programs need to be tailored to meet the different needs and interests of passive versus active amenity-oriented landowners and of rural versus urban owners. (Surendra et al., 2009)
 - In the southern region of the US the **awareness of non-industrial private forest owners and managers about the threats posed by southern pine beetle (*Dendroctonus frontalis*) were associated with forest holding size and land**



manager objectives: Owners and managers with larger holdings (100 acres and above), timber revenue objectives and formal management plans were more aware and more likely to act against southern pine beetle. Those with smaller holdings (15 acres or less) were less likely to be active managers for timber, or to have management plans. In addition 60% were slightly aware to unaware that southern pine beetle are a source of timber loss, about 50% have slight or no interest in limiting southern pine beetle impacts, and 82% do not have a forest management plan (Molnar et al. 2003 and Mayfield et al 2016 reported in Nowak et al., 2008).

- **Education and awareness programs have been a critical part of managing landowners' behaviours** through a variety of media and events, including workshops and with local non-profit, community-based agencies to help people without forestry backgrounds better understand what threats there are to their forests, how they can respond, and why they should act.

2.1.2. A range of theoretical approaches are applied to understanding land manager behaviours including studies looking at tree P&D

Looking across research investigating land manager behaviours, theories and approaches from a range of scientific disciplines have been applied to try and increase understanding. These approaches include:

- **Behavioural and classic economics**, for example: econometric analysis of decision making using utility maximising economic modelling around a host of forest functions and outputs (Amacher et al., 2003); contingent rating and statistical regression to find associations between land manager choices and a range of influencing variables (Khanal et al., 2017); Willingness to Accept payments for specific management measures (Vedel et al., 2015); or the application of Nudge Theory exploring the process and drivers of behavioural change as a land manager journey including specific moments of opportunity for change (Valatin et al., 2016).
- **Behavioural science**, for example: the concept of Psychological Distance and the impact on management and harvesting behaviour (Huff et al., 2017); the Theory of Planned Behaviour and choice of reforestation method and silvicultural operations such as thinning (Karppinen, 2005, Karppinen and Berghäll, 2015).
- **Contextual decision making**, for example: factoring-in social, cultural and historical factors as influences on decision making (Ficko and Boncina, 2013); quantitative (Ficko and Boncina, 2013) or qualitative analysis of social, economic and ecological factors driving decision making and behavioural outcomes (Dandy, 2012) or understandings of resilience and response to risks (Ambrose-Oji et al., 2018); and the application of cognitive and social reasoning in problem solving scenarios (Hujala et al., 2007).
- **"Cross-boundary" science**, for example: studies which examine the spatial sensitivity of landowner forest management and how far responding landowners



account for adjacent lands when making land management decisions, particularly for non-market benefits and when considering uptake of schemes and programmes that might be affected by other landowners (Vokoun et al., 2010); the values and motivations of land managers likely to cooperate with their neighbours on specific issues such as biodiversity, wild fires and invasive species management (Finley et al., 2006, Fischer et al., 2018, Vainio et al., 2018)

2.1.3. The importance of differentiating between land manager types is emphasised

Regardless of the theoretical and disciplinary approach taken, much of the most recent literature has stressed the importance of differentiating between different types of land managers involved in forestry and tree management. Researchers and extension specialists suggest that such models are required if the development of policy tools and communications strategies are to be effective reaching target audiences and changing their specific behaviours. Work from the UK, Europe and the US has developed a range of characterisations, typologies and segmentation models to describe different groups based on their personal motivations, attitudes and management goals and other significant features affecting their decision making and behaviours (see for example Eves et al., 2014b, Feliciano et al., 2017, Ficko et al., 2017, Kelly et al., 2016, Klapwijk et al., 2018, Salmon et al., 2006, Surendra et al., 2009).

Despite differences in contextual details, there is a remarkable degree of similarity amongst those studies which seek to characterise woodland and forest managers. Findings show that managers sit along a spectrum from those with more productivist attitudes and revenue generating objectives, to those with more conservation and stewardship oriented ecological objectives, with a central group displaying a mixture of attitudes and objectives which are more multifunctional or amenity focused (Deuffic et al., 2018, Ficko et al., 2017, Gregory et al., 2003). Ambrose-Oji et al (2018) found that there were differences in understanding of “forest resilience” and land manager responses linked with particular land manager types. There is also an apparent relationship between the size of woodland holdings and the type of woodlands associated with the different kinds of land managers identified in these models. These differentiating features may have a bearing on the propensity of land managers to take up grants and different forms of support mechanisms, as well as the types of tree health threats they might face.

However, in their review, Ficko et al (2017) have shown that researchers rarely provide specific policy recommendations for each owner type identified, and policy makers rarely use such empirical work to develop their policy tools and mechanisms. None the less there are examples of successful application of segmentation approaches by policy makers and forestry services building communication strategies about P&D response and management options to reach particular types of manager (for an example around red oak borer in the US see Surendra et al., 2009), or with a view to connect with particular

types of land manager around other objectives (Ma et al., 2012, Butler et al., 2014, Kilgore et al., 2015).

2.1.4. Much of the behavioural evidence considers small-scale woodland managers

The focus of the empirical studies and reviews considered in this REA is on understanding the behaviours of what are classified as “non-industrial” forest owners, “family forest owners” or owners and managers of small woodlands. There is less coverage of larger commercial owners, or of medium sized businesses with an interest in forestry, e.g. estates. There is very little coverage at all of non-traditional managers of trees, woods and forests, for example, Local Authorities, urban residents, or community groups and social enterprises.

Whilst it may be the case that what constitutes a small-scale woodland or a family forest in terms of the size and type of holdings varies by country, and such owners and managers may be found across the different characterisations of land managers as described above, many of the studies suggest they tend to cluster more around stewardship/conservation and multifunctional management.

There is evidence that the characteristics of small-scale woodland managers are changing. Even though Eves et al (2014a) found just 5% of new woodland owners (i.e. less than 5 years) in their study indicating low turnover in woodland ownership is still the case, many studies report owners and managers are increasingly urbanised (Lawrence, 2018). The consequence of this is that there is an erosion of connection with the land-based sector, reduced forestry knowledge, and a move towards management objectives which are increasingly multifunctional or amenity focused rather than about timber production (Bond et al., 2018, Butler et al., 2014, Church and Ravenscroft, 2008, Dayer et al., 2014, Eriksson, 2018, Wade and Moseley, 2011, Wolde et al., 2016). For example, in England, Eves et al (*ibid*) found new entrants to forestry tended to be wealthier, less likely to be from a farming background, and were also more likely to cite lack of skills/knowledge as a barrier to their forestry practice.

There is a considerable gap between forest policy makers who consider large areas of woodland to be “undermanaged” with associated negative outcomes for P&D management, and evidence which suggests that many small scale woodland owners with such “undermanaged woodland” see themselves making specific and rational choices in their management behaviours: It may be an active decision to “let nature take its course” or follow close to nature management (Feliciano et al., 2017, Thomas et al., 2015, Dandy, 2016).



2.1.5. General behavioural insights about woodland managers are noteworthy

In summary what these different studies tell us about the behaviour of land managers, particularly non-industrial owners and managers of small and medium sized holdings, is that:

- **There are complex and interrelated opportunities and barriers operating at different scales** that have differential impact on land manager decision making depending on the particular policy issue considered (Klapwijk et al., 2018). Some of these may be “external behavioural controls” (e.g. policy measures such as subsidy, advice or regulation) and some may be internal to land managers themselves involving emotions, values and attitudes that are more difficult to understand and disentangle to promote change (Thomas et al., 2015).
- **A wide variety of information from non-traditional forestry organisations is accessible to land managers.** Land managers, particularly new entrants, may be accessing information from a far wider range of sources than traditional forestry and agricultural advisory services, and may include NGOs, local farmers and peer groups (Lawrence and Dandy, 2014).
- **Not all information and knowledge about best practice is trusted.** Land managers are selective and negotiate what knowledge they feel is legitimate, relevant and meaningful for their own practice (Uggla and Lidskog, 2016, Zobrist et al., 2016).
- **Organisations and platforms land managers consider trustworthy and credible are critical** when dealing with complex problems and novel responses. There is often a distrust of the information around complex problems (e.g. climate change or P&D issues), so the role of information providers and knowledge brokers considered legitimate by different kinds of land managers is significant (Eriksson, 2018, Hujala et al., 2007, Kittredge et al., 2013, Knoot and Rickenbach, 2011, Knoot and Rickenbach, 2014).
- **The social norms, values, beliefs and attitudes of peer groups**, professional groups, family and friends or the wider social context in which land managers are situated will impact their decisions and behaviours. Evidence suggests social networks play a part in maintaining and propagating these social norms, and can be highly influential (Lidskog and Sjödin, 2014).
- **Social networks and informal communication develop understanding and acceptance of novel management practices**, because individuals often only support a practice they understand and trust through discussion and demonstration amongst their social networks (Kumagai et al, 2004).
- **A sense of response-efficacy is important.** Land managers are unlikely to change or adapt their behaviours if they have no belief in their own capability or in the



effectiveness of their actions to make a difference to particular forestry risks or problems (Mills et al., 2017).

- **Behavioural change should be understood as a pathway.** It is a combination of factors, and a number of different “nudges” to move woodland managers to action, and there may be points within a land managers’ lifecycle or forestry management cycle where nudges lead to action (Valatin et al., 2016).

2.1.6. There is little evidence about managing trees in the urban context

There is very little published research considering management of the urban treescape, and less so considering P&D. However, urban tree management remains an important issue because trees planted in urban locations are often imported from outside the UK and continue to ‘represent a critical pathway for pest introductions’, they may play a role in the spread of new pests and pathogens, and they might also warn of new threats to the forestry environment (Tomlinson et al., 2015). In addition to this, urban trees are frequently planted in unfavourable sites where they experience stress, predisposing them to attack and increasing the likelihood that pest populations will successfully establish themselves.

There are a variety of managers in the urban context including Local Authorities, amenity land managers e.g. Royal Parks, businesses, e.g. zoological and botanical gardens, sports clubs, community enterprises and private residents. Amongst this complex stakeholder landscape, there is some literature which considers city residents attitudes to tree planting in general terms and suggests:

- Home owners find the **responsibility of tree care and maintenance a barrier to tree planting** because of a lack of knowledge about trees, and the time and resources required, regardless of how far they appreciate and value the environmental, social and economic benefits provided by urban trees (Conway, 2016, Greene et al., 2011a)
- **Tree planting activity tends to be greatest earlier in the tenancy of a resident** (1.26 trees/year in the first 5 years of ownership for Sacramento County residents); however, these same first 5 years were also found to have the highest rates of tree removal (0.43 trees/year) (Summit and McPherson (1998) cited in Greene et al., 2011a)

Research from the US discusses the importance of the urban/peri-urban interface with wildlands or national parks and how the complexity of land ownership in these situations present challenges around engaging land managers in control and management actions for specific pests. Such interface areas also present challenges in terms of interaction with the public who are key stakeholders in national park and wildlands management (see for example Flint and Luloff, 2007, Flint et al., 2009).



2.2. Do policy tools influence land manager responses to tree P&D?

Investigations of land manager responses to tree pest and disease issues is an emerging topic so the number of published and easily available studies is significantly smaller than that for other areas of land manager decision making, so it is harder to make general inferences.

2.2.1. Treatment and felling

Very little evidence exists from the UK on the specific topic of the influence of incentives on woodland managers in the context of pests and diseases only that:

- Marzano et al (2017) suggest that economic costs are not borne equally between stakeholders. Property and land owners (e.g., home-owners and local authorities) bear the greater part of costs, and the costs of responding by treatment or felling is a barrier to action particularly of those stakeholders not used to finding the finance to manage trees.
- Eves et al. (2015) found that “more support for pest & disease control” was the third most significant incentive for woodland creation among farmers, after simplification of grant application and higher grant funding. They also found that concern over pests and diseases is the least significant barrier to farmers planting woodland.

There are a handful of studies from the US, which examine the impact of cost sharing programs (i.e. public grants) in the context of treating and felling to manage large scale beetle infestations. What these report is that:

- In the southern US a number of different cost-sharing programmes have been devised to control and manage the southern pine beetle which follow similar principles across different states (Nowak et al., 2008). In Florida, Texas and Virginia state forest services have provided incentives set at 50-60% for pre-commercial thinning and prescribed burning as control actions, and they have also provided a flat-rate share of costs for first pulpwood thinning. In Texas there is also a cost-share element associated with consulting forester fees. Overall the cost-share programmes have led to the treatment of about 400,000 acres (c. 162K ha) by nearly 6,000 landowners across 10 states.
- Lessons from the southern pine beetle control programmes emphasised that land manager awareness of the pest, increasing knowledge about management options, and communicating the availability of a cost-share scheme was as important as the grant for motivating managers to act, particularly if the land managers' main concern was not timber production.
- Rossi et al (2008b, 2010a, 2011b) looked at the motivations and experiences of land owners for enrolling in the programme, and as well as describing widespread support

for engaging in proactive forest management in exchange for receiving an incentive payments, they questioned whether increasing the incentive to participate will motivate more land managers to engage, since it is not clear to what extent respondents choose to enrol in the cost-share program specifically to help prevent the SPB, or to carry out management (i.e. thinning) tasks that might have attended to anyway.

2.2.2. Restocking and diversity

The southern pine beetle control project has some of the best published evidence about the role of incentives in species choice for diverse and resilient restocking (Nowak et al., 2008, Rossi et al., 2008a, Rossi et al., 2010b, Rossi et al., 2011a):

- Florida does not cost share for regeneration even though it encourages non-industrial private land managers to plant with species more resilient to bark beetle attack. The Virginia Department of Forestry does cost-share where land managers agree to plant with more resilient Virginia long-leaf pine (*Pinus palustris var*) at a rate of 60% of costs. restocking with. The cost-share monies can be used for site preparation, planting, and burning costs.
- Evaluation of the programme suggested that the incentives for replanting with more resilient and diverse species are probably beneficial as a nudge to action, but need not be substantial, because land managers are keen to plant with resistant species and are willing to pay to replant with these on their own.

2.2.3. The urban context

The most significant studies of tree P&D in the urban context have been those looking at oak processionary moth or OPM (*Thaumetopoea processionea*) in the UK. The key lessons from Marzano et al. (2018) and Tomlinson et al. (2015) are that:

- Inaction can be attributed not to lack of policy tools, but to a degree of confusion about where statutory responsibility for urban trees lies. This grey area of responsibility is acknowledged by the FC in its Tree Health Strategy (FC, 2011).
- The use of regulatory instruments specifically Statutory Plant Health Notices (SPHNs) through the Plant Health Act is problematic. SPHNs do not allow land managers to manage for OPM in what is for them the most efficient manner, i.e. through risk-based approach, concentrating efforts where risk to human health might be most significant. If no grant is available for OPM management then there is some evidence to suggest that land managers who are expected to bear the costs are unlikely to comply with SPHNs.
- The costs of treating for OPM are relatively high and this represents a barrier to action, particularly where Defra no longer contribute to the costs of treatment. City residents are vulnerable to high and recurrent costs of treatment for OPM, particularly when compared to costs of felling of trees, because of the usually difficult residential



locations where work needs to take place, and their lack of knowledge about the contractor costs. Evidence suggests that some landowners would find a grant or cost sharing scheme an important incentive to

In terms of the studies looking at city residents tree planting behaviours, they did find that tree removal was most commonly motivated by poor tree health. However, underlying many residents' decisions were a lack of knowledge about tree care and species characteristics, which contributed to several healthy tree removals (Conway, 2016, Greene et al., 2011b).

Conway and Vander Vecht (2015) investigated a range of land manager types including local authority staff and landscape architects, to find out more about what was influencing their tree planting choices. Pest knowledge and influence on species selection varied among the actors, but all groups indicated that availability affected what was planted or sold. Results highlight the need for conversations about ways different actors can select species to contribute to a diverse and healthy urban forest.

2.3. Do policy tools influence land manager decision making for management, woodland creation or restocking?

The following section reviews the evidence about the impact of grants on woodland management, woodland creation and restocking which are not P&D specific but provide some potentially useful insights.

2.3.1. Woodland management and woodland creation

Many of the studies mix findings from schemes and programmes aimed at forest management and those concerned with woodland creation, and it is consequently hard to separate conclusions. The following insights emerge as important across studies:

- In Europe, EU agricultural subsidies have been widely analysed, but there is **little research on the efficiency of the support** from the rural development programmes to forestry, particularly where these are to do with the production of public goods (Quiroga et al., 2018, Lawrence, 2018).
- **Studies do not make it clear what kind of grant or incentive is being considered and what the function of the grant might be** (Quiroga et al., 2018, York et al., 2006), i.e. whether the grant:
 - lowers costs by changing the relative price of factors and products,
 - directly affects revenues that impact investment and labour decisions,
 - changes risk perceptions because of the subsidies insurance effect,
 - fosters farm growth or helps with exiting the industry.



These factors are important when considering why different kinds of land managers may or may not be attracted to the incentive, and what kind of behaviours might be changed.

- **Similarly, classifications of policy tools are inconsistent.** They may include regulation, financial incentives, and information or education, but in some country contexts they may include governance mechanisms such as owner associations and cooperatives (Lawrence and Dandy, 2014).
- The studies note that it is **difficult to distinguish between the effects of grants (i.e. market instruments), and of advice (i.e. non-market instruments)**, because in most country contexts the two are supplied together.
- In the UK the predominant policy tools are grants and advice, but in terms of policy tool design, **information and advice is often a neglected factor** (Lawrence and Dandy, 2014, Hemery et al., 2018).
- **There is no general consensus regarding the effectiveness of policy tools** such as grants, subsidies, cost sharing models or alternative support packages, whether looking at specific types of land owner, particular types of schemes, or specific country contexts and some of the evidence is contradictory (Lawrence and Dandy, 2014, Quiroga et al., 2018).
- **Participation in programmes and incentive schemes is consistently viewed as low** across different country contexts (Quiroga et al., 2018, Ma et al., 2012, Straka, 2011).
- Those **most in favour of forest subsidies are forest owners with an utilitarian view** of forest management, with larger forest holdings, full or part-time farmers (Quiroga et al., 2018, Janota and Broussard, 2008), but **non-industrial and family forest owners and those with smaller holdings show poor affinity** for grants and subsidies (Quiroga et al., 2018, Ma et al., 2012, Straka, 2011).
 - The British Woodlands Survey 2017 (Hemery et al., 2018) collected responses from 645 woodland owners. Across the total sample, **about 25% said grants would be an incentive to plant more woodland, but low-cost advice was also important.** Amongst the 43% of managers who had planted trees in the last five years, **45% stated that grants had been an incentive.**
 - Eves et al (2014a) surveyed woodland owners and managers in England and found that the intervention that respondents most often indicated they would be responsive to **was a higher grant rate**, with 47% agreeing and 16% strongly agreeing that this would encourage them to increase their woodland management activity.
 - Eves et al (2014a) also found that **favourable tax benefits, the availability of trusted and impartial advice, and the provision of a free management plan**



were all cited by over 40% of respondents as additional factors that would encourage woodland management.

- The evidence suggests that owners and managers of small woodlands and other non-industrial owners:
 - **Are not primarily motivated by making money from woodlands and do not respond to economic drivers.** Grants therefore have a limited capacity to bring about planting or management activity that is additional or different to what the landowner or manager had already intended (Feliciano et al., 2017, Lawrence and Dandy, 2014, Mostegl et al., 2017, Kilgore et al., 2007, Kilgore et al., 2015).
 - **May take up grants if they align with existing land manager objectives,** but they are not likely to change those existing objectives and behaviours. For example, Church and Ravenscroft (2008) showed that in the UK over 50% of non-commercial owners who were not receiving management grants felt that such incentives were simply irrelevant, and that over 30% of those receiving grants also felt grants had not changed their management decisions.
 - **Take notice of advice and information provided through land managers' own immediate social networks and professional contexts** as they make decisions to take up grants, and to changing specific behaviours (Hujala et al., 2007, Mostegl et al., 2017).
- **Farmers can be characterised as a group of land managers likely to respond to incentive schemes.**
 - In England, Eves et al (2015) found that the probability of planting increases with farm size, proportion of existing woodland, profit levels and type of land. In their segmentation model, **Pragmatic Planters** (often members of the NFU, have large individual land holdings, and environmental sympathies) were found to be the most responsive segment to potential policy interventions. The **Willing Woodland Owners** (smaller individual landholdings, willing to sacrifice profit for the environment) were the second most likely segment to plant but were not necessarily likely to respond to public schemes.
 - In Scotland, Hopkins et al. (2017) reflect previous studies and show that younger farmers, already engaged in woodland and/or other types of non-agricultural activities, who are well educated and/or are relatively new entrants to farming, are an important target population for efforts to encourage woodland expansion and potentially for grant uptake.
 - In Wales, Wynne-Jones (2013), showed that farms with systems that work well alongside woodland, e.g. poor quality agricultural land used for extensive livestock production, and farms with existing woodland, were more likely to participate in woodland creation schemes. The study conclusions agree with IWA (2012, p. 36)



that “Farmers are more likely to embark on tree planting if they can be persuaded that it can be integrated into their overall farming culture and practice, rather than as a separate activity”.

- There are many suggestions about the **barriers to the uptake of subsidies**, across a range of land manager types. The most often mentioned factors include:
 - **Schemes are poorly communicated** resulting in large numbers of land managers unaware of what is on offer, uncertainty about the policy the incentive scheme supports, the sustainability of the scheme, the timing of payments, and what happens in the case of planting failure demands to repay grant aid (Ambrose- Oji, 2016, Ambrose- Oji and Tidey, 2017, Lawrence and Dandy, 2014). However, Crabtree et al. (Crabtree et al., 1998) suggest that lack of awareness is strongly associated with other predictors of non-participation in schemes, so communication may not be the main barrier to uptake.
 - **Complex scheme structures and complicated access points make it difficult for land managers to understand** and navigate the scheme information, to fully understand what it means to take part in a scheme, and to manage the application process (Ambrose- Oji, 2016, Ambrose- Oji and Tidey, 2017, Lawrence and Dandy, 2014, Eves et al., 2015, Hemery et al., 2018).
 - **The amount of paperwork required is perceived as high and time consuming** this is a particular barrier for those with little previous experience of scheme application, or for those with small holdings for whom the effort of applying is seen as disproportionate to the benefits (Ambrose- Oji, 2016, Ambrose- Oji and Tidey, 2017, Lawrence and Dandy, 2014, Hemery et al., 2018, Eves et al., 2015).
 - **Administration is carried out by too many organisations** resulting in poor communication, lack of coordination and poor customer service (Ambrose- Oji, 2016, Ambrose- Oji and Tidey, 2017, Lawrence and Dandy, 2014).
 - **Land manager perceptions that schemes are tied with restrictive and inflexible land management regimes** or fears about a loss of control over their property, means that subsidies are simply unattractive or the perceived disbenefits outweigh the potential benefits (Lawrence et al., 2010, Mills et al., 2017, Quiroga et al., 2018, Sarvašová et al., 2018, Serbruyns and Luyssaert, 2006).
- **Advice-based interventions might also be useful and could be linked with other schemes.** Eves et al. (2014a) conclude from their work that it may be helpful to include a clear focus on the management of small woodlands as part of future agri-environment schemes since 45% of small woodland respondents were NFU members.
- In the UK the **kinds of advice preferred** by small scale managers, farmers, production focused managers and land agents are shown to be:



- Face-to-face interaction with forestry professionals (Andre et al., 2017, Ambrose-Oji, 2016)
- Peer group interaction and study visits (Lawrence and Marzano, 2012)
- Seminars and meetings (Lawrence and Marzano, 2012)
- Regionally trusted capacity building and facilitation. These are recognised as crucial to mobilising six landscape partnerships (land manager identified) that could both strengthen estate and forest resilience. (Bowditch et al., 2017).
- **Policy makers have not taken on existing knowledge and learning about land manager behaviour in scheme design.** This means that existing understanding about how to overcome known barriers to uptake is not being implemented. For example, the Glastir scheme has involved a move towards a remotely administered 'self-service' model of participation, with less project officer support and greater responsibility devolved to farmers: This design is almost the opposite of what farmers have said they are most likely to respond to, and there has been a negative impact on scheme uptake and outcomes (Wynne-Jones, 2013).

2.3.2. Other programmes

Assuming that land manager behaviours respond differently depending on the objectives of policy options and the tools and schemes which come from these, our review also looked for evidence from particular programmes, rather than general woodland management or woodland creation schemes. The schemes which emerged from the literature were carbon sequestration and carbon offset schemes. That evidence is presented in the following subsection.

2.3.2.1 Carbon sequestration and carbon offset

In a survey in the southern USA, Khanal et al. (Khanal et al., 2017) showed that private woodland owners with recreational goals for their property were the most likely group to participate in carbon sequestration programmes, and that having a management plan, needing to verify their management against the plan, as well as the level of carbon revenue were the most important determinants of their probability of participation.

In contrast, an econometric study of willingness to take part in carbon offset programmes by family forest owners in Norway (Håbesland et al., 2016) showed that the most important predictors of participation are payment amount offered, the importance placed on non-market forest amenities, as well as attitudes towards climate change. Forest owners with amenity forest values were less likely to manage for carbon because of the perception that management actions required impacted on amenity values, whereas those owners with production values saw carbon programmes as a substitute to income from timber.

Using stated preference data from private landowners in the Pacific Northwest US, Kim and Langpap (2016) found that incentive payments would significantly and positively

affect enrolment in a tree planting for carbon sequestration program. They also found that program enrolment was affected by variables representing productivity of land, spatial characteristics, and reasons for owning agricultural lands. However, the landowners' demographic characteristics, except for gender and graduate education, did not affect enrolment.

2.3.3. Restocking

There is virtually no found evidence concerning restocking and the impact of policy tools in this area. The few studies that consider restocking provide the following evidence:

In the British Woodlands Survey (Hemery et al., 2018), when asked about future planting activity, land managers said that restocking would make up the largest area (42%), followed by new planting on existing land (40%), and on land purchased for the purpose (17%). Woodland owners indicated that if the right incentives were in place (in declining importance: Grant aid, Viable source of other income, and Free/low-cost advice), then the total area 'offered' for tree planting might increase.

Eves et al (2014a) found that around 51% of respondents said that increased help for management of pests and diseases was an important incentive for woodland creation.

A study focussing on non-industrial private forest owners in Europe concluded that providing public financial assistance after damage-causing events such as storms and wind blow, may reduce land manager incentive to purchase insurance or to invest in protective forest management activities including restocking (Brunette and Couture, 2008).

2.3.4. The urban context

in their overview of the governance of urban tree and forest management Lawrence et al. (2011) noted that with budgets under pressure and difficulties in placing direct monetary values on urban forest benefits, policy makers and managers need to be inventive in securing funding.

Across Europe, a range of grant and incentive schemes have emerged for this to happen. In many countries of North western Europe, for example, grants and subsidies have been available for land owners establishing new woodland in peri-urban areas (Konijnendijk, 2003). Schemes typically stimulate the planting of native, broadleaved tree species, as well as public access. Innovative schemes include the TreeGeneration project in Wales, which offered specific grants to local businesses to encourage greener redevelopment (Owen, 2008). These schemes have met with varying success and have depended on positive land manager attitudes to tree planting (in the case of TreeGeneration in Wales resistance to the project was experienced from the business community, citing a fear that tree cover would exacerbate existing crime and anti-social behaviour), as well as the provision of a diverse range of support, both monetary and other resources including advice.



The other theme in the literature is that of tree planting by residents. As well as looking at tree planting preferences, evidence about specific schemes have little to say about the impact of various elements of those schemes.

However, Greene et al (2011), describe a Toronto-based not-for-profit organization, Local Enhancement & Appreciation of Forests (or “LEAF”). Established in 1996, the LEAF Backyard Tree Planting Program (or “BYTP”) has met success through the provision of trees at subsidized prices (largely funded through local and provincial power utilities) alongside planting expertise (consultation with a certified arborist) to residents interested in planting a tree in their backyard (LEAF, 2010).

2.4. Do policy tools influence land manager decision making for more diverse planting?

The evidence concerning land manager species choice and planting across landscapes is complicated, and it is difficult to discern how, and to what degree policy tools might have influenced behaviour.

2.4.1. General perspectives on land manager understanding and behaviour around diversity

The British Woodlands Survey of woodland owners and managers including agents (Hemery et al., 2018) reported that:

- There was **strong awareness amongst respondents about environmental changes** impacting woodlands over the last five years, particularly around pathogen damage (76% observing change), and vertebrate pest damage (48%).
- **Land managers were strongly motivated to diversify tree species** to support biodiversity (76%) and forest health (72%). In contrast, timber yield objectives stood as the strongest motive against (75%) tree species diversification.
- The majority of respondents **were confident about which tree species were suitable for land they owned or managed** and did not rely on any sources of advice regarding species choice.

2.4.2. More diverse planting

In a detailed study of land manager perspectives on resilience, Ambrose-Oji et al. (2018) found that:

- Different types of **land managers recognised diversity “as a good thing”**, and considered diversity in terms of genetic diversity, species diversity, and diversity in age class and stand structure.
- Land manager type influences attitudes towards diversity. **Timber Producers were likely to look for genetic diversity in terms of improved strains of e.g. Sitka,**

seeing the risk of loss to P&D lower than the risk of switching to different species.

Eco-centric Managers believed resilient diversity would come through natural regeneration.

- There were comments across segments that some of the **available information about adaptation through diversity is conflicting**, e.g. the advice about the right provenances to use, depending on the point of view of the organisation (or the part of the organisation) publishing the advice.

Land managers often **perceive the list of “approved species” that are open to inclusion in grant supported planting and restocking schemes as presenting choices that do not match their specific forestry or woodland management objectives** – this is particularly true among more productive managers who feel they have little choice other than native broadleaves which they feel are so open to attack by deer and squirrels that they do not present viable choices where the primary objective is generating timber revenue (see for example Ambrose- Oji, 2016, Ambrose- Oji and Tidey, 2017, Eves et al., 2015, Hemery et al., 2018, Thomas et al., 2015)

In New Zealand **land manager characteristics were also shown to influence species choice**, where forest restoration with diverse native species has been linked to the farmer segment characterised by environmental attitudes and less concern about generating economic returns from holdings (Welsch, 2011). Many of these farmers were not aware of the Afforestation Grant Scheme that could support such restoration planting and made their species choices regardless.

Lodin et al (2017) and Valinger et al. (2014) report that in Sweden, after the significant storms of 2005 and 2007:

- Reforestation was largely conducted by private forest owners who were **offered public grants to support regeneration with broadleaves to increase diversity against future threats**. Grants for regeneration with conifer species was approximately €300 per hectare and for regeneration with deciduous trees and for species that require fencing between approximately €2100 and €4000 per hectare. **However, managers continued their previous practices and planted Norway spruce (*Picea abies*) over 90% of the replanted area regardless of the differential in grant rate.**
- The analysis reveals that **continued reforestation with Norway spruce (was a result of path-dependencies of practices strongly supported by the species' superior profitability**, and because of a **high browsing pressure from ungulates on the economic and ecologically suitable alternative Scots pine (*Pinus sylvestris*).**
- For those who did chose to plant with species other than Norway spruce, the factors which influenced them were **attitudinal drivers including, risk awareness, consideration to forest aesthetics and curiosity.**

2.5. Do landscape scale networks and partnerships influence land manager behaviour?

2.5.1. Insights into networks, partnerships and land manager behaviours

There is no single definition of networks or partnership. The Audit Commission (1998) describes a partnership as a joint working arrangement where the partners are independent bodies or individuals, they agree to cooperate to achieve common goals, create a new organisational structure or process to achieve those goals, plan and implement a joint programme of work or activity, share information, and pool rewards and risks.

Williams et al. (2004: 2) define networks as groups of people with a common interest who interact and cooperate for mutual assistance and support in relation to the common interest they have. Partnerships they outline involved a relationship between organisations or groups characterised by cooperation and responsibility to achieve a common goal with the involvement of all in the partnership. The partnership they suggest can be formal, semi-formal or informal and can involve different actions such as pooling resources, in kind support, joint funding.

The OECD has a looser definition suggesting a partnership is an agreement to do something together that will benefit all involved (Brandstetter et al., 2006). Other terminology used includes associations which are groups of people organised for a joint purpose, or cooperatives which involve mutual assistance towards a common goal. Networks and partnerships can be formal and include having staff, a defined name and possibly a logo, a written agreement, minutes taken and disseminated from meetings, a secretariat; or they can be informal without any of the above. The line between formal and informal is not necessarily distinct; rather it can be viewed as a continuum. Some networks and partnerships start with government or local authority/agencies involvement and this can then lead to local action on the ground.

2.5.1.1 General information about networks and partnerships: Aims and resource focus

The aims of the networks and partnerships in the review were varied with more focused on forests, conservation and water management and fewer having objectives related to tree health, public access and community engagement, and landscape restoration. Eleven papers and reports related specifically to forests, with three focused on trees rather than forests. A smaller number of papers and reports focused on watersheds/catchments or farmland, with fewer papers still concerning selected or specific areas such as conservation areas or the natural environment more broadly. Forest and tree specific studies are outlined in Table 2. Sudden events that can cause potential harm can often be the catalyst to the formation of networks and partnerships and the actions they undertake (Alexander and Lee, 2010).

Table 2. Forest and tree focused partnerships and networks identified in the evidence review

Natural Resource	Name	Focus of network/partnership	Country	Formal/informal network	Reference
Forest	5 case studies of local action	Sudden Oak Death	California	Both formal and informal with bottom up and top down activity	Alexander and Lee, 2010
Forest	Numerous	Partnerships between the Forestry Commission and Civil Society	Various locations in England	Both formal and informal, bottom up and top down	Ambrose-Oji, 2010
Forest	None given	Cooperative management by private forest landowners	Pacific Northwest and Upper Midwest USA	Informal, Bottom up	Fischer et al. 2018
Forest	The Burney Gardens Timber Harvesting Plan	Cross boundary meadow restoration by private forest landowners	Northern California	Became formal, bottom up	Kelly and Kusel, 2015
Forest	The collaborative forest landscape restoration programme Joint Chiefs Landscape Restoration partnership	Forest restoration with a specific focus on fire	Collaborations across USA	Some formal, others unclear	Schultz et al. 2018
Forest	Six forest-based communities	Response to Spruce Bark Beetle	Alaska, USA	Not applicable	Flint and Luloff, 2007
Forest	No name	Exploring potential for cross boundary coordination	Iowa and Wisconsin USA	Not applicable	Gass et al. 2009
Forest	No name	Exploring the potential for cross boundary coordination	Queensland, Australia	Informal	Meadows et al. 2013
Trees	Gippsland Plains Tree Health Group	Community interest group focused on Red Gums Plain dieback	Victoria, Australia	Not applicable	Measham, 2007
Trees	Redwood Valley Project	Sudden Oak Death in Redwood Valley	California	Formal	Valachovic et al. 2013
Trees	Elm Partnership	Dutch elm disease outbreak	South east England	Formal	Bruin et al. 2013

Networks that focus on the wider environment in the UK are numerous and recent examples include Local Enterprise Partnerships, Nature Improvement Areas, Farmer Clusters, Pioneer Projects, Forest and Woodland Advisory Groups and Local Nature Partnerships to name a few. The topic of networks and partnerships and their successes and challenges is also an issue in many other sectors including business, health, education, and organisational management. Three recent grey literature publications from Defra in 2013 (Defra, 2013b, Defra, 2013c, DEFRA, 2013a) include a review and guidance to using partnership approaches. Although we have outlined formal and informal partnerships in Table 2, there can be a continuum from very formal partnerships to partnerships that are less formal but have created a specific name for themselves, or to those that are more informal with a very loose arrangement. It is not always clear from the evidence which partnerships fit into which categories.

2.5.1.2 Evidence of network and partnership actions

Actions undertaken by networks and partnerships were frequently mentioned in general terms in the literature, but specific details were often omitted. Several themes emerged around which the actions outlined can be loosely grouped, although there may be a substantial degree of overlap between them.

Fund raising: Network and partnership actions related to fund raising were frequently mentioned in the literature, with varying degrees of detail (DEFRA, 2012, Alexander and Lee, 2010, McDonald, 2017). Fischer et al. (2018), for example, cite cooperative fundraising efforts such as writing grant proposals to pay for management activities, and Kelly and Kusel (2015) document how one partnership assisted another group to leverage funding by providing evidence of a successful project. Another article mentioned how project partners had invented creative new funding options (Valachovic et al., 2013).

Stakeholder capacity building/facilitation: A strong theme to emerge from the literature regarding partnership actions is that of stakeholder capacity building and facilitation. Of the actions in this category, the provision of advice was mentioned most often (Alexander and Lee, 2010, Hemingway and Gunawan, 2018) through, for example, stakeholder engagement activities (DEFRA, 2012, CaBA Benefits Working Group, 2017). The provision of training was also mentioned (McDonald, 2017) as well as facilitation through, for example, equipment sharing (Fischer et al, 2018) and the development of plans and strategies (McDonald, 2017). Such planning can be formal or take place during informal communication at social events or daily interactions (Fischer et al, 2018). In the context of a *Phytophthora ramorum* outbreak in California, Valachovic et al (2013) cite the provision of practical tools by the Redwood Valley project to encourage and inform future efforts, and networks mentioned by Alexander and Lee (2010) provided technical assistance and planning.

Habitat maintenance/restoration/creation: Environmental partnerships often undertake actions related to habitat maintenance, restoration or creation. In the first

instance this can involve working with other organisations to identify suitable areas (Hardy and Koontz, 2010). Further actions include treatments such as felling and disposal of infected trees (Valachovic et al., 2013), or the removal of invasive species (Gass et al., 2009, Hardy and Koontz, 2010, Lister et al., 2012). Habitat creation was also mentioned by one report in addition to restoration, where NIA partnerships have restored or created 4,625 hectares of new priority habitat (Collingwood Environmental Planning, 2015).

Two sources mention specific actions relating to riparian habitats. Hardy and Koontz (2010) cite retrofitting existing basins and physically restoring habitat within a riparian corridor, and CaBA (2017) report that 82% of partnerships had undertaken river and riparian restoration, including over 200 projects to open up rivers and streams to migratory fish and eel.

Actions were also mentioned, not directly related to changes in the habitat itself, but to enable human interaction with that habitat. Hardy and Koontz (2010) depict how partnership members developed trails within newly designated parkland and worked with land owners to implement conservation easements.

Community engagement: Several sources emphasised the community aspect of partnership actions, which were often tied into goals relating to environmental improvement. In one example from Birmingham and Black Country, local residents and community groups from a deprived urban-fringe estate were brought together to improve their local open space, learning new skills and meeting people in the process (Collingwood Environmental Planning, 2015). In other larger scale projects, volunteers trained in citizen science techniques were able to conduct biological sampling and water quality monitoring (Hardy and Koontz, 2010, CaBA Benefits Working Group, 2017). Margerum and Robinson (2015) highlight how partnerships can aid restoration efforts through actions to connect community and social networks, which build trust and engagement.

Educating/raising awareness: Closely linked to actions engaging local communities are those relating to educating and raising awareness. Floress et al. (2011), for example, specifically mention water-quality educational events, and the report into NIAs (Collingwood Environmental Planning, 2015) states that over 26,500 people participated in educational visits. In one example an environmental artwork was developed in a country park on the Thames estuary with the aim of improving understanding of biodiversity in the landscape (Collingwood Environmental Planning, 2015). Wider awareness raising actions were cited by Alexander and Lee (2010) in the form of a publicity campaign launched by a locally based oak mortality task force, which enabled the dissemination of information beyond the affected neighbourhoods. ICF Consulting Services (2015) in an evaluation of Local Nature Partnerships (LNPs) found 21 of 35 LNP's agreed that they had increased knowledge sharing through the LNPs providing a platform to meet and discuss ideas.

Knowledge/evidence creation: The literature reveals that actions to create knowledge and evidence make up an important component of the activities conducted by several environmental partnerships. For example, O'Donnell et al. (2018) explicitly mention disparate stakeholders being brought together to co-produce knowledge to highlight the advantages of a new vision for urban flood risk management in Newcastle-upon-Tyne. Other studies cite the production of scientific studies and modelling tools (Hardy and Koontz, 2010; Hemingway and Gunawan, 2018) as well as monitoring activities (Hardy and Koontz, 2010, CaBA Benefits Working Group, 2017). Monitoring was also mentioned in the context of tree health in Redwood Valley, California, where these actions contribute to the collective understanding of what it takes to manage and contain *Phytophthora ramorum* (Valachovic et al, 2013).

Informing/influencing policy: Linked to the creation of knowledge are the ways that partnerships use actions to inform and influence policy. For example, after the aforementioned outbreak of *Phytophthora ramorum* in California, the Oak Mortality Task Force compiled a document informing legislators of prioritised research, policy, education and management needs to support the creation of regulations and quarantines to contain the pathogen (Alexander & Lee, 2010).

Hardy and Koontz (2010) provide detailed information on actions undertaken by two watershed partnerships operating in Ohio, USA. The Grand River Partnership worked with local governments on the development of a comprehensive plan and green space plan, collaborated with the Ohio Environmental Protection Agency on a headwater stream survey that could change habitat designation and result in more regulation, and worked with policy-makers to identify endangered species habitat, which can lead to stricter zoning decisions and greater riparian setbacks. The second group, a community-based branch of the Euclid Creek Partners, have been especially active in the pursuit of policy outputs, working with communities in the watershed to introduce ordinances for erosion and sediment control, zoning, storm water, and riparian setbacks (Hardy & Koontz, 2010).

2.5.2. Partnership performance and sustainability

2.5.2.1 What mechanisms facilitate, encourage and enable partnerships?

There is some overlap between the factors that enable networks to be successful and the mechanisms that might support those networks, enabling them to be sustainable and meet their objectives. For example, some funding to enable a network to develop and meet can be important for success, but it is also a mechanism that can be used to enable a network to get off the ground or sustain an existing network. Firstly, we report on mechanisms before going on to discuss success factors.

There a range of ways in which networks and partnerships can be encouraged and enabled to get off the ground. The existing evidence suggests the following are particularly important.

Funding: Funding can be provided for coordination of networks and their management as was the case for the Catchment Based Approach (CaBA) partnerships which had funding for the hosting of partnerships and for delivery of actions (CaBA Benefits Working Group, 2017). Funding can cover the costs of paid staff and Margerum and Robinson (2015) focusing on watershed networks state that there must be financial support for these and government commitment to the networks. Incentive schemes such as the farmer facilitation fund (via Countryside Stewardship) are one way of encouraging the development of networks of farmers to collaborate at the landscape scale. The Natural Hazards Partnership feels it needs long term government funding to continue and to give a mandate to the partnership (Hemmingway and Gunawan, 2018).

Routes to funding: Assistance with support and identification of opportunities to leverage funding can enable a network to continue or give it fresh impetus. For example, the facilitation fund was set up for the development of farmer clusters at a landscape scale and it was publicised through a variety of routes to encourage farmers and land managers to apply.

Training/field meetings and skills development: Opportunities for training such as awareness raising and identification days can be useful to develop skills. Workshops and field trips can also be important in enabling debate and discussion in situ and are being used in various facilitation fund farmer projects (McDonald, 2017). For large scale activities such as the catchment partnerships, the CaBA (2017) support organise workshops and conferences for partnerships which many engage with. An evaluation of LNP identified a good example of an LNP and Local Enterprise Partnership (LEP) undertaking joint workshops through Natural England (ICF Consulting Services, 2015).

Web-based platform for resources, awareness raising and knowledge sharing: The CaBA Benefits Working Group (2017) found in an evaluation survey that out of 60 partnerships that responded, 28 used social media mainly Facebook and Twitter and 14 had their own websites to disseminate and share information. CaBA support has a website that all the partnerships have access to and can upload information onto.

Access to external expertise or support and guidance: Catchment Based Approach partnerships gained support and guidance from a CaBA national support group as there were 102 partnerships identified in the monitoring and evaluation (CaBA Benefits Working Group, 2017). The national support group provides a website, guidance, newsletter, working groups e.g. urban working group, and training sessions, access to data and evidence and monitoring and evaluation approaches. The national support group encourages partnerships to develop terms of reference that set out the roles and responsibilities and governance structure, and 79 of the 102 partnerships had this.

Government recognition and facilitation: Meadows et al. (2013) argue that government should play a background role in small scale cooperative forest management but equally it can be important as a facilitator of cooperation and provide enabling conditions (Schultz et al., 2018). Floress et al. (2011) call for state agencies in

the USA to provide guidance to newly formed watershed groups. As part of Local Nature Partnership, Defra (2012) outlined that partnerships would get government recognition and have access to government with a liaison function in Defra.

2.5.2.2 What barriers and challenges do partnerships face?

Financial issues: The most common issues in the reviewed literature regarding barriers to partnerships were those centred on resources, particularly financial. Multiple sources cited uncertainty relating to funding amounts and duration as a barrier (see for example: Bruin and Cinderby, 2013, Floress et al., 2018, Hemingway and Gunawan, 2018, Margerum and Robinson, 2015). As a more specific example, partnerships particularly reliant on key members for resources may face challenges if these partners undergo consolidation, restructuring or readjustment periods (England, no date). The issue of flexibility associated with funding if not all partners are eligible, or how money can be spent for example, can also present challenges (Floress et al., 2018; Hemingway and Gunawan, 2018). Alexander and Lee (2010) highlight that less affluent/more dispersed areas are more likely to be at a disadvantage regarding resource availability.

Time constraints: Partnerships often take longer compared with other approaches to achieve actual outcomes and time commitments can be high for all parties both at establishment and delivery stage (Defra, 2013b). Time constraints may therefore present a barrier to effective partnership working if this is not recognised and appropriate levels of commitment made up front (Defra, 2013b). Similarly, Clarke (2015) highlights that partnerships take time to establish and therefore will struggle if stakeholders are not engaged early on. Furthermore, in areas with a diverse mix of public and private landowners it will take significant time to foster support and coordinate agreements (Valachovic et al., 2013).

Longevity: Successful partnerships imply long term, sustainable impact and therefore require long term activity (Clarke, 2015). This is particularly true in the context of managing tree pests and diseases, where landscape-scale efforts require monitoring that is consistent, frequent and conducted at a scale that matches that of the pathogen invasion (Valachovic et al., 2013).

However, maintaining long term partnerships is challenging. The Elm Partnership, for example, which was set up to manage the outbreak of Dutch elm disease (DED) in East Sussex, was active for many years but later became less functional (Bruin et al., 2013). At a meeting to try and reinvigorate the partnership, members voiced scepticism through questions such as: "Are we delaying the inevitable? Is the current management approach sustainable in the long term?" (Bruin et al., 2013). Informal partnerships in particular may struggle with durability in the long term (Davis et al., 2018).

Membership issues and partnership size: In terms of membership, partnerships may struggle to find the balance between inclusion (where decisions take longer) and a smaller, more focused group that makes it easier for governance, development and decision-making, but invites criticism if key interest groups are not represented (Defra,

2013b). Voluntary partnership approaches may lack important stakeholders as these approaches will naturally appeal to individuals/organisations who already have an interest in the issue but are less likely to influence 'hard to reach' individuals (Defra, 2013c). Non-participation from landowners can act as a significant barrier (Schultz et al., 2018), particularly in the context of managing tree pests and diseases where it may result in undermining the whole project (Valachovic et al., 2013).

Conflict between members can present challenges (Schultz et al., 2018). Also, an inequality of effort/support/input between partners may result in an increased workload for one or more stakeholders (Ambrose-Oji et al., 2010).

Communication and mutual understanding: Landscape level partnerships inevitably involve a significant number of participants with multiple objectives/ways of working/limitations that are not always in harmony or understood by the other partners (Ambrose-Oji et al., 2010).

Hemingway and Gunawan (2018) found that the inability to establish secure and efficient channels for sharing data and documents, as well as geographical dispersion of members can act as major barriers to effective communication. They suggest the latter can be overcome through technology such as video conferencing if not limited by partner organization technology infrastructure.

Policy and governance environment: Partnerships may be constrained by existing institutions that are not designed to operate across scales and stakeholders (Floress et al., 2018). They may, for example, miss out on opportunities due to a lack of alignment and integration of networks into other initiatives (e.g. LNPs that may require national action) (CaBA Benefits Working Group, 2017).

Bruin et al. (2013) assert that local partnerships would benefit from a central government framework to maintain pest and invasive species management as a local strategic priority.

The political nature of some partnerships at the policy level makes them vulnerable to political trends and leadership changes (Margerum and Robinson, 2015; Natural England, n.d.).

Monitoring and reporting: Attributing the change or outcome delivered by voluntary partnerships is difficult and consequently there is no comparative assessment between partnerships and other initiatives and government interventions (Defra, 2013a). The CaBA Benefits Working Group (2017) echo this point by highlighting the difficulties they experienced in the reporting of social and economic outcomes. Floress et al. (2018) mention the importance of monitoring in the context of partnership development but cited insufficient time and resources to carry out the work.



Leadership: While effective leadership is often cited as a key factor for partnership success, over reliance on key persons may lead to difficult project implementation (Ambrose-Oji et al., 2010).

Other: Public relations issues including negative publicity or Third Sector organisations taking the limelight (Ambrose-Oji et al., 2010).

2.5.2.3 What makes a successful partnership?

Effective leadership and management of the network: A champion to drive forward a partnership can be important (Meadows et al. 2013), Bruin et al. (2013) suggests an organisational champion is needed as a coordinating body. Leadership skills and diplomacy were identified as important in the Access to Nature Partnerships (Natural England, n.d.), and the Natural Hazards Partnerships (Hemmingway and Gunawan, 2018). Local leadership was identified by Fischer et al. (2018) as important within the community of landowners for emergence of cooperation and continuity. Leadership was also seen as critical in forest restoration cooperation (Schultz et al. 2018).

Shared vision and common purpose: Several studies identify this as important (Defra, 2013b, Fischer et al., 2018, Floress et al., 2018, Mattessich et al., 2001, England, no date)

ICF Consulting Services (2015) as well as Hemmingway and Gunawan (2018) suggest common ground is essential and the CaBA (Catchment Based Approach) National support group advise its partnerships that developing a shared vision is important for an effective partnership.

Developing trust and reciprocity: Trust and respect was identified by Hemmingway and Gunawan (2018) in the Natural Hazards Partnership, by Ambrose-Oji (2010) when working with civil society and by Defra (2013) through the facilitation fund for farmers. Social relationships already in place can make collaboration easier (Fischer et al. 2018), new networks do not often take place within a vacuum and there can be existing relationships that can facilitate the creation of new networks. Trust can be fostered by developing good and open relationships (Kelly and Kusel, 2015). Sometimes a decline in trust can hinder networking. Schultz et al. (2018) outlined a decline in trust of the US Forest Service, with community organisations being trusted more in some communities.

Commitment from the partners: Utilising the existing experience and in-kind support of partners was useful for the Access to Nature Partnerships (Natural England, n.d.), and was identified as a success factor by Leach and Pelkey (2001). Government bodies/agencies, industry, private individuals, NGOs and local authorities, research institutes are involved in many of the partnerships identified and the participants involved in the network need to reflect the issue to be addressed.

Clear roles and responsibilities: Mattessich and Monsey (2001) in a review of collaboration suggest that clear roles and guidelines are essential for success. Changes in role and responsibility can also have an impact on collaboration (Bruin et al, 2013).



Effective communication: Open and frequent communication is important both formally and informally (Mattessich and Monsey, 2013). Shultz et al. (2018) identified the need for a communication strategy. Ambrose-Oji (2010) talks about meaningful communication linked to learning systems.

Monitoring and evaluating actions and delivery: Not all networks and partnerships monitor or evaluate what they do. Monitoring and evaluation can range from a light touch approach to a very structured and well reported evaluation. ICF Consulting Services (2015) evaluated the LNPs network through surveys, interviews, workshops and a review of LNP documents and resources. The CaBA Benefits Working Group (2017) set up monitoring and evaluation of the partnerships, however this was not an easy process in terms of comparison across partnerships as they were not all set up in the same year.

Time, capacity and resources: enough time is needed for partners to be able to commit their time to the network and for discussion as organisations and individuals need to get to know each other and the different objectives that those round the table might have (Defra 2012; Bruin et al, 2013; Natural England n.d.; Valachovic et al. 2013; Hemmingway and Gunawann, 2018).

Simple message and actions: The Defra study (2013) suggests that partnerships are most effective when they can deliver simple message and undertake straightforward actions, the work outlines that more complex issues need incentives. Reed (2008) argues for clear objectives from the outset of any network and participatory process.

2.6. Do landscape scale networks influence land manager decision making for more diverse planting, uptake novel/resilient species, or responding to tree P&D?

There is some evidence that networks and partnerships can influence decision making and action in relation specifically to tree P&Ds, however this evidence is currently very limited. The Elm Partnership in East Sussex came together with the outbreak of Dutch elm disease (DED) in the 1970s, although it became inactive for a time (it is not clear when this happened) before meeting again in 2012 as those initially involved in the partnership were still interested with DED (Bruin et al. 2013). The study by Bruin et al. (2013) suggests that partnerships such as the Elm Partnership, that bring together a range of policy makers, experts, economists and some publics, provide benefits due to continuous engagement over time with practical outcomes being developed at meetings. Such a body can also organise or coordinate activities across administration boundaries.

Alexander and Lee (2010) suggest the creation of the California Oak Mortality Task Force (COMTF) formed by the Californian Department of Forestry and Fire Protection and the Californian Forest Pest Council, with funding and support the county and Federal government, raised the issue of Sudden Oak Death from a local issue to a state and

national issue. COMFT now has 80 agencies and a thousand members made up of public agencies, NGO's and private interests, the network assisted federal regulators in reacting to infestations in national wholesale nurseries. The policy recommendations developed by the group are seen as influential as they derive from a consensus-based approach (Alexander and Lee, 2010). There is evidence that after COMFT and the US Forest Service met with tribe members from a specific reservation, the members worked with private interests and universities on research including spraying treatments and education about the symptoms which enabled the tribe to remove hazardous trees at the appropriate time.

Fischer et al. (2018) in a study of private forest landowners' perceptions of cooperation and collaboration - found that landowners thought cooperating could help them to address a variety of risks including pests and diseases. However, the study did not provide evidence of this occurring. Measham's (2007) survey of landowners in Australia concerned about dieback on the Gippsland Red Gum Plains suggest that the survey conducted by members of the local community raised awareness of the importance of management and revegetation. However, no specific evidence was given about changes in actions but there may be more subtle influences on future decision making that have not been captured.

Flint and Luloff (2007) found that community collaborative action in Alaska (in relation to spruce bark beetle) was more likely for those who had lived longer in the communities and those with higher education levels. Examples of actions included attending meetings, cone or seed gathering and clearing public trails in relation to 90% mortality of white and Lutz spruce. They suggest community activeness around pest and diseases is not automatic. The study also found that broader threats to community and ecological wellbeing were more likely to motivate community members to get involved and take action than immediate threats.

3. Conclusions

3.1. Conclusions associated with grants and other policy tools

Because of the large number of studies about land manager behaviours concerning incentive schemes and programmes connected with forest management and woodland, it is relatively easy to draw generalised conclusions. This is not the case for behaviours around tree P&D because the evidence base is so much smaller. Not all the general evidence necessarily infers similar responses around tree P&D.

There is no consensus regarding the effectiveness of policy tools. Some of the evidence is contradictory. This may be because it is difficult to distinguish between the effects of grants (i.e. market instruments), and of advice (i.e. non-market instruments), because in many country contexts the two are supplied together. In terms of policy tool design,

information and advice is often a neglected factor. Wynne-Jones (2013) in Wales, and Ficko et al (2017) in their work across Europe, suggest that policy makers have not applied the lessons coming through from research to the design of their policy tools and support packages, particularly where these pertain to non-commercial owners and farmers. This is particularly important as the behavioural studies suggest that clearly recognising the needs, motivations and values of different kinds of land manager should provide a lead in identifying exactly who is the target of policy measures, and therefore influence appropriate scheme design, information resources, and effective messaging.

The majority of non-commercial land managers are not primarily motivated by making money from woodlands and therefore do not respond to economic drivers. Consequently, grants have a limited capacity to bring about planting or management activity that is additional or different to what the land manager had already intended (Feliciano et al., 2017, Lawrence and Dandy, 2014, Mostegl et al., 2017, Kilgore et al., 2007, Kilgore et al., 2015). In other words, grants may be taken up if they align with existing land manager objectives, but they are not likely to change those existing objectives and behaviours. This would suggest that, outside of the commercial sector, grants alone are unlikely to change land manager behaviour in the context of treating/felling or restocking because of tree P&D.

Marzano et al (2017) show that while there is a stated willingness to engage in biosecure behaviours, land managers may not be prepared to incur extra costs in doing so. Therefore, the rate at which grants are set is probably still important. Eves et al (2014a) surveyed woodland owners and managers in England and found that the intervention that respondents most often indicated they would be responsive to was a higher grant rate, with 47% agreeing and 16% strongly agreeing that this would encourage them to increase their woodland management activity. It is interesting to note that around 51% of respondents in that study said that increased help for management of pests and diseases was an important incentive that would nudge them to act. Eves et al. (2015) researching farmers in England found that “more support for pest & disease control” was the third most important issue after simplification of grant application and higher grant funding that would encourage respondents to enter woodland creation schemes. They also found that concern over pests and diseases is the least significant barrier to farmers planting woodland.

If the right kind of advice and information bundled up with grants is important, other evidence suggests that advice and information provided through the land managers own immediate social networks and professional contexts are significant in decisions to take up grants and in bringing about attitudinal and behaviour change (Hujala et al., 2007, Mostegl et al., 2017). Studies also suggest that contemporary land managers are drawing on information from a far wider variety of sources than traditional forestry organisations.

Not much evidence seems to exist about the success of policy support for restocking, and there were no found studies in the context of P&D. What evidence does exist is

mostly about windthrow events and fire. One study (Brunette and Couture, 2008) focussing on non-industrial private forest owners in Europe, concluded that providing public financial assistance after damage-causing events may reduce forest owners incentives to purchase insurance, and significantly, to reduce investments in adaptive silviculture and protective forest management activities. Lodin et al (2017) reported that in Sweden, after the storms of 2005 and 2007, reforestation was largely conducted by private forest owners who were offered grants to support regeneration with broadleaves. However, their previous planting practices remained largely intact, with spruce occupying 90% of the replanted area. The analysis reveals that continued reforestation with Norway spruce was a result of path-dependencies of practices strongly supported by the species' superior profitability and a higher browsing pressure on alternatives such as Scots pine (*Pinus sylvestris*). Those land managers who considered species other than spruce, were characterised as having risk awareness, consideration of forest aesthetics and curiosity.

Nowak et al (2008) describe a cost share programme in the southern USA to tackle large scale outbreaks of Southern Pine Beetle. Land managers can receive a financial incentive for improving forest health by proactively undertaking forest management practices, e.g. thinning. Rossi et al (2011) showed that felling and replanting were the preferred options, thinning and prescribed burning were not. Land managers were choosing the easiest lowest risk, management options. Although some land managers have taken up the scheme, Nowak et al (2008) also stress the importance of land owner education programmes for raising awareness and building intention to act, because most small-scale owners have little awareness of southern pine beetle, and very little interest in limiting the spread of beetle by acting against it.

Studies which have applied behavioural approaches suggest that land managers past experiences, social norms, i.e. how other land managers are acting, and the concept of efficacy, i.e. a belief that their actions can actually make a difference, have a strong influence on behaviours. Marzano et al (2017) in their global review of work looking at the social dimensions of P&D management identified these factors to be important in the case of tree P&D.

3.2. Conclusions associated with networks and partnerships

There are many different types of partnerships that have been identified in this evidence review, and there are many more that are in existence but not reported here as they were not revealed in the searches, potentially due to the restriction of search criteria or because little is written or evaluated about some partnerships. What is clear is that there is no one model that will fit every situation, some partnerships operate at the local level, while others operate at a regional or national level. Some work at both local and national level such as the Catchment Based Approach. It is clear that some networks and partnerships arise due to a catalyst event or catalyst disease such as Dutch elm disease



or ash dieback, many partnerships involve existing government agencies, local authorities and non-governmental organisations as well as some businesses, industry or private landowners or managers. There is some evidence for the effectiveness of networks and partnerships; although many have not been specifically evaluated. Those that have been evaluated (e.g. Access to Nature, Farmer Clusters and Facilitation Fund, Catchment Based Approaches, LNPs) highlight some of the success and barriers to partnership working. For large partnerships it may be necessary to develop working groups or sub-groups to focus on specific topics and have a clear definition of roles and responsibilities. The Defra reports (2013a, b and c) suggest partnership approaches work well alongside incentives, regulation and advice, and outline that there is a need to focus on how partnerships can add value to or be combined with these other mechanisms. It is clear that networks and partnerships are a useful way to communicate to others in the network and across networks, and there is some evidence of learning between networks and partnerships (ICF Consulting Services, 2015, CaBA Benefits Working Group, 2017).

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