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KNOWING TO GROW: INCREASING THE RESILIENCE OF PLANT-CENTRED FOOD PRODUCTION SKILLS

Horticulture in the UK – Resilience to and beyond pandemic

Research Report 2022

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1. Introduction

Knowledge and skills are essential for producing food; ensuring their future availability is therefore vital for resilient agri-food systems. The Knowing to Grow project focuses on this challenge in the specific context of UK horticulture - the most labour intensive part of food production. It was initially intended to inform plans and policies for the future of agri-food systems to help increase their resilience. The Covid-19 pandemic not only made it impossible to continue with the research as originally designed; it provided a 'natural experiment' in how horticultural businesses respond to a significant external shock. Experiences of the pandemic and its impact on growers revealed how resilient horticultural businesses were, and brought into relief ways in which they are vulnerable. Analysis of this presents lessons about how the sector may need to be supported to become more resilient.

The pandemic affected food businesses quickly and to a significant extent, as apparent in the amount of media attention their experiences received through 2020. Producers were hit almost simultaneously by dramatic changes in consumption patterns, the urgent need to implement controls to protect their workforce, and interruptions to supply chains including the flow of workers into the UK. In most cases this created additional costs, and workload as businesses sought to adapt to new modes of operation and demand. Other industries were facing similar challenges but issues of timing and timeliness that are inevitable when selling fresh produce and working with cycles of plant growth complicate this.

It should be noted that the pre-pandemic, horticultural businesses were already concerned about one significant shock facing their operations: the UK's exit from the EU. Commentators predicted that this would affect supply chains and availability of workers (Hendry et al 2021). By the time the worst impacts of the pandemic were felt, the industry had not yet experienced a peak season under post-Brexit trade and immigration rules. The pandemic being un-foreseen no doubt had effects distinct from the relatively predictable events of leaving the EU (Hendry et al 2021), but it remains difficult to wholly untangle the effects of or responses to the two changes. What is apparent is that many in the industry and students of it felt that the pandemic served to exacerbate and intensify challenges already foreshadowed (Ag Agyemang and Kwofie 2021; Garnett et al 2020; Sanderson Bellamy et al 2021).

This report presents research results on the topic of resilience and what the pandemic revealed about this. It outlines what the pandemic suggests about the relative resilience of different business types, and where points of weakness concentrate. Although focused on skills and labour, challenges around these are so connected to other dimensions of food growing that wider issues are also explored.

2. Thinking about resilience

Resilience is not an unproblematic concept for interrogating systems, but is beneficial for drawing attention to dynamism and unpredictability (Tozzi 2021). It refers to how able a system is to maintain its key characteristics and to re-organise in response to disturbance (Hollings 1973). Initial interpretations rooted in natural sciences emphasised stability in that a resilient system is either robust to withstand change, or can soon return to its original state (Benton and Thompson 2016). This has been recognised as an important dimension of food systems as disturbances of various forms are expected to increase, particularly due to global heating (Hertel et al 2021). Agri-food systems comprise all activities essential to the production, distribution and consumption of food (Ericksen, 2008). A resilient agri-food system is typically taken to be one able to continue producing food and ensure food security (Benton and Thompson 2016; Bullock et al 2017; Tendall et al 2015). A similar output focused assessment applied to

farm systems means resilient farms are those able to continue producing desired functions (Meuwissen et al 2019). The scale of analysis is significant as a system may be resilient whilst individual farms are less so (Meuwissen et al 2019). The complexity of such systems makes it difficult to measure their resilience, leading analysts to focus on their adaptive capacity (Himanen et al 2016). Key characteristics of a resilient food system are identified to include diversity, flexibility, agility, skills and profitability (Himanen et al 2016). Others apply this analysis to individual farms (Darnhofer 2010) or farm systems (Meuwissen et al 2019).

In addition to thinking about the scale of analysis, it is important to recognise that resilience may not be a desirable characteristic, particularly when applied to social systems. Critics note that an emphasis on stability tends to reinforce the status quo which may be undesirable (DeVerteuil and Golubchikov 2016). Perpetuating or returning to conditions which disadvantage or harm some – as in food systems which leave some people undernourished, and exploits too many workers (Hedberg 2021; Garth and Reese 2020) perpetuates harm. Under some analysis, global food supply chains were found very responsive and robust during the pandemic – food kept coming (Hobbs 2021). But this focus on outputs can mask inequalities of access, and the impacts of work to keep producing. Key questions then are resilience of what, to what, and who has control (Walsh Dilley et al 2016). Following these critiques, resilience is perhaps most useful as an analytical lens to interrogate adaptive capacities at individual and collective level (Tozzi 2021). Rather than assuming it is desirable to return to the pre-shock patterns, a focus on resilience helps to interrogate how systems may need to be transformed (DeVerteuil and Golubchikov (2016). Such analysis should consider multiple scales, ask who is served, and attend to the most vulnerable (Hedberg 2021).

3. The Research

The findings reported here form part of the Knowing to Grow project 2018-2022. This focused on skills and knowledge in UK horticulture, gathering data from a range of growers and related organisations. The project received ethical approval from Cardiff University School of Geography and Planning Research Ethics Committee. Methods included semi-structured interviews, participatory workshops, and observation or go-along interviews at growing sites. Data collection was interrupted by the coronavirus (Covid-19) pandemic, which reduced the potential for on-site fieldwork and in-person engagement. This was counter-balanced by use of remote methods (online interviews and workshops) involving a wider range of growers than originally planned. In total at least 50 Individuals were interviewed for the research, representing 15 growers and 17 associated organisations; additional participants joined workshops across the project. All data was stored and processed in NVivo to enable thematic analysis. Initial findings in relation to the focus of this report were explored with stakeholders during a workshop; the characterisations were refined in light of these discussions. Results reported here relate to analysis of growers' resilience as highlighted by impacts of the Covid-19 pandemic.

4. Covid-19 impacts

The Covid-19 pandemic and public health measures implemented in response had a range of repercussions for growers, with particularly acute impacts during the first period of lockdown (Sanderson Bellamy et al 2021; Tyfu Cymru 2020). Retail demand for fresh produce increased dramatically, particularly through local supply chains (Wheeler 2020). But growers' capacity to supply the market was affected by reduced productivity due to social distancing measures, and shortages of

experienced workers (Tyfu Cymru 2020). This section highlights impacts experienced by growers, and how they acted to mitigate these effects. It is important to note that all growers who discussed this period had managed to continue producing at a level equal to or beyond their standard output through the 2020-21 season. This suggests that each enterprise exhibited a degree of resilience to the shock of the pandemic, but as will become apparent, this should not be interpreted as wholly positive.

4.1 Recruitment and workload

International travel to the UK was restricted from March 2020, coinciding with the period when most seasonal workers begin arriving to work in horticulture. This presented the prospect of growers reliant on recruits from overseas facing significant labour shortages, and workers scheduled to return for the new season unable to take up their jobs. However, research participants managed to secure sufficient seasonal workers due to a combination of quick reactions, and investment in emergency responses. Firstly, as the prospect of travel restrictions became apparent, growers asked returnees to come early:

> So when COVID looked like it was going to put us into lockdown, we made a conscious decision to spend the best part of two days ringing around all of our returnees and we doubled, or we tripled the number here before we locked down. And then we isolated them here, as per government guidelines (L3[1]).

Recruitment processes were triggered early and with extra intensity to bring as many workers into the country as soon as possible. Practical measures like providing travel, helped but social capital was also beneficial:

> We know lots of people in Romania and Bulgaria that have already worked with us. So we had that, kind of, contact and that goodwill before we start. That's really important because people needed a bit - can you imagine this time last year, people needed to feel confident to set foot out their front door (L2).

These growers were not able to secure their usual numbers of seasonal workers from overseas as not all returnees wanted to travel at such an uncertain time, whilst others could not access their usual child care support. However, the shortfall was not as significant as initially feared.

To secure enough workers for the season, growers looked to recruit domestically – both through local promotion, and in connection with initiatives such as Pick for Britain campaign. As a result, growers appointed far more UK-based workers than they would in a standard year, or have done for the past 10-20 years. Whilst this helped ensure sufficient people to take up available roles, it was not without challenges. Firstly, the volume of work involved in promoting opportunities and administering applications was significant as growers had to establish new processes and recruitment channels at short notice:

> It initially was a bit of a challenge cos obviously you're there going 'we've never done this before, how are we going to do this?' and you've got a lot of processes and steps and things that we'd never done on bulk before, all coming into us trying to recruit people. As a whole it was an absolutely brilliant experience, I mean throughout the whole thing, even though there was times I was literally sat here, it was that heatwave last year, I was sweating away, I was thinking

[1] Growers are categorised as larger (L) or smaller (S) and referred to be a number to maintain anonymity.

> ‘oh my goodness, are we going to recruit seventeen people for this rig by the end of the day?’ (L2).

Media coverage of potential worker shortages, and advocacy by everyone from farm unions to Prince Charles gave the issue a high profile, and attracted large numbers to apply for jobs: “quite frankly we were just inundated this year with people” (L1). Lock-down had created a significant pool of people available for work:

> because everywhere was locked down and so many people were out of work, we actually – so we advertised in the usual way and we were absolutely swamped with applicants, far more than we ever have been before (L1).

This proved a double-edged sword for growers though, as they were faced with a huge volume of applications to process. As a result, some felt that it had not been possible to carefully communicate the nature of the work and ensure that recruits appreciated how challenging it would be.

Growers reported that they tried to convey the nature of the work, balancing the need to attract workers with conveying the reality of how hard it is:

> this is a commercial venture. You have targets and speeds and it’s not a PYO farm. […] But I think they just had this fantasy of casually bumbling around the countryside in the sunshine (L3).

More than one grower noted that people were attracted by the will to be useful during a crisis, but perhaps had unrealistic expectations:

> it was people that just wanted to help out and help harvest some salad and vegetables, well it’s, like, you know: “Have you seen this? It’s like a factory?” (L2)

Other factors they tried to convey to potential recruits was the likelihood of being in a minority as most workers are not British, and the nature of piece rates which incentivise speed and working overtime.

This fed into the second significant challenge which was the relatively low retention rate of UK-based recruits. One grower explained that they want at least six weeks of service to payback their investment in recruitment and induction, and to make up for the initial period when the worker is unlikely to be efficient enough to pick at a rate which covers minimum wage. However, the average stay of their UK-based recruits was 29 days, with only 2 of 40 staying for six weeks or more. Another grower reported that on average UK recruits stayed around four weeks out of the nine month season. As a result: “we didn’t get the productivity and we didn’t get the length of service” (L2). This had severe impacts on efficiency and costs:

> We didn’t get some of the more experienced people early in the season that we would like, you know, so we were missing experience. Cos we had a lot of non-returners last year, so the people that came needed more training, and we didn’t have as many experienced supervisors to train them. So you know, we were up against it, we had productivity issues (L2).

There was a view expressed by growers that UK-based recruits working in horticulture for the first time did not have the same drive or enthusiasm for working hard, fast and long that they have come to expect from overseas recruits:

> I think the major thing that- for us was that – or for me, certainly – was their attitude. The Romanians and Bulgarians want to be here. They make a trip across, they know what they can earn, they know what they can take back and they can survive for four, five months to the time that they're back home before they come back again. The Brits were here on a cry for government and society to say that if they didn't pick it, then it would all rot but some of them were furloughed and they kind of thought it might be just a good idea to go and spend some time in the countryside and I think they were here for the wrong reasons. That's my perception. They weren't working for the right reasons. […] the UK workers lack that enthusiasm (L3).

Whatever the reasons for their lower productivity, UK-based recruits generated less income for growers at a time when labour costs were higher than usual. As noted above, this was in part due to the requirement for new HR processes, but also because seasonal workers had been brought in earlier than necessary:

> by the end of March we were supposed to have about 60 people here, I think by the time we got to the end of March we had 134 people here (L3).

This meant providing wages and accommodation for 74 additional people for whom there was insufficient work. Additional costs were also incurred for chartering flights, and public health measures. It was an expensive season due to decreased productivity and increased production costs.

Smaller growers experienced a version of these effects, as those relying on volunteers coming from overseas similarly faced the prospect of no arrivals during the peak season. They lacked resources to fly people into the UK or host them outside the period where they were needed to work. Some of this shortage was made up through recruiting within the UK, with growers receiving interest from people unable to do their usual jobs, or attracted to support essential work during the pandemic. But this was unlikely to be sufficient, especially given that local supply chains were particularly hit by increases in demand (Wheeler 2020). As small growers typically manage sales themselves, this translated into more orders to handle, high volumes of customer queries, and processing unprecedented numbers of deliveries (Tyfu Cymru 2020). And all this at a time when families were managing home schooling too. Facing unprecedented amounts of work, and uncertainty regarding volunteer recruitment, additional work typically fell to the farm owner(s) and their family. Growers described how all generations of family members helped more on the farm, and they worked longer hours, as discussed in this exchange regarding the prospects of filling a vacancy for assistant grower:

> I: So, if you don't get someone, is it what - extra volunteers? How, how can you make up for it
> 1: More head torches.
> 2: [Laughter].
> 1: I, I, honestly, I don't know, I think that's what it's gonna be, I think, I'm just gonna end up –
> 2: I mean hopefully –
> 1: I'm working seven days a week as it is, I never get any time off and I, and I don't know how we're gonna do it, but I'll just keep going (S1).

The need to work harder and longer was a common theme across all growers during the pandemic, but it is felt most acutely by family farms who have a smaller team to bear the load. These participants described moments of intense stress and feeling over-whelmed.

4.2 Adapting operations

In addition to the impacts noted above which created additional workload, growers had to implement disease control measures at very short notice, and with - at least initially - minimal guidance. Although standard health and safety measures reduced the risk of spreading the virus, additional controls were required to ensure production could continue and to minimise staff absences. These included introducing additional hygiene facilities (e.g. hot water washing stations in fields) and reorganising teams into self-contained bubbles. Where staff live on site this extended to social distancing across accommodation and transport. For small growers the need for residential volunteers to self-isolate was problematic due to lack of additional accommodation. All these measures had cost implications:

> we still made a profit last year, but we lost a lot of money to COVID. We probably don't know exactly how much, because so much was done and because it happened so quickly (L3).

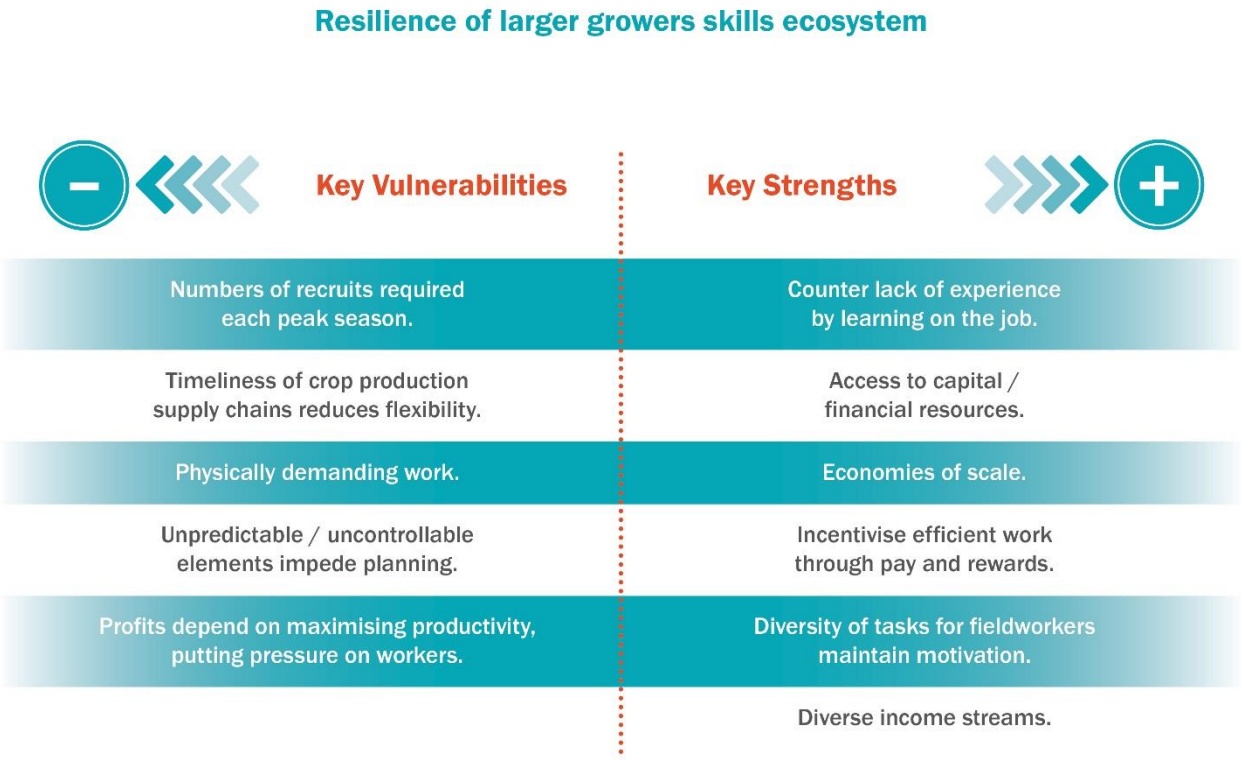
Some controls also reduced efficiency and flexibility, further impacting productivity and profit margins. They also required expertise or guidance which was not immediately available from outside agencies, meaning staff faced additional work to develop, communicate and enforce suitable measures. Additional workload continued through later stages of the pandemic as many growers supported initiatives to promote vaccination to their staff.

5. Growers' resilience to Covid-19

Growers of all scales faced multiple impacts of the pandemic, all of which created additional work at a time when workforce availability was less certain than ever. Some increases in production costs were off set by additional demand, but it is not easy for growers to significantly increase crop production at short notice. These impacts, and the extent to which growers were able to mitigate them are revealing of their underlying resilience. These constitute robustness – the resources and capacities which enable a system to withstand shock, and their capacity to adapt or adaptability (Meuwissen et al 2019; Surefarm 2018). Figures 1 and 2 summarise the vulnerabilities and strengths this research has identified in growers' knowledge and skills systems which together indicate how resilient they are. Some of these traits were negatively affected by the pandemic, whilst others became particularly important in adapting to it.

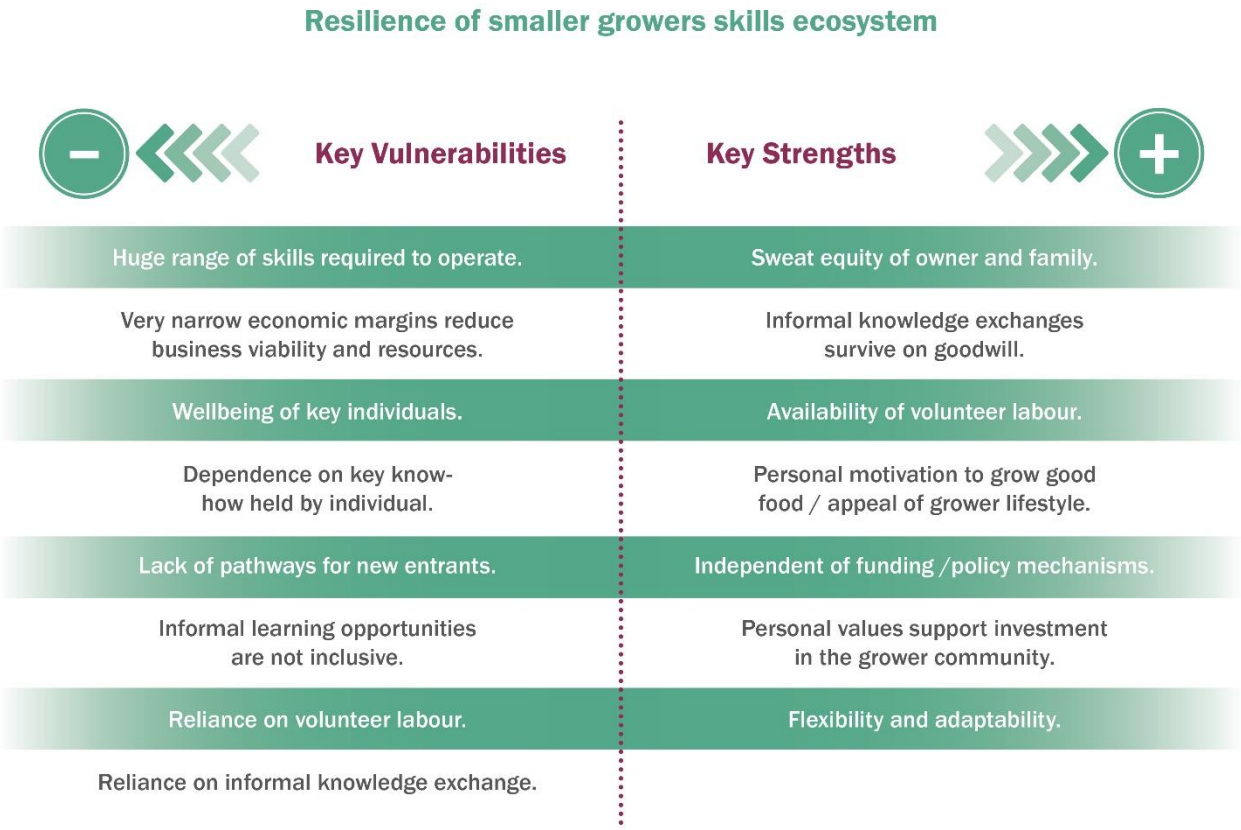
For large growers, vulnerabilities around reliance on large numbers of seasonal recruits were exacerbated by disruption of labour supply chains. Unfortunately, this coincided with the start of the first season operating outside EU free movement rules, with growers and labour providers managing new immigration rules. Growers noted that late decisions regarding details of the Seasonal Workers Pilot, and delays processing visas meant they were already managing additional uncertainty about worker arrivals. Lower than usual retention and return rates meant fewer workers were proficient at the start of the season, or were able to develop desirable levels of efficiency on the job. These businesses could bear the resultant costs due to their scale, by drawing on reserves and in some cases, by relying on parts of the business less affected by the pandemic.

Figure 1



Smaller growers perhaps stood to gain most from increased appetite for UK-grown fresh produce, and tended to be flexible enough to respond to opportunities such as online sales (Tyfu Cymru 2020). But this depended on them rapidly accessing new skills such as website creation, or capacity to invest in additional production infrastructure. Capacity to adapt largely depended on the grower's ability to do more, placing additional stress on the already pressured mental and physical wellbeing of them and their family. The good-will of voluntary workers could absorb some of this pressure as more people were drawn to help grow food at a time of crisis. But volunteer availability was hampered by travel restrictions, hence a mixed picture of strength and vulnerability in this area. Like larger growers, small growers could not count on having enough capable volunteers available for the peak season, creating additional stress.

Figure 2



These experiences suggest a degree of robustness - the capacity to withstand disturbance in order to maintain production (Tendall et al 2015). This depended on growers' pre-pandemic adaptive capacity: during the pandemic, strengths became particularly important. For example, growers with a reputation as being good employers, and which tend to have good retention rates were able to apply these strengths to ensure adequate recruitment even as headlines reported national shortages of pickers. Those with good relationships with their seasonal teams were able to encourage workers to arrive early, to travel internationally at a time of huge uncertainty, and to stay longer than usual. Strong organisational structures and specialist teams also helped:

> The teamwork was unbelievable on that, cos it's very much a case of things happen at [company name], you've got to be resilient, you've got to be hard-faced but [company name] is very good at pulling it out the bag, very, very good at it (L2).

Similarly, having financial reserves or being able to use credit to cover short-term costs were significant to being robust against shock. For small growers without such financial leverage, their own forms of wealth were important:

> we're not rolling in cash so we have to roll in zest and, and thrive (S1).

Willingness to work hard, and other personal qualities such as commitment and adaptability were identified as particularly important resources they drew on to respond to challenges. The scale of

operations aided this as it was relatively straight-forward to decide and implement changes. Being used to operating with a relatively small team meant that absences or gaps in recruitment could be covered by others doing more. However, the burden of all these solutions were falling on a small number of people making for a heavy workload and stress.

The crisis showed that relying on a small team provides some adaptive capacity whilst also representing a vulnerability:

> it's a lot of, a lot of work and a lot to keep in your head and a lot to keep on top of. So again, that'll be a strength and a weakness, or a vulnerability (S2).

Each of the growers had sufficient adaptive capacity to survive through the shock of the pandemic, and to continue operating after 2021. They demonstrated key adaptive capacities of adaptability, flexibility and resourcefulness (Tendall et al 2015). However, their capacities are not limitless. Growers at both scales noted that whilst they had made it through this crisis, they were not sure how they would manage a recurrence of similar pressures.

5.1 Bounce back or bounce forward?

Resilience thinking distinguishes between responses to change which return a system to the prior state (bounce back), and those which improve or evolve it (bounce forward) (Hedberg 2021). In relation to imperfect or unjust systems the latter is likely to be preferable (De Verteuil and Golubchikov 2016). Given the long standing problems horticulture has faced in recruiting and rewarding sufficient workers (Pitt 2021) bounce forward from the pandemic would seem a desirable aspiration. There was certainly an aspiration that smaller, more localised food system actors might build on their pandemic successes towards transformation (Sanderson Bellamy et al 2021). It is too early to say whether this has been achieved for the agri-food system or even that individual growers' resilience has been enhanced. Some capacities which will be beneficial in future have been accrued, for example learning in relation to recruitment:

> we ended up creating a system which we know now that if this happens again - hopefully not - but if it does happen again, we have a plan and a system and a process in place that we can easily pick up (L2).

This participant noted that feedback from UK-based recruits had already been incorporated to improve induction processes. Taking a longer-term view, some hoped that attention to food growers as essential key workers, and the profile given to their roles might have enduring impacts:

> Certainly, in terms of public awareness - so I think that's great, everybody's now aware of how important domestic food supply is, which is lovely, it's great. It's good isn't it, that people are talking about it? So, I think we've got more of an open door, but I think we're talking about a massive culture change that's gonna take many years. And it took this crisis to, kind of, get people to come in those roles. It is - the knock-on effect will be, people are more aware and will probably apply for, kind of, more, for permanent jobs which is what people deserve and need isn't it? (L2).

Whether this optimism about impacts on desirability of horticultural jobs is justified remains to be seen. Others had a less positive interpretation:

> we now know definitively that the UK workforce can't do what these guys are doing […] We knew deep down it probably wouldn't work, but you can't have a voice unless you've got the data (L3).

Referring to the relatively poor performance of UK-based recruits, this participant felt that experiences from 2020-1 showed that this was not a long-term option. In their view, the positive outcome of this is having evidence to convince government of the need to expand and continue seasonal worker visas. If migrant labour is required for the longer-term viability of UK horticulture, then this could contribute to bounce-forward.

Taking this longer-term view, it is important to note however, that the capacities which enabled growers to absorb the shocks of Covid-19 are to a degree, time-bound or finite. Buffering capacity and redundancy are the slack which was taken up to help maintain production (Tendall et al 2015). Growers' applied extra sweat and financial equity to adapt to the pandemic, but neither type of resource is unlimited. Consider the costs of managing the response to the pandemic and a less productive season:

> - But how can you afford that though?
>
> - Yeah, we can't cos the margin is, the - we can't go through that again (L2).

Resources providing adaptive capacity are not limitless, meaning that they can support resilience to a one-off shock, but bouncing back from a second or third may be impossible. For growers who survive on zest more than money, it is their personal capacities which are dwindled by crisis, and may not withstand successive shocks:

> I'm ageing. That's hard and I've got awareness that I'm not quite as strong. I'm mentally strong but I'm physically maybe not as strong, and that - and things are taking longer and that's hard (S1).

Whilst age is a contributor for this grower, the sense of strain is also associated with the levels of physical work and long hours common in the sector, which over the years build into tiredness or possibly burnout. Field workers who laboured through the 2020 and 2021 harvests described being tired and frustrated after another peak season. Physical strains were apparent at larger growers as teams worked harder than ever, with additional emotional pressures such as migrant workers not being able to travel home. For those doing hands-on horticultural work these pressures often limit how many years people can continue; adaptive capacity reliant on human bodies is a finite resource. It is questionable that the ability to sustain food production which threatens people's physical and emotional wellbeing is truly resilient.

These factors show that resilience is time-bound in that adaptive capacity can become depleted or exhausted if shocks are ongoing or recurrent. In addition to sudden disruption from a shock, producers might be under more enduring pressure or stress (Darnhofer et al 2010). The ongoing challenges around recruiting horticultural workers, and economic strain mean growers' systems were already stressed, pressures not isolated to individual growers, but systemic (Pitt 2021). Adaptive capacity is also temporally dependent in that the coincidence of multiple shocks reduces potential to bounce back or forward. The effects of the pandemic on recruitment and labour were compounded by coincidence of other shocks: changes to immigration rules and late notice regarding the operation of the Seasonal Workers Scheme added complexity and uncertainty for growers needing large numbers of seasonal

workers. At the opposite scale, growers used to using Workaway to recruit volunteers were affected by sudden changes to their requirements which excluded commercial farms. The coincidence of these impacts meant that even when well resourced, growers struggled to absorb multiple shocks. And growers' hopes for a 'normal' season to allow them to recover and re-build resources have been undermined by the impacts of war in Ukraine – home to many of their seasonal recruits. If adaptive capacity is conceived as the flex in the system that allows growers to bounce back, it seems that by 2022 it has been stretched to the limit, with some reducing or halting production due to lack of workers (Sijmonsa 2022).

6. Resilience and horticulture

Of course most businesses were hugely affected by the pandemic, and in some regards horticulture had advantages from being treated as an essential industry. Growers benefited from dispensations such as permitted travel, dedicated support such as the Pick for Britain campaign and associated publicity. However, the nature of plant crops presents specific challenges and creates distinct vulnerabilities. Fresh produce is perishable, and whilst technology has extended its lifespan, picked fruits and vegetables can only be held so long before reaching the consumer (Friedberg 2009). Growers constantly seek to coordinate plants' timings and cycles with those of the food supply system (Medland 2021). Timeliness and deadlines are experienced as particularly acute pressures. Added to this is the impact of seasonality which means missed tasks cannot be caught up:

> If you haven't got your potatoes in you can't harvest your potatoes. If your onions aren't in the ground you can't harvest them. You can kind of catch up in ways with certain crops but the spring is a crunch (S1).

Some mistakes cannot be corrected meaning some losses are irretrievable. The seasonal cycle also creates intense workload pressures at certain times, hence the need for a larger seasonal workforce. Technology has extended the harvest season for some crops so a seasonal role can last nine months, but there is still too much downtime to make year-round roles viable. Seasonality also reduces flex in the system because many crops have a long lead-in time so production cannot be rapidly increased or decreased in line with short-term demand. To meet the surge in demand for local produce UK growers would have needed to know it was coming in time to sow and plant sufficient crops in 2019. And for plants such as tree fruit even that would not be too late.

Plants are not like the products of other industries because they are not wholly controllable or predictable. Knowledge is a key factor in adaptive capacity because it enables prediction then evaluation of potential courses of action (Williams et al 2015). But what plants will do is never completely predictable (Marder 2013). Experienced growers are certainly very good at knowing what is likely to happen when, but all stress how no two seasons are alike, and something might always go wrong. Even in 'controlled' environments such as polytunnels weather has an impact, meaning cropping rates can never be wholly predicted. This uncertainty means there is always a degree of vulnerability which cannot be wholly mitigated, and which growers are used to accounting for and working with. The notion of resilience as "coping with uncertainty in all ways" (Folke et al. 2010) is therefore inherent to horticulture. But as highlighted by the impacts of the pandemic, capacity to manage uncertainty and change is not sufficient to maintain a healthy horticultural sector or to ensure its workforce thrives.

Plants are also different because they are amongst the cheapest foods we consume, meaning profit margins are incredibly narrow which creates pressure to minimise costs of production, and reduces their financial capacity (De Roest et al 2018; Rye and Scott 2018). Responding to shocks often requires investment meaning that economic capacity is a key determinant of adaptive capacity, hence producers are likely to have the lowest adaptive capacity within the food system (Hinamen et al 2016). With additional economic capacity growers might invest in employing more year-round staff, adding greater redundancy and therefore enhancing resilience (Darnhofer 2014). But at present over-employment is unaffordable. For small growers, being able to pay more employees would reduce the burden of work, add diversity and division of labour to their capacities, and enhance individual wellbeing. This demonstrates that business level and individual level resilience are thoroughly connected: workers in a squeezed business are pushed to work harder, depleting their resources and ability to contribute to the strength of the business. The same is true of the next scale up: a sector's resilience depends on the resilience of individual actors (Jones et al 2022), meaning the economic viability of horticultural businesses is a key limit on the sector's resilience.

Horticultural businesses were robust in face of the shocks of 2020-21 in that they could withstand the pressures and keep producing (Meuwissen et al 2019; SURE-Farm 2020). But adaptability or transformability are less apparent so far in that there are few significant changes to operational logic or structures (Meuwissen et al 2019). The temporary increase in diversity of recruitment channels has not persisted – growers are not still seeking large numbers of domestic workers. It is too soon to judge whether there are enduring impacts on work and recruitment in the sector such as horticultural jobs becoming more appealing to the UK workforce. Changes which might lead to more fundamental shifts in the food system such as the ability to pay higher wages or offer year-round roles are beyond growers control.

7. Conclusions: Enhancing resilience?

Following certain definitions of food system resilience, UK supply chains proved themselves to be resilient as supplies were maintained and production continued. Any such optimistic interpretation is clearly undermined by evidence of unequal access to food, and significant increases in levels of household food insecurity (Loopstra 2020). Even if goal-oriented assessment of food system resilience is refined to emphasise food security for *all* (Tendall et al 2019) it remains an inappropriate measure if met through production in fundamentally unjust or structurally unsustainable systems (Garth and Reese 2020; Rotz and Fraser 2018). The evidence presented here shows that output focused assessment of resilience is also problematic for masking weaknesses in adaptive capacity such as finitude of resources. Other studies have found similar strains experienced by those working in food businesses and supply chains due to pressures from the pandemic (Jones et al 2022). Robustness might be achieved through problematic responses such as overwork which threatens resilience at the level of the individual person. Many growers were stretched to their limits so might not bounce back from further pressure. Being able to (just) make it through a difficult year is a limited sign of success when food systems are expected to face increasing pressures and successive shocks. Systemic resilience has to be enhanced through a systems approach (Benton and Thompson 2016).

As noted in many commentaries, the system's weaknesses have been highlighted and exacerbated by the pandemic (e.g. Anderson 2021). It is equally common to note that this moment must be taken as an opportunity to transform them for the good of people and planet (Meine 2021). What is less clear is

how this opportunity can be seized, or how the systemic problems like those noted here can be undone. More diverse production systems (Hertel et al 2021), and more collaboration between producers (Darnhofer 2020; Barling 2020) are both proposed as part of the solution, and have synergies. Smaller growers involved in this research repeatedly returned to the need for more cooperation and collaboration to increase the resilience of their individual businesses. They favoured scaling through more numerous and more connected growers, rather than growth of individual enterprises as the way to increase levels of domestic horticultural production, thereby making a more diverse production - hence more resilient - landscape in the UK. This vision is supported by literature on farm resilience which identifies connectedness as a route to increase adaptive capacity (Fleming et al 2015) and economic viability (De Roest et al 2018). Greater collaboration may also be required if growers are to influence government and others who control factors such as immigration rules and so crucial to their operations.

Another area for potential cooperation is to enhance the base of knowledge which allows producers to predict pressures, and know how to respond (Darnhofer et al 2010). The pandemic highlighted the need for more agri-food science, counter to the trend for reduced public investment and greater privatisation of this knowledge resource (Glenner 2020). There is a clear case for better insight and sharing of this knowledge which allows producers to prepare or adapt. But information needs to be accompanied by power and resources to make the necessary changes, and build up redundancy or buffers.

It is too early to judge whether the pandemic has prompted enduring changes within UK agri-food systems, or that lessons have been learned. Others assessing this are pessimistic regarding the signs of transformation, highlighting the rigidity of the dominant food system (Jones et al 2022). The experiences shared here also suggest that positive transformations are limited by the systemic, long-term pressures which make horticulture a low-profit sector reliant on significant numbers of relatively unappealing jobs. In addition to highlighting different pictures of resilience at scales down to the individual worker, these insights also demonstrate the necessity of assessing adaptive capacity across time-scales. As growers face another challenging season this year, we may be entering a phase not of bounce back or forward but of ongoing wobble.

8. References

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