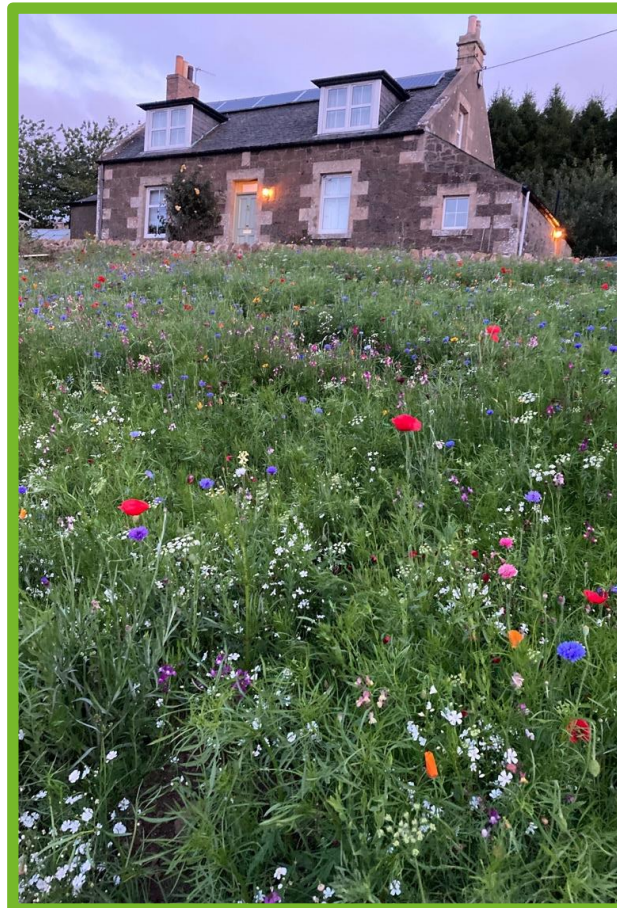# Action Research to gain a deeper understanding of large-scale biosecurity risks to Scotland

Project Final Report

This work was commissioned by Scotland's Centre of Expertise for Plant Health Funded by Scottish Government through the Rural & Environment Science and Analytical Services (RESAS) Division under grant agreement No PHC2021/08

Authors: Rehema M. White[1*], Harry Watkins[2], Lucy Carson-Taylor[3] and Mariella Marzano[4]
[1]School of Geography and Sustainable Development, University of St Andrews
[2]St Andrews Botanic Garden, Kinburn Castle, St Andrews, Scotland, KY16 9DR
[3]Animal and Plant Health Agency, Shrewsbury, England, United Kingdom
[4]Forest Research, Northern Research Station, Roslin, Midlothian, Scotland, EH25 9SY
*Corresponding author - rehema.white@st-andrews.ac.uk

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Research Team: The research team comprised of Mariella Marzano (Forest Research), Rehema White (University of St Andrews), Harry Watkins (St Andrews Botanic Gardens) and Lucy Carson-Taylor (Animal and Plant Health Agency)

Content

1   Executive summary

Project background

There are several large-scale interventions that pose particular biosecurity risks to plant health in Scotland and beyond. Previous Plant Health Centre (PHC) projects explored threats and opportunities for intervention in relation to tree planting for environmental benefit, landscaping and infrastructure projects, non-specialist and online horticultural sales and other contexts. Human behaviours, actions and inactions are key drivers in threats and management of plant pests and pathogens. Organisations and institutions thus have key roles in determining regulations, norms and knowledge flows of groups of stakeholders involved in plant health.

Research aim and objectives

Aim: To undertake a participatory action research approach to identify leverage points for change within selected key organisations and opportunities to embed plant health and biosecurity training and awareness.

Objectives:

- To develop a theoretical framework around Participatory Action Research, Education and Systems Thinking for future stakeholder engagement.
- To create new partnerships with key actors.
- To identify pathways to influence hard-to-reach actors through their membership organisations.
- To highlight actions (mainly regarding education and training) that could have significant leverage potential and impact for plant health.

The key sectors selected were *landscape architects/construction* and *garden design*.

Methods

The co-design approach involved the purposive selection of a small sample of participants who could offer critical insights on the organisations involved and their policies and processes and who had the capacity to engage. Our mixed method and participatory action research approach involved activities including:

(1) online and in-person participatory workshops with project team experts to determine target organisations, clarify theoretical framework and highlight likely key system leverage points (Activities 1 & 3).
(2) an interactive exercise with a broader audience at Scotland's Plant Health conference in 2022 to test the system approach (Activity 2).
(3) co-design of action points by testing system leverage points and identification of people and processes that could lead to change with:
    a.   two landscape architects (Activity 7)
    b.   one contracts manager for a construction company (Activity 8)
    c.   three garden designers (Activities 4, 5 and 6)

Results and discussion

Theoretical framework

- A participatory and co-design approach is particularly useful in plant health where there are shared responsibilities amongst multiple stakeholders across complex and

uncertain pest and pathogen threats and invasions, and a need for innovation and collaboration.

- The complex interactions between people, plants and pests/pathogens across multiple places and projects create systems in which key nodes, interactions and leverage points can be identified for management of plant health.
- Plant health requires formal, non-formal and informal educational inputs for all stakeholders across all sectors, to support the knowledge, skills and competencies required to develop and enact adaptive biosecurity processes.

Activity 1: *Key organisations and system approaches* were identified by a group of experts, and rationale developed for focus on landscape architects/construction and on garden designers (through Society of Garden Designers).

Activity 2: Scotland's Plant Health Conference participants approved the system approach but argued for retention of the role of the wider public along with specific organisations and groups.

Activity 3: A *generic system framework* for an organisation was developed to promote plant health and potential leverage points identified (Figure 1). This framework represents a 'system' in illustrating relationships and interactions between nodes. It is generic in that it can be applied to any organisation or institution to enable analysis of leverage points. This generic framework illustrates key aspects of the system that could be targeted to provide better plant health practices. For any given organisation or institution, this generic system framework enables us to identify suitable leverage points to target action for plant health. In this framework, areas of activity are aspects of the organisation /institution itself (e.g. staff, roles, culture), external factors (e.g. client education, policy context) and internal organisational practices (e.g. accreditation, training, practices).

Activities 4, 5 and 6: *Society of Garden Designers (SGD)* key informant discussion and co-design debates proved the utility of the generic system framework to discuss plant health and identified potential leverage points. These included:
- Need to avoid biosecurity jargon and align with organisational language e.g. use 'sustainable practice' and 'ecological planting' to introduce plant health.
- Accreditation and Continued Professional Development could include more plant health focus.
- Newsletter and Garden Design Journal could highlight new issues for members.
- A plant health stand at the biannual symposium would enhance visibility and relationships.
- Inclusion of SGD representation in the Defra policy and communications groups and possibly Scottish Government related fora would enhance knowledge exchange.
- Contracts and client awareness could be strengthened to support garden designers in making positive plant biosecurity decisions.

Activities 7 and 8: *Landscape architect* workshops and an interview with a construction manager identified several leverage points including:
- Importance of Local Authority planning personnel and processes.
- Education and training on plant health for landscape architects, planners, local authority staff and building contractors.
- Add plant health practices and biosecurity into checklists for landscape architects and contractors e.g. adopt Fitter Flora, embed in Considerate Constructor Scheme.

- We could go beyond 'no damage' minimum in planting guidelines and actually promote positive planting, e.g. ethical planting and planting for biodiversity (bees and butterflies).
- The Chartered Institute of Builders is usually involved in training- health, safety and environmental – and could underwrite and accredit processes related to better biosecurity.
- The Landscape Institute Technical Committees could include biosecurity in their list of core competencies and support training in biosecurity.
- As well as planting protocols, we need to encourage excellent soil management to manage seed and pest dynamics.
- BREEAM assessment (Building Research Establishment Environmental Assessment Method) is widely used by contractors and strengthening plant health guidelines within this framework would have a widespread impact.
- Contracts and client awareness could be strengthened to support landscape architects in making positive plant biosecurity decisions.

Figure 1: Generic system framework developed
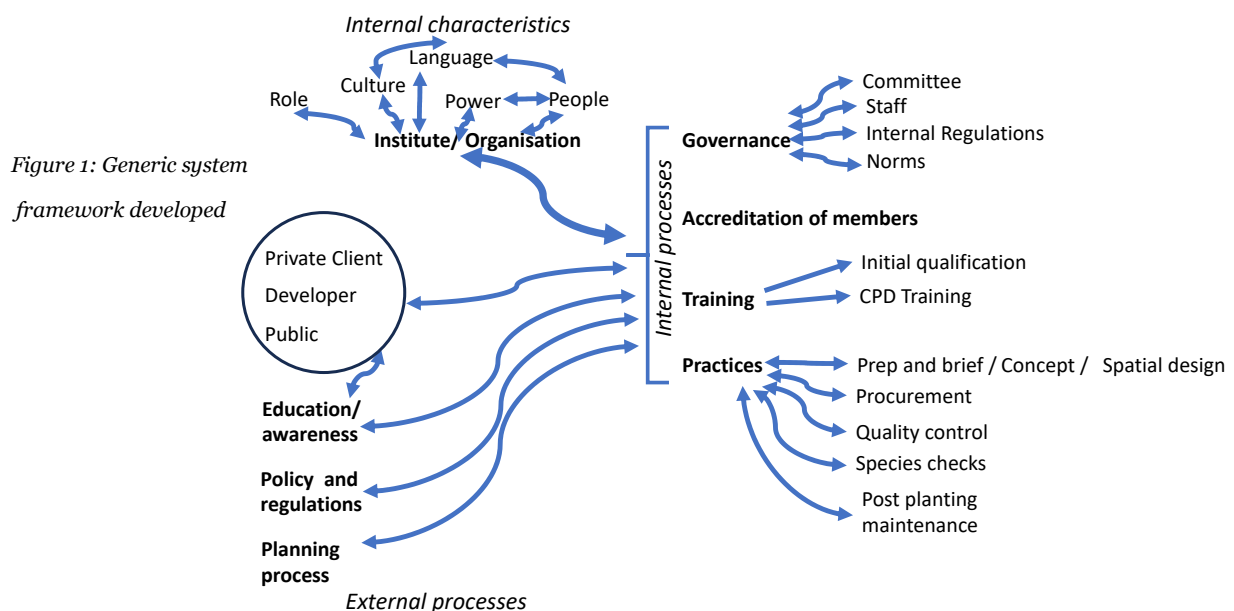
Conclusions

Our results suggest that identifying key leverage points within a systems approach is an effective way of enhancing plant health processes and practices within different organisations. Such leverage points include education, accreditation, certification, continued professional development (CPD) and formal contracts, practice manuals or checklists. We identified opportunities where Scotland's PHC could work with partners to map out training provision or encourage inclusion of plant health in key processes and guidance documents. However, we also promote wider system change for more sustainable plant health practices. A number of recommendations and associated target audiences and partners were identified in the report and are summarised below.

Recommendations

Key recommendations included:

- Work in partnership with relevant *organisations* and *institutions* that have key roles relevant to plant health (i.e. not only targeting individuals or groups). We developed a

generic system framework to help us to identify leverage points and support plant healthy knowledge, behaviours and regulations together with such organisations and institutions.

o Support development and offer a combination of targeted, generic and organisational learning courses and resources clearly signposted for organisations and members.

o Continued Professional Development (CPD) should be compulsory for all professional groups involved in plant selection, planting and maintenance. Whilst external providers may provide such courses (see above), it may be more effective for professional organisations to make inclusion of such CPD mandatory within existing professional training requirements.

o Accreditation in relevant professions should include biosecurity learning.

o Ensure industry standards refer to plant health standards at design, implementation and maintenance stages.

o Ensure sector/organisation representatives sit on biosecurity and policy committees as appropriate.

o Educate the public, clients and contractors regarding plant health standards.

2 Introduction

Scotland's treescapes are facing unprecedented threats due to changes in climate, land use, and the spread of plant pests and diseases (Scottish Plant Health Strategy 2016). A whole range of social, economic and political actors are affected by the need to prevent, respond, recover and adapt to pests and diseases (White et al 2018; Dunn and Marzano 2019). Human influences are key drivers of many biological invasions (Spence et al 2020), and networks of organisations and businesses that grow, trade, transport, purchase and manage these plants have a role to play in plant biosecurity (Freer-Smith & Webber 2017). However, a number of factors affect the actions of these 'stakeholders,' including their awareness of the issues, perceived risks, values and motivations and the push and pull of existing institutional, regulatory, social and economic contexts (Marzano et al 2017; White et al 2018).

Three projects led by Forest Research (PHC04/05/06 [Assessment of large-scale biosecurity risks to Scotland | Plant Health Centre](#)) were conducted in 2020/21 that investigated large-scale biosecurity risks to Scotland from several supply-chains and planting approaches. These projects were exploratory in nature, aiming to outline the potential scope of biosecurity risks and to identify areas of immediate concern in the context of retail, infrastructure landscaping and planting in the natural environment. Each project had a modest budget and was conducted during the Covid pandemic and EU Exit, which impacted on the total volume of data gathered and analysed. Project findings highlighted information gaps that would be very valuable to fill, and different approaches to garner this information were suggested. An opportunity was therefore identified to conduct continued research to build on the recommendations of PHC2019/04/05/06 projects.

This project aimed to undertake a participatory action research approach to identify leverage points for change within selected key organisations. The goal was to identify opportunities to embed plant health and biosecurity training and awareness within relevant organisations. Our project aims were to develop a theoretical framework for future engagement, create new partnerships with key actors, identify ways to influence hard-to-reach actors through their membership organisations and highlight actions (mainly regarding education and training) that could have significant impact. The key sectors selected were landscape architects/construction and garden design. We clarify below the selection process, but actors within these sectors are involved in the choice and procurement of a large variety of plants with associated biosecurity risks related to the import, propagation, and distribution of live planting materials as well as the movement of soil, equipment and people. While the scope of the discussions and possible interventions cover the UK, impacts are significant for Scotland. Our results suggest that identifying key leverage points within a systems approach will be an effective way of enhancing plant health processes and practices within different organisations. Such leverage points include education, accreditation, certification, continued professional development (CPD) and formal contracts, practice manuals or checklists. We identify opportunities where the PHC could work with partners to map out training provision or encourage inclusion of plant health in key processes and guidance documents.

3   Theoretical framework

3.1.1   *Participatory Action Research and Co-design*

Participation can range from merely consulting participants through involvement in a project to the devolution of power and decision making to participants (Arnstein 1969, White et al 2018). Participatory approaches can lead to better instrumental outcomes along with normative and substantive benefits (Blackstock et al 2007). Participatory Action Research is understood to be research by, with and for people affected by a particular problem (Kindon et al 2008). Whilst it can extend power asymmetries between individuals and groups if undertaken without care, if conducted with integrity it can empower people to address issues and can be an important aspect of action-oriented research (Kindon et al 2008). It is a key aspect of sustainability research, along with interdisciplinarity, integration of knowledges and other aspects (White 2013).

Co-design shares the concept of engaging stakeholders, in this case in the initial design of possible interventions or project, and not just carrying out pre-developed plans. Co-design can enable us to harness the creativity and knowledge of different stakeholders both in design of products and of policy processes (Enserink and Monnikhof 2003).

Plant health requires many stakeholders to share responsibilities, and needs participation to maintain wider networks and to work effectively in times of crisis and response to a plant health emergency (e.g. detection of a new pest or pathogen) (White et al 2018). We also know that stakeholder participation can enhance innovation in biosecurity science (Marzano et al 2018). When designing social interventions to prevent, contain or manage the spread of pests and pathogens, a participatory and co-design approach will clearly be advantageous.

3.1.2   *Systems thinking*

A system is "an interconnected set of elements that is coherently organised in a way that achieves something" (Meadows 2008). Meadows describes how it has elements, interconnections and a function (non-human systems) or purpose (human systems). A feedback loop is a closed chain flowing from a stock and back to that stock. She explains how leverage points, places to intervene in a system, can be remarkably difficult to identify in a complex system and how they can sometimes be pushed in the wrong direction.

Proponents of socio-ecological systems focus on adaptive governance to enable those systems to adapt and transform (Folke et al 2005; Olsson et al 2006). Rigid control of such systems can sometimes make a situation worse (e.g. excluding fire disturbance, imposing altered strict property rights), and instead we should seek to support the resilience of such systems (Lebel et al 2006). Resilience is the amount of change a system can endure without altering function or shifting domain (Holling et al 2001). Adaptive governance requires a participatory and dialogical approach, multi-layered and polycentric organisation, and justice and accountability to navigate scale, uncertainties and diversity (Lebel et al 2006).

Systems thinking has underpinned many theories in environmental management and governance and is often used to explain and understand complex and uncertain contexts. It is less frequently used to pro-actively identify practical actions for stakeholders to undertake. In one such case, interventions were identified as leverage points to enhance human-nature relationships through specified educational pathways to action (Richardson et al 2020).

There has been some resistance to a focus on resilience, when the system is perceived to be flawed, either in having an unsustainable purpose or in not achieving its purpose. For example, the capacity of communities to be resilient to climate change is limited, and wider structural change is required to enable them to thrive (Meyerricks and White 2021). There have been

many calls for societal system change, and a transformation to sustainability (Patterson et al 2017).

In terms of plant health, we can identify systems at the level of sectors or pest or pathogen species, including ecological factors and social factors. If we look at particular sectors, we can explore the potential for leverage points that will enable us to shift the system in desired ways. We can support resilience, whilst recognising that we may need the system to transform and not merely adapt, in some sectors or for some species.

3.1.3   Education

Education is often perceived to mean formal education and acquisition of qualifications in school, college or university. In fact, non-formal and informal modes of education are also critical, both in supporting formal education and in reaching different groups of learners. Non-formal education is structured and intentional (Rogers 2019) and can include learning in CPD in professional contexts (e.g. garden designers, landscape architects), community based learning, training in organisations or awareness raising by NGOs, businesses or government (White et al 2023). Informal education is less structured and can comprise influences from social media, news media, television, radio, arts and literature, informal discussions and wider cultural influences (White et al 2023).

Plant health requires formal, non-formal and informal educational inputs for all stakeholders across all sectors, to highlight the importance and relevance of plant health across sectors and support the understanding, knowledge and skills required to put biosecurity processes into practice. A key aspect of plant health and biosecurity is the need to constantly update information with new threats and regulatory requirements, to communicate and collaborate with others and to be able to adapt to new contexts. Hence, along with other sustainability issues, education for plant health should focus not only on information but also on the development of key competencies (Wiek et al 2011). These might include systems thinking, critical thinking and future thinking; collaborative, normative, self-awareness and adaptive capacities; and abilities for interdisciplinarity, problem solving and strategy (Giangrande et al 2019).

3.1.4   Application of theoretical framework

It has been demonstrated that maintaining and enhancing plant heath in Scotland and beyond will require the engagement and collaboration of many different stakeholders (White et al 2018). A participatory action research approach in this project recognises the roles and responsibilities of all participants in contributing to biosecurity and encourages them to take immediate action, whilst preparing them for further engagement with other stakeholders. A systems approach enables us to develop a generic conceptual framework and to explore individual organisations or sectors as systems. Since systems can scale together, linking these enables us to vision the different sectors with influence on plant health. Understanding how systems work enables us to identify key leverage points for immediate action and to consider who might be able to press those levers and make significant changes with a particular action. Unsurprisingly, many of these leverage points are focussed around training and education in accreditation or CPD requirements for professionals, but key contract documents or regulations might also be possible leverage points. It is important to acknowledge that whilst these leverage points enable us to manipulate the system in the short term for enhanced plant health, in the longer term, we should also modify the system itself and introduce changes needed to support more sustainable processes and outcomes, including biosecurity. System change is one way of conceptualising and enacting a transformation to sustainability (Patterson et al 2017).

4 Methods

This project used a mixed method and participatory action research approach, involving several activities. These included:

1) online and in-person participatory workshops with project team experts to determine target organisations, clarify theoretical framework and highlight likely key system leverage points (Activities 1 & 3)
2) an interactive exercise with a broader audience at Scotland's Plant Health Conference in 2022 to test the system approach (Activity 2)
3) co-design of leverage points and action points by testing system leverage points and identification of people and processes that could lead to change with:
    a) two landscape architects with current or previous roles in the Landscape Institute (Activity 7)
    b) one contracts manager for a construction company (Activity 8)
    c) three garden designers, two of whom have active roles within the committees of Society of Garden Designers (Activities 4, 5 and 6)

The co-design approach involved the purposive selection of a small sample of participants who could offer critical insights on the organisations involved and their policies and processes and who had the capacity to engage. We had aimed to conduct workshops and focus groups, but difficulties in scheduling multiple busy people from hard-to-reach groups led to us working with expert pairs or individuals in several of the activities.

Data from the participatory and interactive exercises (Activity 1-3) were collected on paper, on individual sheets or through flip chart exercises. Summary outcomes (Activities 1 and 3) were converted into diagrams that were circulated again amongst participants until consensus was reached on the best way to display systems and to highlight potential leverage points. For Activity 2, materials were handed out at the conference and notes and verbal summary feedback points were collated and synthesised. Co-design discussions (Activities 4-8) took place over Microsoft Teams and were recorded and transcribed using Teams software. Project team members also took notes. Analysis included synthesis of comments on the system maps leading to modified maps if required and coding for key process and action points from the interviews. Key points were fed back to co-design partners to clarify and confirm outcomes. Some action points were enacted immediately by the team, some were identified for implementation by co-design participants and others were listed for potential action by the PHC or other actors.

5 Results

5.1 ACTIVITY 1: Expert meeting May 2022

The project team held an online workshop to explore the potential of the action research and co-design approach to enhance biosecurity in key sectors.

Key findings:

Refined project approach

While the proposal was originally about identifying opportunities for biosecurity awareness and training to wider memberships through key organisations, the team considered that it would be more fruitful to focus on the potential of 'in-house' training and processes within specified groups. However, in order to make the project findings more widely applicable, it was also agreed that a system mapping approach would help to identify commonalities as well as specific intervention and trigger points for biosecurity support. This approach was confirmed with the PHC.

Identification of key organisations

Several sectors were identified as being appropriate for this approach. These included:
  a) Landscape designers
       o Landscape architects
       o Garden designers
  b) Regulatory bodies
       o Local Authority planning departments
       o Accreditation assessors (eg BREEAM, Building with Nature, Considerate Contractors)
       o Industry bodies that certify professional members (Landscape Institute, Society of Garden Designers, BALI, HTA etc)
  c) Landscape developers (typically acting as clients)
  d) Contractors
  e) Horticultural producers and nurseries
  f) Retailers
       o British Retail Consortium
       o Other retailer groups
  g) Natural Environment
       o Land managers
       o Contractors

Some organisations were in a period of transformation which made it difficult to engage during the project time frame; others were beginning a period of change and it was suggested that it was a good time to facilitate possible changes in education and training as part of an ongoing transformation. It was decided to focus on, firstly, the processes and practices of **landscape architects,** who are certified through the Landscape Institute, because they play a key role in landscape design, specification, development and construction and work in collaboration with local authorities. These processes and activities can significantly affect plant health in newly planted development projects. Secondly, it was concluded that **Society of Garden Designers** would be an excellent organisation with which to co-design potential educational and training opportunities in relation to plant health as their members buy and specify plants and trees for both domestic and commercial projects. It was considered that British Retail Consortium was suffering from ongoing EU Exit issues and hence the timing of

our intervention might not be good. In future, this may be a key area to co-design change. There has recently been rapid progress in Natural Environment thanks to the work of Ruth Mitchell (as part of her [Plant Health and the Natural Environment Fellowship](#)) and others, hence we felt that our efforts were best placed elsewhere. However, the systems approach may yield new insights for Natural Environment as well, in the future.

Initial system approach

In this workshop, it became clear that we were dealing with a system of interacting actors and processes regarding plant health. In addition, we were dealing more with the demand than the supply side of plant procurement, movement, planting and maintenance. These ideas were taken forward into later activities.

5.2 ACTIVITY 2: Participatory exercise at Scotland's Plant Health Conference June 2022

Scotland's Plant Health Conference was considered an excellent opportunity to capture insights from a wide range of stakeholders. Authors R.M. White and M. Marzano ran an exercise where sheets illustrating a basic system focusing on supply of plants and potential target institutions and processes were distributed to each table alongside some discussion questions.
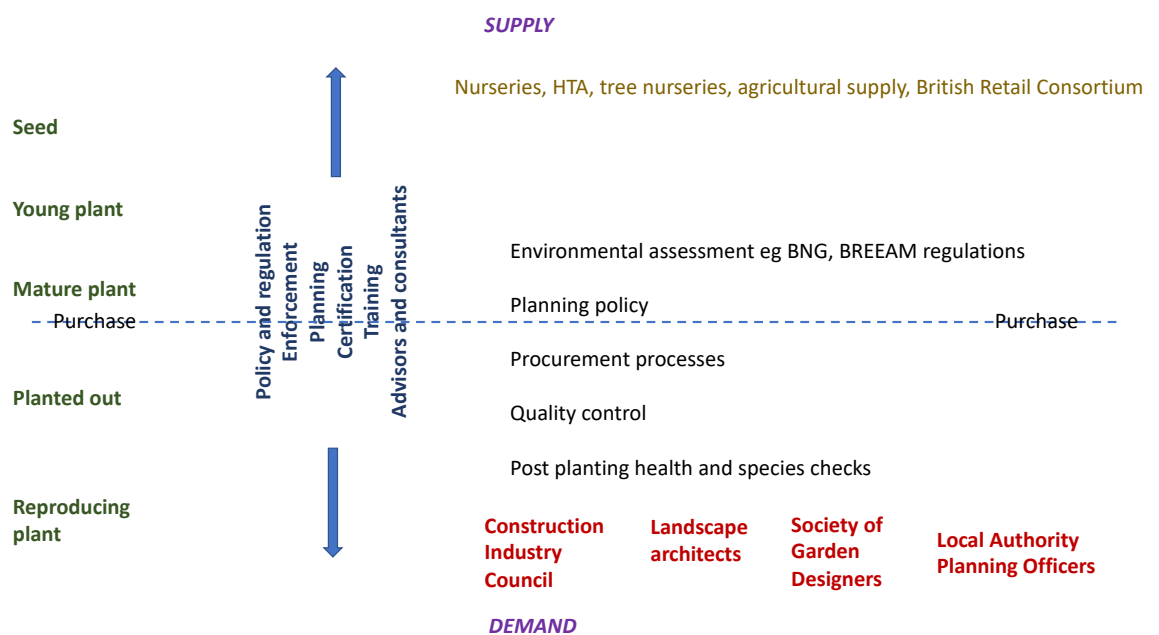
Figure 1: the system map used to generate discussion in Scotland's Plant Health Conference

Key findings

Written and oral feedback from conference participants was collated regarding specific points and the general system. Overall, they liked the system approach but felt that it needed to include the public along with specific groups. It was concluded that even if we wanted to focus on specific institutions, we needed to consider how they interact with the public in different ways.

5.3 DEVELOPMENT OF GENERIC FRAMEWORK - ACTIVITY 3: Workshop St Andrews June 2022

Drawing on the expertise of team experts, we spent a full day in a workshop to investigate the process of landscaping as undertaken by landscape architects, as well as considering the Landscape Institute, and the process and context for organisations supporting garden design.

Key findings

For each organisation, a sketch was produced and potential action areas, positions or people were circled. A generic system framework emerged (Figure 2) that identified key organisational characteristics, processes external to the organisation and internal organisational processes. We then identified potential key areas for leverage points. These included aspects of the organisation itself, education/awareness, policy, and how these factors affected governance, accreditation, training and practices in the sector. We developed an action plan of who to contact, and when, for specialist workshops.
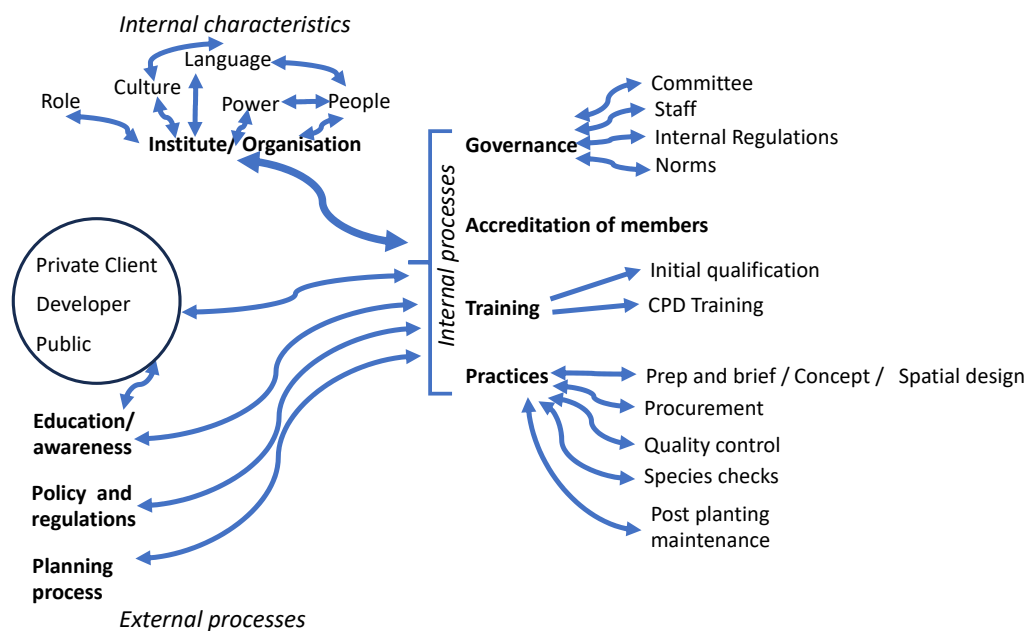
Figure 2: Generic system map developed in project team workshop (Activity 3)

5.4 Society of Garden Designers

The Society of Garden Designers states that it "is the only professional association for garden designers.... championing excellence in garden design, and supporting our Members to train, work, develop and continually maintain the highest standards" (Society for Garden Designers website). Members undertake an accreditation process and sign up to a Code of Conduct. This organisation has done much to professionalise the work of garden designers and has influences members on garden design choices and therefore plant health.

5.4.1 ACTIVITY 4: Specialist workshop

A discussion was held with a key participant to understand the processes by which the Society of Garden Designers recruits, trains and supports the professional development of members, and to explore the potential for biosecurity to be more deeply embedded at key points. The informant also understood many aspects of the inspection regulations and processes, hence

could offer a robust view of the system. Specific system maps showed two options to explore ways in which the system might be visualised.

Key findings

The system map facilitated a detailed discussion and was broadly approved as capturing the form of, and interactions between, practices and processes. Key individuals were named who could offer or modify existing training to support plant health. Enhanced understanding of processes was developed.

5.4.2   ACTIVITIES 5 AND 6: Co-design with Society of Garden Designers committee members

Separate discussions were held with two individuals who were active in the Society of Garden Designers and who had influence over future education and training opportunities, to co-design opportunities to strengthen biosecurity.

Key findings

The system map helped facilitate the discussion but the experience, knowledge and influence of these individuals identified several specific, more detailed leverage points for action. The position of project team members also led to specific collaboration opportunities (e.g. invitations to join plant health related policy groups) that will strengthen future knowledge exchange.

5.4.3   Synthesis of system and leverage points for Society for Garden Designers

The system maps produced (Figures 3 and 4) were said to broadly identify leverage points for action in this organisation and with their members. All co-design participants agreed that the language used to encourage members to learn was important. There is increased interest in 'sustainable practice' and in 'plant health' or 'plant pests and diseases' but the term 'biosecurity' is less commonly used. Currently there is interest in 'plant passport' and 'plant purchasing', but the terms 'ecological planting' and 'naturalistic planting' also provide an opportunity to link with the principles and practices of plant health.
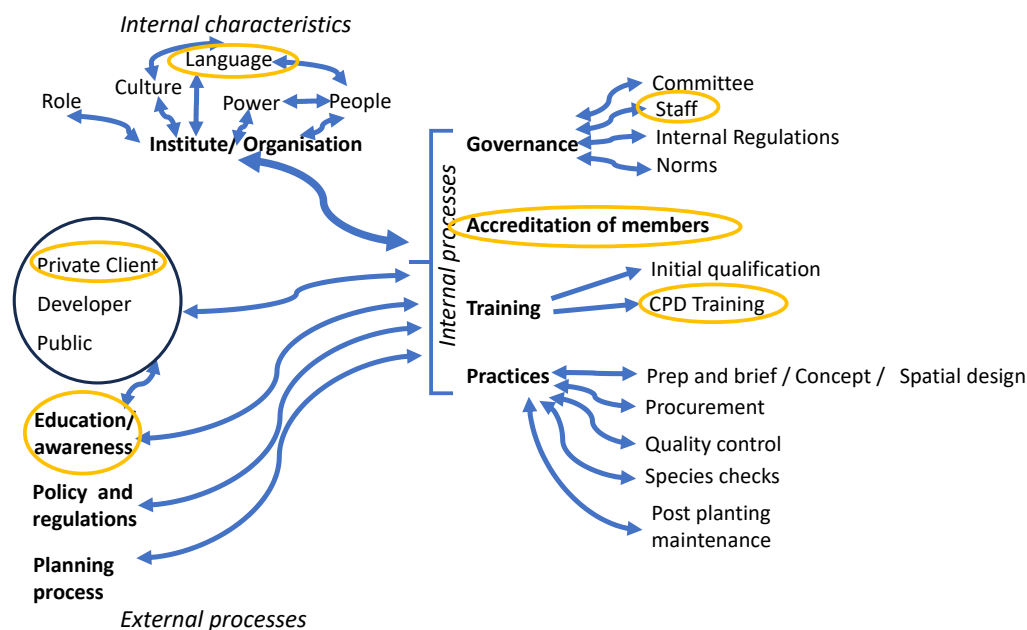

Figure 3: System representation of key plant health intervention points for Society of Garden Designers
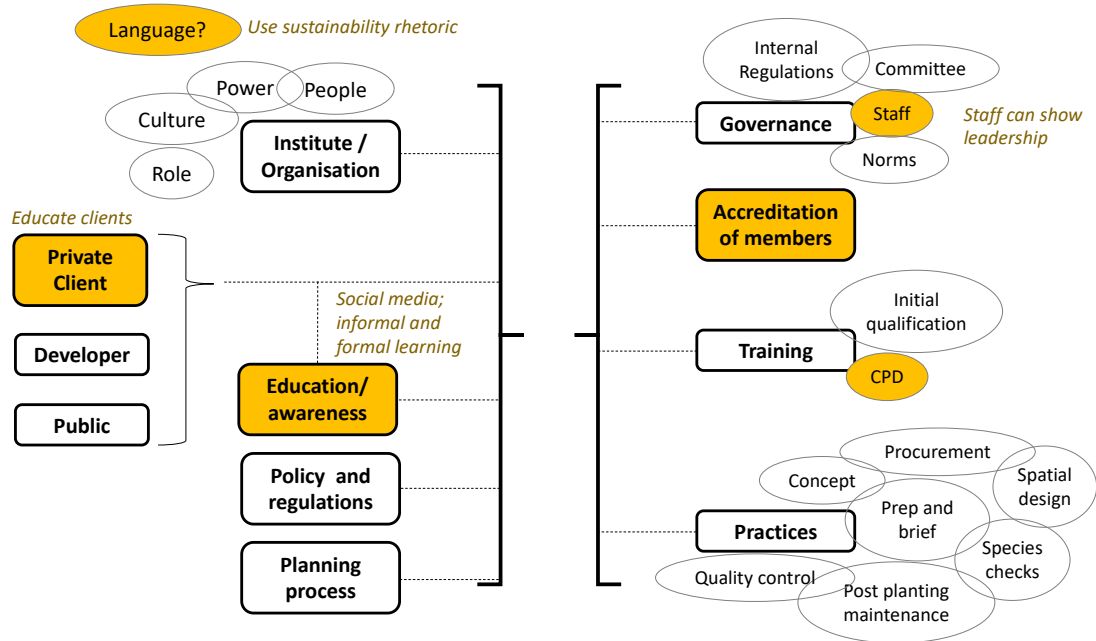
Figure 4: Alternative system representation of key plant health intervention points for Society of Garden Designers

There is employed administrative staff for SGD. It was noted that many of the people running training and processes within the SGD are volunteers, not paid staff. Rapid turnover of some of this group means that changes in practices or emphasis on education and training must be embedded in process as well as through good relationships. The increasing pressures and accountability on garden designers and on the SGD is leading to enhanced professionalism of the organisation and members. The SGD is an influential body with many members, including very well-known garden designers.

Garden designers tend to usually work in private gardens, with less regulatory context than for landscape architects. There is strong competition between garden designers and pressure on garden designers to deliver what the client wants, with the possibility that the client may just look elsewhere if their demands are not met. There are often several conversations between client and garden designer. Some garden designers work 'end to end' but others sub-contract works or planting to a gardener or landscape contractor; there can be complexity in these relationships and with regards to legal responsibilities. It is often the case that whoever sources the plants obtains the price margin.

Opportunities were identified for enhanced plant health training in accreditation and CPD processes. Aspiring members of SGD are associate members before submission of portfolios; accreditation can take up to 5 years from first submission, with 3 projects needed, and is a substantial amount of work. The categories include friend, student, pre-registered members, registered members, fellow. There are 10 regional coordinators for cluster groups for training, who report to a national manager. Accreditation and CPD are important leverage points to support plant health learning. SGD requires 25 hours of CPD per year. Some established providers are popular with garden designers and could be supported to include more biosecurity ('plant health and sustainability') material. There are many colleges (approximately 15) associated with SGD; the quality and amount of training delivered varies across these but provision of simple resources for them to include could be useful, as could strengthening of benchmarks. There is a newsletter and a Garden Design Journal which are widely read which could also include plant health material. A plant health (APHA and/or PHC)

stand at the biannual symposium in London (usually at Royal Geographical Society in April and November) would gain visibility and help build relationships. The inclusion of SGD representation in the Defra policy and communications groups would strengthen the group and enhance knowledge exchange and there is potential for inclusion in Scottish Government related fora. In addition, contracts and client awareness could be strengthened to support garden designers in making positive plant biosecurity decisions. Table 1 illustrates these key interventions in relation to the system framework.

5.5 Landscape Architects

5.5.1 ACTIVITY 7: Specialist workshop Landscape Architects

A small focus group was held with project team members and key participants to understand the processes by which the Landscape Institute recruits, trains and supports professional development of landscape architects, and to explore the potential for biosecurity to be more deeply embedded at key points in the wider practice of landscape architecture. Specific system maps showed two options to explore ways in which the system might be visualised (Figures 5 and 6).
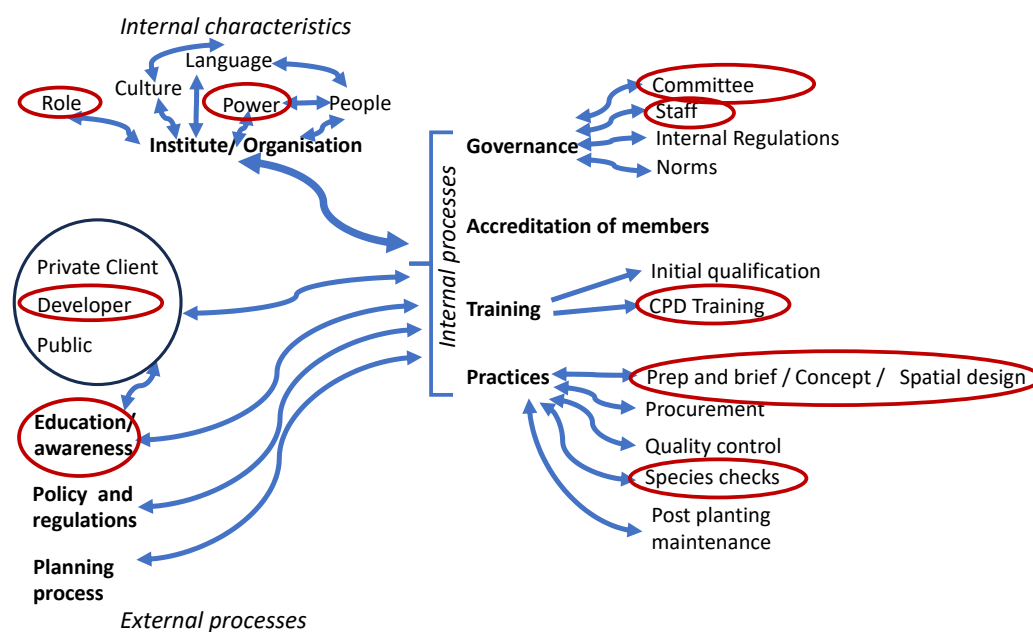

Figure 5: System representation of key plant health intervention points for Landscape Architects
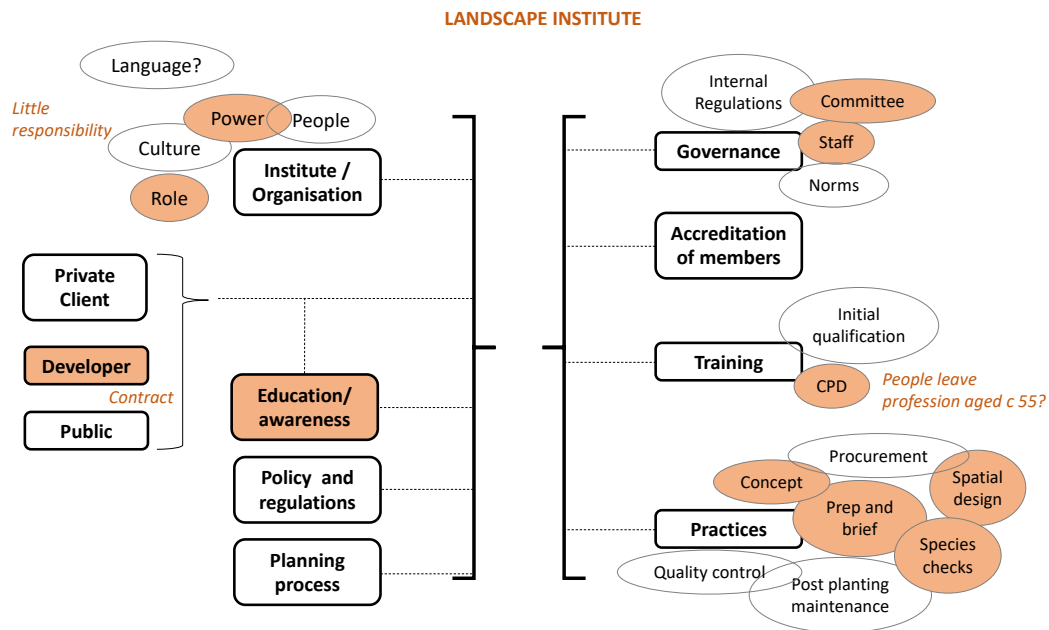
Figure 6: Alternative system of key plant health intervention points for Landscape Architects

Key findings

The system here goes beyond practices and processes and also includes key people. In this case, several people were identified who could further support co-design of interventions. There was also discussion of how closed the system map should be because landscape architects work closely with local authorities and construction companies. As for SGD, the challenge of client demands was raised as a constraining factor on contracts and possible choices by landscape architects. Finally, in this case the process of concept and project brief preparation were complex, formally regulated and key in the decisions that landscape architects could make in relation to plant choice, procurement, and planting. Some key points are drawn out in the synthesis below, regarding training needs and working relationships and practices.

5.5.2 ACTIVITY 8: Co-design with construction and development manager

A guided discussion with a construction manager active in Scotland unwrapped many of the processes by which their construction company hires and manages landscape architects. This discussion elicited further opportunities for inclusion of plant health and biosecurity decision-making during development processes (see also Karlsdóttir et al 2021). Planting and maintenance is often the responsibility of the contractor, not the landscape architect. Local authority personnel were also seen to be critical in this process, particularly with regard to planning permissions. There are several certification schemes and contract points at which biosecurity can be embedded.

Key findings

- **Importance of local authorities** - The local authority planning officer is critical. Local council biodiversity officers look at EIA. Local authorities are responsible for some plant invasion control.
- **We need to be careful about soil**. Soil origin is important. Soil bought in can carry seeds. If not stored properly, it will lose fertility and impact on plant success and resilience against disease.

- **Tie plant pest and pathogen practices to invasive plant management**. Not only pests and pathogens but invasive plants are a concern e.g. Japanese knotweed, Himalayan balsam.
- It is important to instil passion and provide **training** for all actors involved including local authority staff, landscape architects and, of course, contractors.
- **Practices and roles** - landscape architects do design, then planners approve, and contractors do the landscaping. **Contractors** often plant and usually do the post planting maintenance. There is scope to encourage contractors to take on a 10 year contract, not just 1, which would encourage longer term planning.
- Contractors usually have a checklist for activities that may be linked to the contract. **Put biosecurity in checklist for contractor** – all big contractor companies have quality checklists and smaller contractors may use the construction company list.
- Include biosecurity in **risk assessments**.
- Most construction companies aspire to be in **Tier 1 registration** – so there is potential to ensure that biosecurity is included in these certification requirements.
- Those who give out contracts and have work available can specify requirements and also provide biosecurity information to contractors e.g. **Cairngorms National Park** can promote through industry media.
- Industry bodies need to register with the **Considerate Constructor Scheme** and so ensuring that this includes reference to biosecurity would strengthen biosecurity awareness and practices.
- We could **go beyond 'no damage' minimum** in planting guidelines and actually promote positive planting e.g. ethical planting and planting for biodiversity (bees and butterflies).
- The **Chartered Institute of Builders** is usually involved in training- health, safety and environmental – and could underwrite and accredit processes related to better biosecurity.
- We should **engage and empower everyone in responsibility**, from labourers through to project managers.

5.5.3 Synthesis of system and leverage points for Landscape Architects

We now offer a synthesis of the system in which landscape architects function. This is a composite system derived from different activities in this project, in order to collate potential leverage points. Further detail on this system can be found in the PHC 2020/05 project (Karlsdóttir et al 2020).

A landscape architect is often subject to strict financial and time constraints and following industry protocols (e.g. Royal Institute of British Architects (RIBA) Plan of Works), will need to produce several plans to incrementally build the plant specifications and planting methodologies. Hence, there can be pressure to go for the same few 'known' low maintenance species (Watkins et al 2022). Sometimes, landscape architects have little influence in the face of the local authority (which may have specific objectives set out in the Local Plan) and contractors (who practise 'value engineering'). Effective leverage points could be developed if planners require biosecurity measures to be met and/or if the contractors are obliged to highlight the biosecurity implications of variations to contract that are made and recognise and resource biosecurity measures. The latter obligations could be embedded in certification and process schemes such as the Considerate Construction Scheme, checklists and client demands, or through the more effective implementation of BIM (Building Information Modelling) resources to ensure that all parties have standardised levels of information about

plants. In this case, training of landscape architects and contractors is required to ensure that all recognise the importance of plant health in development and construction processes.

Breaks in communication between actors and changes in plans can have biosecurity consequences in construction and development. For example, houses may be built in slightly different locations from an original plan, procurement can take place late in the process (meaning that plant source may not be a very reliable source), contractors plant different plants to the ones that the landscape architect specified. There are often no checks that stated practices were followed (by the local authority or by the landscape architect). Maintenance after planting is often done by the contractor for one year but may be a 5 year or 10 year contract. Hence, the need for all actors to be compliant with biosecurity and plant health practices.

A key finding of the PHC 2020/05 project (Karlsdóttir et al 2020) was that only 24% of green infrastructure projects were planted as approved by the Local Authority (Watkins et al 2022). The Fitter Flora pilot (Watkins et al 2020) identified opportunities for embedding high quality plant performance and biosecurity data into existing digital workflows and shared across actors (local authorities, developers, contractors) through software-agnostic data templates. There is not as much cross sectoral collaboration as there might be, and there needs to be agreed methods for auditing plant materials in some construction processes.

Devolved nations have different standards although some are UK wide e.g. Building with Nature Standards. There is perceived to be a need for more training on plant health and biosecurity for landscape architects. There has been a range of CPD offered, although little focusing directly on biosecurity. Online courses are popular because they are cheap and easy to attend. Because of the governance structure of the Landscape Institute, the focus group suggested that it may be effective to target CPD in branches. Currently, landscape architects require 25 hours per year of CPD, including 5 hours on climate change. CPD can include discussions, attending talks and going to visit nurseries. Technical standards control all the work in groups and decide which areas are funded. There is no longer a working group on biosecurity, although this could be revived in the future. However, there is an environmental standards group which functions well and biosecurity might fit into that remit, or may also fit under climate change. The curriculum on the pathway to chartership was recently restructured, and now supports a list of core competencies that landscape architects should have. The Landscape Institute Technical Committees reviews this at intervals. Including biosecurity in this list of core competencies would help ensure that training in biosecurity was seen as valuable and necessary. There are officers and trustees on technical education and policy areas. These committees are elected for two years but can be reappointed, so some people are there for 6 to 8 years. RIBA practices are important but it is difficult to influence the client. There is potential for this in the future but it is not seen as an immediate possible leverage point. There is an Environmental Impact Assessment (EIA) process. BREEAM is very influential but it may be difficult in the short term to change their criteria or processes. While we did not start discussions with BREEAM assessors, this may be considered in the future. Key leverage points for possible intervention are highlighted in Table 1.

Table 1: *Possible leverage points for garden design and landscape architecture / construction sectors that could lead to real change in positive plant health practices.*

Area of change	Aspect of change	Garden designers: suggested leverage point	Landscape architects/ construction: suggested leverage point
Organisational characteristics	Language	Align with organisational language e.g. use the terms 'sustainable practice' and 'ecological planting' to discuss plant health	
Organisational characteristics	Role / Power		Landscape Institute has relatively little responsibility or power in the construction process
External processes	Education / awareness	Key engagement opportunities with private clients and garden designers including Newsletter, Journal and biannual symposium	Education for landscape architects, planners, local authority staff and building contractors
External processes	Policy and regulation	Inclusion of SGD representation in the policy and communications groups	Contracts and client awareness could be strengthened to support landscape architects in making plant healthy decisions
External processes	Planning process	Importance of Local Authority planning personnel and processes	
Internal processes	Organisational governance		Support staff and committee to strengthen focus on plant health
Internal processes	Accreditation and CPD	Accreditation and Continued Professional Development could include more plant health focus	Add plant health practices into training for landscape architects and contractors
Internal processes	Practices	Contracts and client awareness could be strengthened to support garden designers in making positive plant biosecurity	Ensure the concept and spatial design retain plant choices for plant health and follow through with species checks Add plant health practices into checklists e.g. Fitter Flora, Landscape Institute, Considerate Constructor Scheme, Chartered Institute of Builders, BREEAM

6 Discussion

The theoretical framework and system approach proved extremely useful as a tool for engaging with sector participants. An action research, co-design approach with key actors in the fields studied helped to clearly identify opportunities for change. These opportunities could be acted on by participants, by the research team, by the PHC or by other relevant actors. The act of discussion itself highlighted the importance of plant health to these individuals. Whilst these participants were cognisant of the relevance of biosecurity, they all acknowledged that the pace of change (around pests, climate change effects, regulations, recommended practices, certification) was such that regular updates to education and training were required.

The systems approach permitted a generic overview of how we might identify leverage points and influence change. Applying it to key stakeholders enabled focus and rapidly highlighted opportunities for a few key leverage points (see Section 4.7). The leverage points identified proved robust when ground truthed against co-design participants in the field. In addition, the system maps proved to be good tools to use in participatory action research. Discussion of a system diverts any sense, even if unintended, of personal blame, and made it easier for participants to engage. In the past, we have suggested that trust and relationships are critical in developing biosecurity across diverse stakeholder groups. We now also support the elaboration of underpinning process and network system diagrams to underpin decision making and training steps and to reduce reliance only on individual relationships with researchers or government officials when working with a sector.

Some of these leverage points will derive benefits in the short-term but others may take a longer time period. There is a degree of opportunism to how PHC might approach some of these actions. For example, SGD is currently reconsidering some of the training and this is an excellent opportunity to engage. Certification schemes are updated sporadically, at which point inclusion of biosecurity is timely. Many of the leverage points can be pressed by PHC/Scottish Government through putting different actors in contact with each other and highlighting resources. For example, APHA in England has already offered to support some SGD training. Ensuring that the Plant Health Risk Register and Plant Health Portal are accessible and well known can help support learning. The simple messages regarding plant health behaviours produced by PHC offer an excellent resource for raising awareness widely.

In a relatively small project, we have thus devised an approach by which we can take diffuse and serious threats to plant health and identify key stakeholder groups, identify key organisations influencing the training, processes and practices, identify key leverage points and potentially have a big impact through targeted support of accreditation, training, education, policy or contracts. This understanding can link to the PHC communication strategy to ensure that these efforts have a significant effect. In some cases, it will not be PHC who facilitates training, but PHC could potentially act as a bridging agent to link appropriate bodies together.

The Society of Garden Designers is a key organisation that supports garden designers across the country. It has significant influence yet is run largely by volunteers. Their experience can impact on training opportunities, but as biosecurity becomes a greater, more complex and ever-changing threat to gardens and their plants, there is a need to link to more up to date and motivational training on plant health.

Landscape architects are key players in the choice, procurement, planting and maintenance of plants in large-scale projects. They must be supported by good training but this also needs to stretch out to other actors in the value chain. In this sector, there are many contractual steps that have potential to lock in plant healthy awareness and behaviours and protect landscape architects in making good decisions. We note here the existing Landscape Consultant's Biosecurity Handbook led by the Landscape Institute and published jointly with SGD, British

Association if Landscape Industries (BALI) and Association of Professional Landscapers (APL) (https://www.landscapeinstitute.org/technical-resource/biosecurity-toolkit/). This handbook was the first attempt at cross-sector collaboration, mapping out practices (within the RIBA framework) and species guidance. Developing and promoting this further could underpin many of the activities listed under recommendations.

Project progress was slowed by delays in timing of workshops with key individuals and by some Covid related issues. However, we mitigated this by drawing on the diverse team to cover Covid related absences. We undertook an additional step with workshops and introduced a system mapping approach that was not originally planned. The recommendations provided in this report provide some opportunities for the PHC to further support plant health in specific and generic ways.

Whilst we identify leverage points to ensure that efficient and effective impact can be made or supported by the PHC and other stakeholders, we note that these tweaks to the system will not be sufficient to meet biosecurity and other sustainability goals in the longer term. Wider system changes are required to ensure a healthy environment, flourishing society and prosperity shared across stakeholders and regions and include changes to regulation and contractual relationships. Changes in systems can be gradual or can occur after a system has reached a tipping point or is flipped by some external shock. Along with our immediate actions on leverage points, we recommend continued exploration of opportunities for system change.

7 Recommendations

7.1 Options for interventions at leverage points with landscape architects and others

These co-designed interventions should be implemented in collaboration with key individuals in relevant organisations. PHC could be responsible for initiating discussions and interactions and supporting initiatives.

Table 2: Top ten leverage points identified for plant health with landscape architects

	Area of action	Leverage point	Responsibility to initiate	Possible partners
1	Accreditation	Ensure landscape architects are learning plant health and biosecurity practices	Landscape Institute	PHC, APHA, SASA, training provider
2	CPD	Training for landscape architects e.g. Landscape Institute topic days	Landscape Institute	PHC, APHA, SASA, training provider. BALI have established training and may be able to share
3	CPD	Training for local authorities especially planning departments	Local authorities	NatureScot, Universities teaching planning, PHC, SASA, APHA, training provider, COSLA
4	CPD	Training for contractors and developers, linked to regulatory requirements and professional training	Not identified but possibly Construction Industry Council	PHC, APHA, SASA, training provider
5	CPD	Other relevant organisations – developer, construction materials providers, plant nurseries etc	Not identified, but a need for all actors in this arena to be educated	PHC, APHA, SASA, training provider
6	Practices and standards	Ensure key industry texts such as the Barratt Construction Best Practice Guide include reference to plant health standards	Barratt	PHC, APHA, SASA
7	Practices and standards	Building with nature. Include in maintenance manual and financial and systems organisation; would be easiest for RIBA early stage	RIBA	PHC, APHA, SASA
8	Certification	Ensure schemes such as the Considerate Contractor Scheme include plant health	Considerate Contractor Scheme	APHA, PHC
9	Education	Support sector webinars such as those from BALI and	BALI	APHA, PHC

		Arboricultural Association and promote key websites.		
10	Education	General awareness so that client and all stakeholders are aware of plant health	Important that existing organisations continue to push this (e.g. RHS, Chelsea Flower Show, magazines, campaigns at shows)	All plant and gardening organisations

7.2 Options for interventions at leverage points with Society of Garden Designers

These co-designed interventions should be implemented in collaboration with key individuals in SGD. PHC could support by initiating discussions and gatekeeping.

Table 3: Top ten leverage points identified for plant health with garden designers

	Area of action	Leverage point	Responsibility to initiate	Possible partners
1	Accreditation	Support SGD in including more plant health material in accreditation learning	APHA	PHC, training providers
2	CPD	Run one session per month for SGD cluster groups	SGD	APHA, training providers
3	CPD	Investigate college benchmarks and potential provision of resource for them	SGD	PHC, training providers
4	CPD	Support resources of other CPD providers e.g. London College of garden design, also approved trainers	SGD	APHA, training providers
5	Practices	Include plant health in good practice checklists (e.g. sourcing, species) and contracts with contractors, and use a BALI registered contractor if possible	SGD	BALI
6	Education	Have a biosecurity conference stand at the bi-annual SGD symposium	APHA, PHC	
7	Education	Write a 1 page article for the newsletter; ensure that each newsletter highlights latest information from Plant Health Portal	APHA	PHC encourage scientists to produce articles
8	Education	Write an article for the Garden Design Journal	PHC and research team	
9	Education	Continue to raise public awareness of plant health so that clients are aware of risks	Important that multiple organisations continue this (e.g.	All plant and gardening organisations

			RHS, Chelsea Flower Show, magazines, campaigns at shows)	
10	Policy	Invite SGD to the Plant Health Advisory Forum and STAG	Defra	

8 Conclusions

This project has developed a systems approach to facilitate further understanding of key organisations and identify general and specific leverage points at which interventions could have a significant effect on the system. Typically, these include provision of plant health training and education for accreditation and in CPD, wider education and awareness and interventions in relation to practices and policies, often targeting key checklists or certification schemes. These interventions should be undertaken in partnership with plant health organisations (e.g. PHC, SASA, APHA) and in collaboration with key individuals in targeted organisations to ensure that cross-border solutions are co-designed and embedded within professional processes. Hence, such interventions can target resources to catalyse relatively large benefits in plant health education, practices and processes across different sectors. In addition to these possible effective interactions, we should continue to push for system change towards a sustainability transformation within and across sectors.

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Plant Health Centre
c/o The James Hutton Institute
Invergowrie,
Dundee, DD2 5DA

Tel: +44 (0)1382 568905

Email: Info@PlantHealthCentre.scot
Website: www.planthealthcentre.scot
Twitter: @PlantHealthScot