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EXPLORING OPPORTUNITIES FOR FARMERS IN WALES TO PRODUCE FOODS FOR FUTURE MARKETS

What would it mean for farmers in Wales to produce more plant foods?

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Contents

Changing diets and pressure to reduce impacts from livestock present challenges for many Welsh farmers. But these changes also present opportunities. What if a Welsh farmer wanted to produce more plants? This project considered how farmers might be enabled to produce plant crops, and the challenges they face.

1. Introduction

1.1. Context

In 2019 a group of international researchers gained global attention for their proposal of a planetary health diet, designed to meet the needs of human health and environmental sustainability (Willett et al 2019). Much coverage focused on recommendation to reduce meat consumption in favour of vegetables, grains and nuts (Table 2019). The authors were criticised for failing to understand farm systems which produce meat, or the implications of trying to produce sufficient plant foods from the UK's land. The Chair of National Farmers Union Cymru was quoted as saying: "Here in Wales around 80% of our land is made up of marginal areas where crops cannot grow, but we do have optimal conditions for grass growth which can, in turn, be converted into high quality protein" (Forgrave 2019). Not surprisingly, many livestock farmers received the call for reduced animal product consumption as a threat. These reactions are a snapshot of the very polarised debate around farming and diet and the fraught issue of what people should eat during climate emergency (Lonkila and Kaljonen 2021). This project was conceived in response to these tensions – an attempt to move beyond conflict and threats to consider opportunities.

If global demand for plant-based foods continues to increase (Saari et al 2021), there will be a growing market for plant produce – fruits, nuts, vegetables, cereals and legumes. Who will grow those plants? Might some farmers currently dependent on markets for animal products be able to? Wales offers an ideal context to explore these questions given the country's farming is livestock dominated (Welsh Government 2020). The landscape is predominantly less favoured area (LFA) meaning the climate and topography present disadvantages for agriculture (OECD 2002). As the NFU Cymru spokesperson indicated, this is not regarded as land suitable for much other than grass. But it is likely that in the past, many more farms produced plant crops, for home consumption or local markets (Higgins 2021). In Wales recent years have seen increasing numbers of enterprises introducing edible horticulture, although this is an uplift from a low baseline. At present Welsh growers produce sufficient vegetables to feed each person in the country just 0.25 of a daily portion (Tyfu Cymru and Wheeler 2020). Meanwhile, UK farmers are facing considerable upheaval due to withdrawal from the EU's common market and agricultural subsidy schemes. Beyond this is the pressure to move to net or zero carbon agriculture and adapt to climate crisis. These trends suggest that farms increasingly need to consider potential to transform.

This research foregrounds opportunities these transitions present, seeking to unlock them through better understanding farmers' concerns and aspirations. It explores perspectives on shifting the focus of current farm production in Wales, and what support farmers would require to follow the path of innovators who have moved in this direction. It begins to address lack of attention to producers' perspectives on plant based diets (Lonkila and Kaljonen 2021). The project sought to harness the

capacity of academic researchers to act as facilitators who can bring stakeholders together to shape consensus around a vision for change (Pereira et al 2018).

1.2. Aims and Approach

This research aimed to: understand traditional livestock farmers' attitudes to opportunities to feed plant-based diets, and identify what affects their capacity to transform production.

Objectives:

- Investigate Welsh farmers' attitudes to plant food production.
- To facilitate informed stakeholder discussion on opportunities linked to plant food production.
- To identify barriers and enablers in relation to shifting to plant food production.

1.3. Methods

Research methods were selected to collect rich data on farmers' perspectives on reduced consumer demand for meat, and transforming production. Participatory workshops utilised researchers as trusted facilitators of transformative spaces, where opinions can be exchanged to shape a vision and recommendations (Pereira et al 2018). We employed a three stage process involving an online survey, semi-structured interviews, and a participatory online workshop. A bilingual online survey was open from September 2021 until February 2022. This comprised multiple choice questions, with some optional free text options for elaboration. Initially recruitment targeted farmers in North Wales in the effort to maximise participation by those farming in marginal areas. Having encountered difficulty engaging participants we extended it to any Welsh farmer and received 24 valid responses. SPSS was used to analyse trends and relationships in quantitative data, whilst free text responses were coded thematically.

During this period, we carried out 13 semi-structured interviews; these were undertaken via online video calls. Three categories of interviewee were recruited: stakeholders, "innovative farmers" and livestock farmers interested in plant food production. Stakeholders were representatives of key farming organisations and policy makers, targeted to bring perspectives from their professional expertise and familiarity with farming communities. Innovators were targeted to share their experiences of establishing plant food production; these insights were shared during other interviews and the workshop as a discussion prompt. Three interviewees were accessed through the survey; others were recommended by organisations working with farmers.

Towards the end of the data collection period, we hosted an online workshop for stakeholders and farmers, including some survey respondents and interviewees - a total of 13 attendees. During the workshop, we presented four case studies of plant food production in Wales based on interviews with innovators. Participants joined facilitated breakout discussions of opportunities and challenges around moving into plant production, and potential replication of the case studies. Discussions reflected on the case studies and their feasibility in other contexts (including participants' own farms), and actions which would enable farmers to follow similar pathways. All interviews and workshop discussions were transcribed and entered into Nvivo to enable thematic analysis of qualitative data.

Reflecting a trend in research with Welsh and British farmers (HSE, 2009; Hyland et al, 2016; Davies, et l, 2019; Welsh Government 2019 & 2020; White et al, 2021) our response rates for the survey were low.

We sought assistance from organisations already working with farmers including Menter Môn, Lantra, The National Sheep Association and farming unions, and used social media platforms and posters at the Royal Welsh Agriculture Show in November 2021 to attract participants. Recruitment proved harder than expected; some key gate-keeper organisations did not respond. It is notable that the research fell at a time of considerable pressure and uncertainty for farmers, as the impacts of the Covid-19 pandemic continued, and they awaited clarity on post-Brexit trading rules and subsidy. This may have affected willingness and capacity to engage in research. It is notable that all of the farmers who participated in interviews already had some interest in diversifying from livestock farming, or already produce plant foods. This suggests that those already interested in the topic were more likely to participate. The entirety of the research was carried out digitally, which was essential during the pandemic. Although it is estimated that the majority of British farmers have internet access (HSE, 2009), other studies have found that digitalization has been a barrier to participation (Davies et al, 2019: 13). We found that the lack of face to face contact was challenging, and may have excluded some farmers. IT literacy must be improved in order to carry out effective online research with farmers (White et al, 2021),[3] especially when not complemented by face to face research.

In designing the research and discussing it with stakeholders, several suggested that terms related to plant based foods and diets can be off-putting or exclusionary amongst Welsh farmers. For some the term is unfamiliar, thus risking alienating potential participants. For those familiar with the term it can be exclusionary due to controversies around promotion of plant based diets amongst farming communities, and perceived tensions with their promoters (Potts and White 2008). It is certainly a tricky area for researchers to negotiate, with the risk that terminology might be read as indicating a certain viewpoint Lonkila and Kaljonen 2021). We therefore decided to avoid referring to any particular foods or diets in promoting the research, instead using generic terminology about diversification and changing farming. Whilst this had the advantage of a more neutral tone, more explicit reference to plant based foods might have increased our response rate and prompted those with strong views to participate.

1.4. Research participants

Survey responses were received from seven Welsh counties with the largest number from Powys (Table 1). Responding farms included a mix of sizes and operations, with a majority focused on livestock. Half employ some workers other than direct family. Although not statistically significant, the majority of farms already producing fruit and vegetables in the survey were smaller than 50ha, with only one larger farm already producing fruit and vegetables.

In total, we interviewed 10 farmers - five male, four female with one couple interviewed together about their farm. Only one of these was aged under 30 and the oldest 67; all were White and three identify as Welsh. Two farmer interviewees had not already began to produce plant foods for human consumption commercially. Considering that the majority of participants were already involved in plant food production, and the high proportion of female participants this sample seems distinct from the general farming population. The majority of farmers (n=8) interviewed could be considered “innovators” already producing plant foods for human consumption. Of those recruited to speak as farmers, three are quite actively involved in or work part time for farming organisations, hence a dual role as stakeholders. It could be said that our interviewees are particularly interested in the innovation and future of farming, as well as plant food production.

Table 1 Characteristics of Survey Respondents

Farm Location	**% Survey Respondents**	**Production**	**% Survey Respondents**
Powys	33.3%	Livestock Only	79.2%
Gwynedd	16.7%	Mixed farming	16.7%
Conwy	20.8%	Horticulture	4.2%
Pembrokeshire	12.5%	*Agri-environment scheme*	
Anglesey	8.3%	Within a Glastir scheme	45.8%
Denbighshire	4.2%	Not within a Glastir scheme	54.2%
Carmarthenshire	4.2%		
Farm Characteristic		*Primary income stream*	
Size		Sheep	62.5%
<20Ha	8.3%	Dairy	0%
20-50Ha	20.8%	Beef	16.7%
50-100Ha	37.5%	Poultry	0%
100Ha+	33.3%	Non agricultural e.g. tourism	12.5%
Less Favoured Area		Work outside the farm	4.2%
0 LFA	29.2%	Single Farm Payment	0%
1-29% LFA	17.6%	Horticulture	4.2%
30-59% LFA	23.5%		
50-89% LFA	29.4%		
90-100% LFA	29.4%		

2. Results

This section summarises the results of all research methods (survey, interview, workshop) in order to answer the research questions, and reveal other significant themes in the data.

2.1. Concerns about the future

The survey data indicates how optimistic Welsh farmers are, and whether they are already adapting to likely changes. A majority (58%) reported that their farm income had been relatively stable in the last five years whilst 33% said it has increased, and 8% note a decrease. This confirms a context noted by stakeholders: that livestock farmers were benefiting from good prices at the time, which may have affected their attitudes to changing production. A majority (58%) expect to be farming in 'broadly the same way' for the next five years, with others likely to introduce non-agricultural business such as tourism and reduce livestock numbers. This suggests that few are preparing for drastic changes in their farm business, with none expecting to exit the industry. However, 38% expressed uncertainty about the likelihood of changing their business, perhaps indicating a need for guidance about the future.

When asked about their priorities for the future, a majority were most concerned with financial viability – either maintaining or increasing margins and income. Alongisde this, participants noted a range of social and environmental goals for their family and the wider community (Table 2).

Table 2 Survey respondents' priorities for the future of their farm

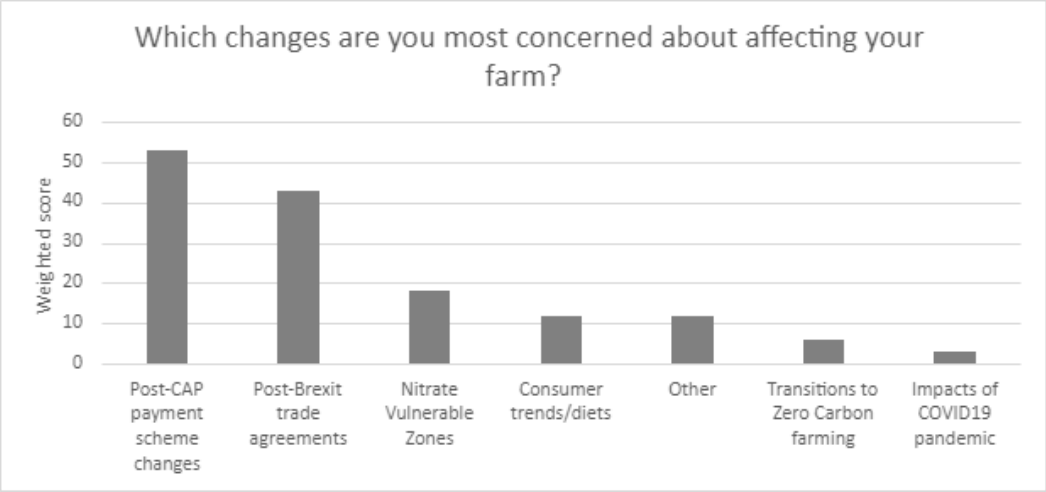
Theme	**Count** (Respondents could list numerous priorities)
Profit and income generation	10
Economic viability / increasing margins	5
Environmental benefits (soil, carbon, biodiversity)	4
Working less / retiring	4
Livestock quality	3
Succession	2
Diversification	2
Expand production	1

Of those changes most imminent or significant to Welsh farming, the survey showed that respondents are most concerned about Post-CAP payment schemes, with Post-Brexit Trade agreements being the second most concerning. This finding is reinforced by interview and workshop data, where it was a strong theme. However, in both interviews and the workshop, these transitions were often viewed as an opportunity:

> The subsidy system should change. The subsidy system should reward small scale family farmers who produce a greater variety of food, reward farmers for producing food using agroecological methods, that actually sequester carbon and work with nature. The potential's there (Stakeholder).

Consumer trends and diets tended to emerge as a lower priority concern, being ranked highest when farmers selected the issue they were third most concerned about.

Figure 1 Survey respondents ranking of future concerns[1]



2.2. Attitudes to trends towards plant based diets

[1] Respondents selected which of the listed options they were most, second and third most concerned about. Responses were combined and weighted so primary concerns are scored more highly.

The survey indicated moderate concern about changing diets and varying degrees of interest in the topic. Only 38% reported that they pay 'a lot' of attention to public debates about reducing meat consumption, and only 25% expressed 'a lot' of concern about the effects on their business. Of those seven respondents who stated that they have acted in response, only two responded through changing their operation (diversification, efficiency) whilst the remainder engage in education and advocacy, including through farming organisations, to promote the benefits of livestock and quality meat. When asked how reduced levels of meat consumption in Wales would affect their business 50% said it would be a problem, and 21% thought of it as an opportunity. Explanations of these answers reveal the range of views amongst farmers (Table 3). Survey responses suggest that the prospect of people in Wales eating less meat is not yet perceived as a significant threat to farm businesses, even by those reliant on livestock. Those who do recognise the trend regard their produce as the type of meat for which a market will remain. Whilst there are signs of concern about limited potential to produce other food, some recognise this as an opportunity. Contrasting opinions are reflected in these two comments from survey respondents:

> *"My whole business depends on people eating meat".*
>
> *"We have capacity to grow crops".*

Table 3 Explanation of views on changing diets and effects on farm business

Response to reduced meat consumption in Wales	**No. of farmers**
Positive - expect people to continue eating quality meat	7
Positive - could / do produce plant crops	3
Negative - expect lower demand for Welsh meat	5
Negative - limited opportunities to produce plant crops	3
Neutral - don't accept consumption will decline	3

Interviewees also expressed mixed views on the trend, and noted that some farmers feel under pressure due to their reliance on meat production, particularly hill farmers: "they get very, very concerned about it because for a lot of them, there is no alternative" (Stakeholder). Some interviewees referred to anecdotal evidence of increased popularity of plant based diets: "our meat business isn't what it used to be, and I think that's going to carry on" (Innovator). There were also some who regard the trend more positively:

> there's no point in fighting against more plant-based foods and vegan, it just needs to be an opportunity that's created there rather than thinking of them as a threat (Farmer).

Others expressed support for the need to eat less meat:

> you do have this battle - you can see it playing out in public and I think we can't continue to consume meat with the developing areas of the world consuming what we consume and have things like grain fed cattle. So, I think more enlightened, younger farmers know that the tide will change. […] I hope they do start to change their view and stop being antagonistic to something that does have to happen (Innovator).

This interviewee noted the hostile tone of the debate, and hoped that farmers and others could move beyond this to recognise positive factors on both sides.

Interviewees suggested that dietary change is unlikely to influence many farmers yet:

> I don't think any of them would be thinking about changing the production system in anticipation of consumers moving to a more flexitarian or vegetarian, vegan diet. I think your mainstream livestock and dairy farmers wouldn't see it as an opportunity at all (Stakeholder).

Any threat may feel a little too remote at present, particularly at a time when prices for lamb and beef are strong. Lack of urgency may also be because Welsh farmers believe they can continue producing meat within a climate emergency; several participants highlighted their meat is environmentally friendly compared to intensive global production. This creates concern about perverse effects of reducing production in Wales:

> there's pressure put on British farmers or Welsh farmers to somehow cut back livestock and it just creates a hole for imports from New Zealand and Australia (Stakeholder).

A national approach was proposed in which those who can only use land for grazing maintain stock levels with livestock reductions focused "in areas where they can do alternative things" (Stakeholder). Reduced demand for meat may not mean all farmers seek alternative income streams, although some disagreed:

> I'm sorry, but the way most of those farmers were bought up, isn't going to be sustainable going forward. And so things have got to change (Innovator).

Those thinking longer term are conscious that:

> farmers will have to start to see alternative forms of production as no less valid as a farming activity (Stakeholder).

This highlights the diversity of opinions and lack of consensus regarding how far Welsh livestock farmers need to change what they produce. Some consensus did emerge amongst workshop participants, that the key is to think not of wholesale changes in farm system, rather introducing new elements and change by degree. A patchwork approach to change seems likely at the national level, with some livestock farmers making significant changes and others very little.

2.3. Attitudes to diversifying into plant crops

> *"I feel quite passionately that there's a need to do it - but we have to be realistic about how easy it is to do as well." Stakeholder*

A key aim of this research was to understand whether promotion of plant based diets is perceived as an inherent threat by Welsh farmers, particularly those who rely on livestock markets. So far the results have shown a spectrum of views regarding this prospect - from threat to opportunity. Next we outline whether this is likely to translate into diversification into plant crops. Over half of respondents have recently considered diversifying their production in some way, with the most popular option being tourism (e.g. café, camping). Of those not currently operating any horticulture (83% of survey participants), 32% saw opportunities to introduce this to their business, whilst 47% did not, and 21% were unsure. None of those in the survey currently producing horticultural crops have land classed as LFA, although some who did regard this as an option for their farm. For those ruling it out the main

reason was unsuitable land, with other prominent reasons being lack of labour, capital, and market uncertainty.

Changes livestock farmers are facing may push them to seek opportunities to diversify:

> as a sheep farmer I'm worried about the trade deals that have come out of Brexit. Before Brexit I was worried whether we would have a deal or a no deal situation. We've probably been very fortunate that the trade stayed with us, but it doesn't always mean that that's gonna be the case and having your eggs all in one basket is never a good thing. We do keep some beef cattle, but obviously we've got the problem then of NVZ and huge investment of covering a slurry store and different things. So do we continue doing that, it's all a struggle. It is literally just me and my husband (Workshop).

During discussion this farmer expressed interest in introducing some crops onto their farm; others noted that a time of much change is a good time to look for new opportunities. But current attitudes can discourage such diversification:

> I think horticulture has probably historically been seen as the poor relation, and I think, unfortunately, it was taken over by the community movement for a while which probably ostracised commercial farmers to think 'Well, it's nothing to do with us, we don't need to get involved' (Stakeholder).

Those who have begun horticultural enterprises amidst traditional farming communities have faced these perceptions:

> 'you're growing vegetables in Wales? that'll never work, cos only sheep work around here.' It's such a bad misconception (Innovator).

Several of those farming beyond the mainstream sheep and beef model described being perceived as eccentric, hippies, or idealistic incomers. However, others noted precedence for mixed farming in Wales, hence diversification is rooted in tradition. Participants mentioned examples of horticultural production on marginal and high altitude land which suggests that the perception that most Welsh farms are only suited to livestock might be misplaced. Variation between farms is important:

> every farm is different, but there are pockets of land in Wales with the right soil and the right micro-climate to be able to grow higher value crops, like veg. […] I think we need to be identifying the suitable bits of land that we could convert to horticulture (Farmer).

But the message from many participants was that where plant crops can be grown this could be encouraged, to increase national production above current levels.

Some participants saw this transition as essential to increase national food security. Other perceived drivers included environmental sustainability and farm viability, particularly through expanding sales through local supply chains. Some stakeholders noted that the Covid-19 pandemic made the importance of local supply chains more prominent, and highlighted opportunities. Those involved in policy making, noted that political priorities pull in this direction:

> Welsh ministers would be very keen to see more diversification in agriculture, cropping and horticulture, for lots of reasons not least because there is a strong body of opinion that thinks that livestock and dairy production does contribute significantly to greenhouse gas emissions

> and climate change. […] The government policy is for a healthier diet for the nation as well and part of that is looking at locally grown foods, short supply chains and community based food production (Stakeholder).

Government priorities for shorter supply chains were noted as an area for horticulture to contribute to, with job creation also noted as beneficial outcomes.

Although there are diverse views on the extent to which Welsh livestock farmers should move away from meat production, it is clear that there is potential to produce more than meat. A consistent message was that this will not be possible for all, and will not be easy for those who choose to do so. Another recurrent theme was that changing what farmers produce with consideration of how it will be sold, to who. Altering supply chains and targeting different markets is as important as diversifying into different produce.

2.3.1. Benefits of Diversification

The previous section highlighted that the route into plant production is not suitable for all farms, but those who have already pursued it note benefits for their business, and beyond. The potential for these multi-faceted outcomes is associated with these models:

> So there's short supply chains, we're more self-sufficient, we're more resilient. If we're using, crop rotations and mixed farming methods and organic manures, measures to produce metrics showing the improvement and circular economy, and how that's helping achieve climate targets, and also biodiversity targets, and measure the improvement in-soil biodiversity and above-soil biodiversity as a consequence of moving to agroecological methods (Stakeholder).

Another participant described the potential in terms of resilience at farm-level and beyond from introducing different crops:

> I think that brings a huge opportunity to produce a healthier diet for your community, to increase the farm income, to increase the farm's social outreach, cos it brings people onto farm and it really diversifies that element of the farm and it just adds a lot of resilience, doesn't it? (Workshop).

The environmental benefits cited include enhanced soil health and on-farm biodiversity. One stakeholder noted that many growers in Wales use agro-ecological methods which are likely to have environmental benefits. And the nature of the crop can be beneficial: "the winter stubble over winter, after the oat crop - basically you're creating a big bird table" (Farmer).

In terms of economic benefits, those already operating a mixed farm argue that it makes business sense and that changes have 'paid for themselves'. Income generation is often associated with job creation on farm or supporting more family members. Enhanced farm viability and job creation is seen as positive for rural communities with many family farms:

> quite often the children want to be involved in the farm in some way. But it's probably the case that the existing enterprises on farm, because of their profitability situation, can't afford to pay them a wage for staying on the farm. And getting into a growing opportunity is a way of saying

> to the younger generation 'here you are, you develop this'. […] The whole social structure of the Welsh language, Welsh culture, would be enhanced because you're keeping Welsh speaking young people in the community (Workshop).

It was also noted that horticultural crops are often sold direct or through local outlets bringing further advantages:

> it's quite a nice opportunity to connect directly with your customer base and shorten that supply chain and take more of the profit yourself (Workshop).

These supply chains bring farmers into contact with customers which was seen to benefit farmer and community. For example, a PYO brings people onto the farm: "the atmosphere is buzzing and you've got people just loving it" (Innovator). This could raise awareness about food production and producers by "giving people opportunities to connect with the food" (Workshop). This might be for local residents, or tourists who were often seen as a key market for many of the business opportunities discussed.

Whilst a common theme was that entering into diversification is hard work, on top of an already heavy workload, one farmer noted that vertical growing benefited their wellbeing. They described harvesting the crop as like mindfulness:

> We have the radio on in the background, and you've just got to carefully prepare and tend to these greens and then package them up. So it's actually for mental health and wellbeing we think it's [good], and then you, you can eat them at the end. It's really good (Innovator).

Encouraging people onto the farm could also be beneficial:

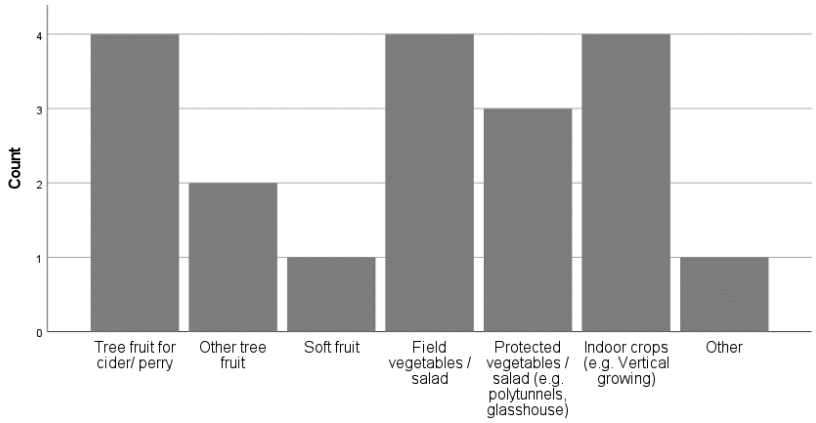
> I think issues of isolation and mental wellbeing in farming is often, sort of, overlooked and that isolating aspect of the rural environment. So, if there's a way to connect better with the local community or bringing people in, and that's desirable, then I think it's a real win-win (Workshop).

Not all production systems allow such pleasant workplace moments, but they can introduce welcome variety to farm work. However, participants also noted that not all farmers want more people on farm, or are good at interacting with the public. Again, the opportunities and benefits vary between farms, and should be tailored to the farmer.

2.4. Opportunities to diversify into plant production

Given the range of benefits from introducing plant production, how would other Welsh farmers pursue this? The survey indicated interest in various crops with the most popular being tree fruit for cider/perry, field vegetables, and indoor crops among those expressing interest. The least popular option was soft fruit (Figure 2).

Figure 2 Survey participants' interest in plant crop types



When asked to consider opportunities for Welsh farmers to produce plant crops, several participants noted this represents a return to historic patterns:

> We've been growing oats or barley every year for the last 13 years now. Dad always grew a field of barley up until the late 70's and then the advice you got from the professionals was to specialise in doing one thing and intensify your grass production (Farmer).

Mixed farming was discouraged by economic drivers:

> since we joined the common market the agricultural subsidy system, the basic payment system, has rewarded farmers just for owning land and that's allowed the spread of a monoculture, of sheep rearing, and has provided a disincentive for the more traditional forms of agriculture. And that's especially true where combined with wider macroeconomic circumstances, so that it's cheaper to import food from elsewhere (Stakeholder).

This participant noted that changing conditions - not least climate emergency - make a return to mixed farm systems important. They have collected data on past land-use in one Welsh region and are sharing it to aid discussion of changing farm systems:

> You can learn from the past and look to the future, then we can have a lot more varied agriculture here in Wales (Stakeholder).

Somewhat ironically, several participants noted that those adopting mixed farm systems are often newcomers - to Wales and to agriculture - rather than those with family connections to Welsh farming. But for what they called the 'mainstream farming community' it was noted that the next generation could be given the chance to run an 'add-on' enterprise alongside the existing livestock business, for example a PYO, which gives them an income.

Participants' views highlighted that whilst there are clearly opportunities for more Welsh farmers to produce plant crops, this need not mean a wholesale transformation of their farm system. Mixed farms emerged as central to the vision shared by many. Those currently farming only livestock recognised they might turn some land to vegetables, either grown by them or someone else. Combining the two has multiple benefits: productivity and soil management benefit as grazing livestock fertilise the ground. Secondly in terms of supply chains: the same local customer base will likely be interested in vegetables,

meat, eggs and other farm products. This approach was agreed as a good model to promote to current farmers as an opportunity to generate new income streams, without completely transforming their farm.

Discussion of what types of plant crops Welsh farmers might produce identified what one participant called the "low hanging cherries" - production systems which could be introduced to farms relatively easily. These included field vegetables:

> It's not a big step from looking at growing fodder type crops to growing crops for human food as well. In fact, a lot of people grow swedes for sheep to graze on, but I love swede as well. It's not a big step to selling some of those (Workshop).

Cereals were also seen to be a relatively easy step for farms, being more familiar crops and requiring skills they already have. Other options were identified which could fit into current systems such as orchards, tree nurseries, vineyards or soft fruit:

> dare I say a lot of traditional farmers might be able to do that more easily. It's not a world away from planting hedges to planting raspberry canes and stuff [laughter]. It's also technically it's maybe less difficult to get a good crop in terms of the technical knowledge you need (Workshop).

Tree crops were also seen as more straightforward opportunities due to the potential for agroforestry to combine fruit and nut production with livestock as tree shelter. Fruit and vegetable PYO which reduces labour need was also seen as flexible enough to fit into existing farm business. Controlled environment agriculture (CEA) was also noted:

> there's a real market there particularly because farmers understand the supply chains, farmers understand how to grow crops and how to market them and I believe there are a lot of opportunities to retrofit agricultural buildings to facilitate CEA (Workshop).

Equipment, skills and field patterns might make farms adaptable to these crops. Participants felt that part of what makes certain crops appealing are that farmers might feel more confident working with them - they already work with fodder crops or hedging - so could adapt skills and knowledge.

In addition to 'low hanging' crop opportunities participants noted options for farmers to produce for established supply chains via specialist processors. For example, supplying wine producers:

> rather than everybody who does growing having to go and do all the legwork for their own marketing and getting a supply chain in place, the way forward is to let the people who've established the supply chains deal with that side of things (Workshop).

It was suggested that rather than expecting many farms to produce plant crops at scale, increasing domestic production will come through collaboration.

These examples highlight that participants understood diversification into new produce as coming hand in hand with new business structures, such as partnerships or contracting. Those expert in livestock deploy their expertise, whilst a partner or tenant brings their skills and interest in market gardening for example. Several participants – including those already operating this model – praised cooperation or partnership approaches:

> I like this model where people with skills and expertise can carry out their projects, things I'm interested in, without me necessarily being the expert, because I never will be. […] What I want to be is I want to be an incubator I want to enable (Innovator).

Whilst reducing the risk and workload for the farm owner, this provides opportunities for those without their own land to establish production enterprises.

Whilst most participants were optimistic about potential for farms in Wales to capitalise on opportunities, there were notes of skepticism or at least realism:

> I know we want more horticulture, more vegetables produced in Wales for the Welsh population, but the reality is it's not gonna be easy (Workshop).

> I feel quite passionately that there's a need to do it - but we have to be realistic about how easy it is to do as well. (Stakeholder)

This was connected to the limits of selling into local supply chains, particularly in areas of low population density. There were also doubts about the extent to which horticulture can expand given the small scale of current enterprises. A message from many participants was the need to balance ambition to produce more than is currently grown in Wales, with a pragmatic approach: "some blue sky thinking is good, but don't get carried away with blue sky thinking" (Workshop). Pragmatism means being selective about which opportunities to pursue:

- Like a farm hasn't got to be everything and do everything.
- There is this expectations that farmers kind of do everything, isn't there? Educate, grow fruit or, or meat or whatever, and then actually ensure that people eat it at the end as well. And quite frankly that's not all of our jobs [laughter].
- There's only so many hours in the day, eh?
- Yeah. I mean if you were making a washing machine you wouldn't expect to put it in somebody's house and then do their washing for them, would you? Like the realism of farming, isn't it? (Workshop).

Participants also noted that it is counter-productive for a large number of farms to pursue similar opportunities as it increases competition. There is also potential for negative environmental impacts by diversifying in the wrong place:

> You'd have to be really careful that you don't end up with a situation where you're encouraging people to plough up land that is less suitable and end up maybe putting nitrogen, or potassium, or phosphates, on that land simply because everyone wants to eat local food when actually it makes more sense to put sheep and lambs and cattle on that land and grow the carrots down at the bottom of the valley (Stakeholder).

This highlights the need for a planned approach to diversification, informed by knowledge of the whole farm system, its impacts, and long term prospects. Plant production should focus on the most suitable land, with plant crops an add-on rather than alternative for many current farms

To summarise, a range of opportunities to introduce or expand plant crops on farms were identified, with some felt to be relatively easy to introduce into current systems, including livestock farms. Making these changes is not just about identifying which crop suits the land, but considering new supply chains and business models. Popular options discussed during the workshop were cooperative models or contracted arrangements which reduce risk and bring a range of skills into a business. However, all opportunities

come with challenges. Therefore, participants emphasised the need for a farm by farm approach to selecting appropriate opportunities. Diversifying production should not be seen as a way out of failure for failing farms as it takes a great deal of work, and is most likely to succeed when incorporated into a successful business. Careful business planning is needed before any change.

3. Learning from successful plant producers

The research sought to learn from experiences of Welsh farms which have recently established plant production, and whether these could inspire other farmers to pursue similar opportunities. This section summarises key lessons from the four featured case studies, and how they were received by other research participants.

3.1. Case Study One: Pick Your Own

"It's a diversification not reliant on any subsidy".

This mixed farm (beef, sheep, arable) in South Wales introduced a PYO to offset declining subsidy. It grows soft fruits (strawberries, raspberries), beans and sunflowers in polytunnels. The owners explained how the PYO brought visitors to the farm, and sold the fruit without needing additional workers or significant labour costs. Some fruit is processed into goods sold through the on-site café which is an additional attraction in a popular tourist area. This was considered effective, and a good income generator: the PYO represented one third of profit and 25% of turnover. However, some difficulties were highlighted, most notably, complexity of applying for government grants.

This case study attracted significant interest in the workshop. Participants recognised the flexibility of this approach, and identified flexible options from pumpkins, to flowers. It appeared appealing for offering an enjoyable experience for customers and promotes engagement with farms:

> I think it's just offering something more and giving people opportunities to connect with the food (Workshop).

It was regarded as a relatively easy "bolt on" to existing operations – a perception confirmed by the case study farmer who described not having any prior expertise in fruit growing. However, practical limitations were highlighted. These included managing customers on a farm (parking, safeguarding, safety, traffic) as well as set up costs. It was noted to be very location dependent, with one livestock farmer claiming it may not be an option for those who - like them - live "in the middle of nowhere". Workshop discussions expressed doubt about whether PYO sales can be relied on for more than occasional purchases during holidays or for Halloween pumpkins. Participants concluded that for farms located close enough to suitable markets, PYO is a flexible and relatively achievable option. They suggested that support with set up costs (e.g. polytunnels), administration (e.g. planning permission) and customer management (e.g. payment systems) would enable farms to pursue this option.

3.2. Case Study Two: Direct Fruit & Veg Sales

This mixed farm sells produce through their own retail outlets, including a PYO and café on site. Crops are produced using a bed system, coir filled pots, glasshouses and Spanish tunnels. The café is particularly useful for preserves and cooked food utilising unsold produce - avoiding waste, whilst enhancing the visitor offer. The farm reported multiple benefits: soil health, profit, and minimal waste. Difficulties included: sourcing sufficient labour, meeting regulatory requirements including planning permission, and the pandemic's impacts on operations.

This case study received some interest in the workshop, with several participants recognising value in shortening supply chains, and fostering a sense of community. However, one farmer said not all farmers seek customer interaction:

> The farm shop side of things doesn't appeal to me at all. I'm much [more] happier in the field with vegetables and animals than I am people. I'm alright doing deliveries, I can cope with that without having a panic attack! I think there's gonna be a lot of farmers would feel the same. It's like we want to feed people, but we don't necessarily want them in our home and workspace (Workshop).

Several participants noted this option is not be for everybody:

> I'm very pro these ideas in the right location, I just don't want to think it's, it's a possibility for everybody (Farmer).

It was seen to suit farmers with the time, space and money to make it happen.

3.3. Case Study Three: Cooperative Model

"The cooperative structure gives everyone the space to branch out and try different things."

In the 1960s the owner of this dairy farm sold most its land to a cooperative which transitioned into horticulture. It produces food on 9 acres, providing 170 weekly local vegetable boxes plus wholesale businesses. They have an on-farm café and host educational workshops which generate income. The cooperative structure allows effective distribution of responsibility and specialisation between members. Trainees and volunteers provide additional capacity. The farm is profitable, and reported numerous benefits including: education experiences for the community, supporting local jobs, and a structure that allowed specialist knowledge to flourish. They did, however, report difficulties accessing funding and establishing the structure through trial and error.

In the workshop, this case study attracted significant interest, with farmers and stakeholders positive about the business structure. A key theme was the benefit of different people working on elements of a farm:

> it's another form of diversification that kind of makes those other diversifications easier in many ways. You get more people on board, ideas, potentially more tools and resources (Workshop).

Involving more people and more knowledge was seen as an effective way to make a farm more resilient. Others noted the radical nature of such a system, expressing doubt over how applicable it could be on

existing farms, particularly where owners have more traditional values. There was much discussion about the process of establishing a working cooperative and how feasible it is to find a cohesive, willing group. It was noted that there are examples of this kind of structure failing, as well as working.

3.4. Case Study Four: Vertical Indoor Growing

Two farms trialled a hydroponics system provided by Menter Môn, who also gave advice and support. Both installed the equipment in redundant buildings on their farm to grow salad and micro greens, which they sell to local businesses (e.g. pubs, restaurants). The farms were operating the growing profitably, and found they had been able to operate it with minimal additional labour input. They found that initially the design of the system required a lot of maintenance, and noted that it would be expensive to establish had funding not been provided.

When discussed with other research participants, vertical farming was controversial with some farmers finding it contrary to their beliefs about what farming 'should be':

> I think it's unsustainable and unhealthy. It seems to be technologically advanced and futuristic. But at the end of the day I think the only healthy and sustainable way of growing crops is to be planting and growing food in healthy soil (Farmer).

One speculated it may not appeal to farmers:

> I think traditional farming is all about the soil, the land, the fields, understanding generations of animals that you've bred, to have the ultimate sheep that loves the mountainside. It's very difficult to drive too much science. So something like hydroponics, it's difficult, I don't know where it would sit (Innovator).

This farmer suggested initiatives like Tech Tyfu appeal more to those interested in technology and science, offering an opportunity for a factory rather than a farm.

Together these case studies illustrate how Welsh farmers have introduced plant crop production to their businesses, often in combination with livestock. They demonstrate successful business models, whilst highlighting issues which might deter others from pursuing similar opportunities. Feedback from other participants indicates that each has some appeal, but should only be pursued if suited to the particular location, business, and person.

4. Barriers to transformation

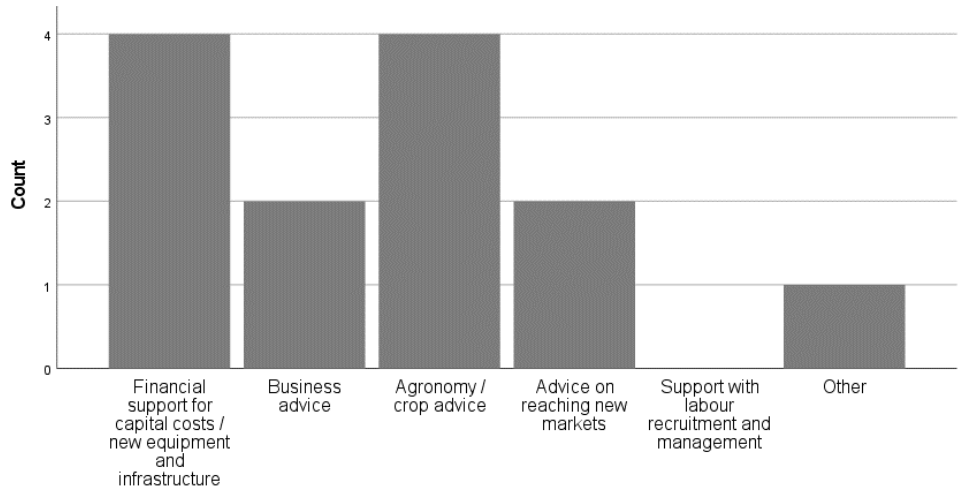
"I think change is, is stressful for people generally, whatever the change is" (Farmer).

To assess barriers to transformation we used data from all three methods. The survey provided insights into the experiences of farmers who had not diversified, with most seeming to have quite a different perspective from those interviewed or the workshop. However, reasons survey participants gave for not moving into plant production echoed findings across the research. The data highlight four categories of concerns and constraints to be addressed to enable more farmers to transform their production.

4.1. Business and Financial Concerns

Perhaps the strongest theme across all data was economic considerations: the need for financial support, concerns about the difficulty making profit, expensive start-up costs, and needing assured income generation. Amongst 13 survey respondents who identified support they would need to produce plant foods, financial support was a popular option (Figure 3).

Figure 3 What farmers would require in order to introduce plant crops



Interviewees noted that little financial support - grants or loans - is available for farmers to move into horticulture, particularly for capital costs. Those who made the transition typically had private funds, whilst others negotiated complex funding applications. Those who own land have an advantage over others seeking to move into horticulture; one case study farmer had been pleased to rent land to such a new entrant. Beyond set-up costs, farmers and stakeholders emphasised the need for income security when entering new markets. Farmers need an assured income, and help to enter new supply-chains:

> Livestock farmers know how to market their livestock, they know when they're ready, they know where to take them, whether market or abattoir or wherever, they know all that. That doesn't transcribe to knowing how to market your vegetables. I think a lot of people would, enjoy marketing veg boxes to local people, but just be really daunted about how to go about something like that (Innovator).

One farmer described a past attempt to produce potatoes which failed due to lack of local market, resulting in considerable wasted produce and effort. As noted above, supply chain development is a key factor in diversifying into new products.

4.2. Socio-cultural Factors

A second theme was attitudes within farming communities, which can hinder transformation. Several participants suggested that perceptions of farming in Wales tend to favour tradition, or as one farmer

put it “conservatism”. It was judged that many Welsh farmers are ‘conventional’ meaning wedded to livestock farming and subsidy:

> there's a proportion who are so passionate about what they've been doing for the last 50 years or whatever that they find it - it's a bit like asking them to fly to the moon, I guess. They are really so passionate about their Texel flock or their Welsh black beef flock and they've, in a sense, forgotten that they used to do something different as a family (Stakeholder).

Characterised as older, these farmers were thought to resist innovation. Some stakeholders described younger, successor generations as more likely to seek new opportunities, but facing resistance from their parents:

> almost anybody who’s involved in a family farm and wants to change the concept of what they're doing, their main barrier is their mum and dad (Stakeholder).

For families with a long history of farming, current holders feel responsibility for their land and the traditions associated with it, meaning change can be difficult. Beyond generational tendencies, there was a sense that farmers are either open to new ideas or not – that attitudes to change differ. But individuals are influenced by peers and trusted organisations, such as farming unions. If their social networks are not promoting an opportunity it is regarded with scepticism:

> Is the social acceptability part of this? We live in very conservative rural areas, and actually doing something different might not only be a risk personally, but it might be a risk in terms of people thinking you're an idiot. Everyone thinks I'm an idiot round here (Workshop).

It was noted that those establishing horticultural production in rural communities are perceived as outsiders or alternative, not part of the Welsh farming community. Those who have followed this route described feeling separate from traditional local farmers, and being regarded as a naïve hobbyist - hence the quoted participant saying they are regarded as an idiot. Our innovator participants are quite estranged from farmers in their locality, so instead sought support from networks of new entrants or ‘alternative’ farmers.

4.3. Reliance on subsidy

Changes to subsidy are a prominent concern amongst farmers involved in the research. Losing this income stream is challenging and requires adaptation: “it’s the way people have always had it” (Innovator). However, stakeholders noted the end of CAP as a potential opportunity, particularly those who criticised it for driving intensification and monocultures. They suggested that new subsidy arrangements could be used to favour mixed farming or agro-ecological systems including more horticulture. But the likely changes require farmers to become more self-sufficient:

> Farmers are - possibly too used - but very used to being paid to do things. I wonder if there’s a responsibility to take financial responsibility for your business (Workshop).

It is notable that most innovators had entrepreneurial skills, and were perhaps accustomed to taking risks. Some came from a background in other businesses, bringing skills in IT and other aptitudes beneficial for planning and running an enterprise.

4.4. Practical on-farm considerations

Those who ruled out plant crops cited prohibitive factors on their farm, the most common being land and location:

> in terms of food production we're fairly limited really because of the climate and the soils. The thing that grows best here is grass - that's what the climate and the soils are suited to best of all (Farmer).

The Welsh landscape's terrain, soils and climate are well suited to grazing sheep. Other concerns were lack of infrastructure and time, plus issues around markets and income as noted above. Lack of suitable labour was mentioned as a barrier to establishing plant crops; one farmer who operates horticultural production cited this as a limit on expansion because they previously struggled to employ quality workers:

> Not everyone wants to go and get wet and dirty all the time when there's maybe easier jobs to be done. So yeah, it's always, always, always, always a problem (Innovator).

Work growing plant crops is different from other farm work, with some suggesting it is more physical and hands on - literal dirty work which does not appeal to all: "I just feel a lot of people don't really want to work that hard" (Innovator).

Participants highlighted the need for farmers to have suitable skills to produce plant foods, with some stating they would need support with agronomy and issues such as pest management. Livestock farmers were identified as having many skills which transfer to plant crops, for example hedge laying, raising fodder crops and machinery handling. But crop husbandry entails new skills; farmers need time and resources to acquire these, plus accessible training. One stakeholder suggested pursuing this takes drive:

> there's people generally from outside the Welsh farming community are interested in lifestyles and are propelled to acquire the skills. And it is a highly skilled thing being able to produce food using an agroecological method. And they're prepared to put the work in. But I don't know if that's true of the mainstream Welsh farming community (Stakeholder).

Given the socio-cultural factors noted above, there may be a minority of livestock farmers willing to commit to learning to produce plant crops. Moreover, growing is only one aspect of what they need to learn in addition to navigating new markets and ways of selling food.

5. Pathways to transformation

The findings about barriers to diversification highlight that enabling change is not just about offering practical support, but understanding and working with farmers as people with certain attitudes and practices, both individually and as a community with some shared culture. One farmer noted the importance of encouragement and building confidence: "it's getting positive messages out there and making us feel good again" (Workshop). There was felt to be a need for different mindsets:

> I really believe that where farmers are missing out at the moment is that they're not actually opening their minds and thinking, how can I use what I've got at my disposal in a fundamentally

> different way. And by the way, it doesn't have to be me: how can I facilitate a young person or younger person to do something really different?" (Innovator).

How farmers perceive their identity and priorities can inhibit change; unless there are urgent reasons to do things differently the status quo is maintained.

For those open to change, a key consideration is certainty of a market for the new product, and this requires careful investigation:

> It's ensuring that that kind of forward planning and strategising is in place before you start (Workshop).

But farmers may not have time to explore this, so need support with supply chain insight and development. Participants suggested a viable route is to collaborate with others who specialise in market development or retail so the farmer need not split their time and skills. Suggested models were food hubs which act as the point of customer contact for multiple producers, "helping to take some of the retail burden off the farmer" (Workshop).

Group buying and marketing was noted as a lower risk, lower effort route into horticulture: "more of a collaborative approach which is more safeguarded against risk" (Workshop). Puffin Produce was noted successful model to learn from:

> they provide us with instructions on what to grow, how to grow it and they've got the whole supply chain sorted out and we don't have to worry about the marketing at all, we just produce according to what they require, deliver that into them (Workshop).

This model provides a guaranteed buyer and expert support to growers, addressing many risks a farmer is concerned with. At a smaller scale, the community supported agriculture (CSA) model was noted to reduce vulnerability to market forces and guarantee an income, making it more viable for a farmer to invest in set-up costs. However, participants noted some growers preferred to develop and control their own supply chain. But there was a strong message that government could support the sector by facilitating networks of growers to form cooperatives, akin to EU funded producer organisations.

During the workshop cooperative models were warmly received, with several discussions suggesting bringing more people into a farm business to maximise the skill base and division of labour. A sheep farmer need not become a grower:

> It doesn't necessarily have to be that the same person has to shift to then be an expert market gardener. Because obviously they're both pretty high skilled and, yes, although some farms will do a mix, have a look at that opportunity where you could have maybe a joint venture with someone else who has already done the training and is keen to get into the industry, but doesn't have the access to the infrastructure (Workshop).

This reinforced the need to think of diversification as multi-faceted:

> it's another form of diversification that makes those other diversifications easier in many ways. You get more people on board, you get more ideas, potentially more tools and resources. There's a whole host of ways that a co-operative model could be hugely beneficial (Workshop).

But this is not a simple solution and may not enable farms to generate sufficient income to support the farmer and family. The notion of cooperation may present a barrier:

> for other people, that revolutionary element can be quite sort of threatening I think perhaps, and not necessarily accessible (Workshop).

Those experienced in cooperatives highlighted the need for foundational relationships:

> you need to have strong social ties and, and community bonds within that group of people for a co-op to create the conditions for the kind of trust (Workshop).

Again, it is clear that no model suits all farms, or is without challenges, but the message is that government support should be sufficiently flexible to reach beyond individual farms.

Many of the enabling conditions identified rely on farmers being aware of opportunities to produce different crops, and having access to information on how to do so: “it’s just that barrier of getting that information out” (Workshop). Persuasive communication would include practical case studies which show farmers what is possible, the economic implications of the opportunity and how to make it financially viable. This would include providing accessible data to inform business decisions. Beyond the establishment phase advice and support remain important: “the growers we work with like a lot of hand holding” (Stakeholder).

Discussions highlighted that it is not simply an information gap to be overcome by providing appropriate practical advice. Firstly, there is a need to be heard amongst a volume of communication to farmers:

> so much advice, so many noises being made about where we need to go, what we need to be doing. It’s very hard to cut through the noise (Workshop).

Who messages come from and how those voices are perceived influence whether they are well received. For those characterised as ‘older’ or ‘traditional’ farmers it was suggested that online information is insufficient. Discussion noted factors like talking to neighbours over a pint in the pub, and feeling supported by a peer network influence whether a farmer accepts new ideas. As horticulture is not perceived as a viable or respected option by many in the Welsh farming community, there is a reduced likelihood that livestock farmers are encouraging each other to produce plant crops.

Communication is most effective via people farmers already trust, but many of those who have established successful plant production are not from this background. As one participant put it:

> I'm an Englishman doing weird stuff in Wales, and actually I'm never, ever gonna go and tell a local farmer what to do (Workshop).

Participants suggested that organisations like farm unions and Farming Connect are better placed to promote opportunities and successful models. Their advisors are seen to be “part of the community, they're a farmer's son or daughter” (Workshop). They have good access to farmers and are well received, however:

> Farming Connect can do some really great stuff but it seems like some of what they do is quite narrow or that their expectations of what farming is and what farmers can be is very narrow. But they already have the respect of a lot of farmers. So I think they could actually be very

> powerful in, normalising organic or regenerative agro-ecological farming and being like, “no, this is what normal, serious farmers do, not just hippies” (Workshop).

Participants were aware of support through schemes such as Agrisgôp and Farming Connect mentoring, but suggested this is not reaching those who need it. Some felt this advisors within ‘mainstream farming’ are not all promoting diverse production: “I think they're quite concentrated on pushing production in the normal streams of Welsh farming” (Workshop).

On the other side of this divide, are organisations conscious that their association with agro-ecological production prevents some farmers from approaching them. At present there are distinct communities of farmers and the organisations they feel affinity with. Participants suggested progress depends on more collaboration:

> when I go to other farms, there's definitely barriers between conventional farms who really respect Farming Connect will think that us in Land Workers’ Association [Sic.] are a bunch of hippies, and I just think that those barriers need breaking down and a lot more sort of working together because actually, we're all after the same thing, really. I would really like to see Farming Connect work jointly with the LWA and also the NFFN, the Nature Friendly Farming Network, because I think it would then pool a broader range of farmers together to get to sort of one goal of going more horticulturally (Workshop).

Participants suggested that focusing on reviving mixed farming could be one way to work across these barriers, as a shared goal rooted in tradition. One noted that horticultural businesses have a good track record of collaboration and knowledge exchange, making it a supportive community. This suggests merit in connecting livestock farmers embarking on a similar journey.

Not surprisingly, funding was repeatedly mentioned as a desirable way to support farms to diversify production. This includes support for infrastructural investment, and making sure that small scale growers (<5Ha) are eligible for support. From the funder’s perspective there is also an impulse to invest wisely, which means favouring those who are proven enterprises. However, some participants noted that farm grants which follow this principle have resulted in farmers streamlining their livestock operation rather than investing in new dimensions to their business. One participant suggested that a different approach to grant giving could foster innovation by for example, supporting purchase of infrastructure like polytunnels. A theme was that funding offered to farmers needs to be more flexible and diverse, so it might support grower cooperatives, or purchasing shared equipment and facilities - investment beyond individual businesses.

Across all these pathways to change, the key is risk reduction:

> So there’s a risk around capital, financing, funding, all of that. There’s a risk around the knowledge you need to do this well. There’s a risk around will there be a market, will there be customers for my products? There’s a risk around how much labour will I need, will I be able to find the labour? So it’s doing a risk analysis and thinking about what we have at our disposal to minimise those risks for people (Workshop).

A key mechanism is farm plans, taking a longer-term view on the whole business to guide decisions. But participants noted that a minority of farmers are appropriately skilled for this, presenting a useful area for intervention:

> some kind of funding or structure or something that could actually just step into farm businesses, and just hold their hand and go, 'Actually, why are you doing what you do, and what do you really want to get out of it?' (Workshop).

Any support needs to assume that farmers are busy and committed to what they do on their farm and have done for many years. Some participants noted that past transformations were driven by emergency, as crisis drove people to create solutions. With subsidy being reconfigured, Brexit and climate emergency, participants noted similar urgency should be felt now.

6. Discussion

The research identified a spectrum of attitudes towards the prospect of changing diets amongst the farming community, ranging between feeling threatened by reduced meat consumption, to seeing opportunities to produce plant crops. This diversity reflects that found amongst UK farmers regarding other significant changes; it seems some farmers see opportunity where others perceive a threat. Climate change prompts similar responses ranging between pessimist and optimist, with some disengaged from the issue (Barnes and Toma 2012, Wheeler and Lobley 2021). Another key parallel with attitudes to climate change is the sense that the impacts of dietary change are too remote to prompt a response yet. Farmers typically plan for a 3-5 year timeframe so may not invest in preparing for slower changes, particularly if the potential impacts seem uncertain or insignificant (Wheeler and Lobley 2021). This tendency is apparent amongst participants who were unsure that plant based diets are increasing, or that this trend would affect the market for quality Welsh meat. And there are other more imminent changes to consider right now.

To some extent this diversity of attitudes indicates that how Welsh livestock farmers react to dietary trends or any challenge, is a matter of personal attitudes and values. It has long been found that farmers have different positions regarding risk and are motivated by diverse priorities for their farming (Dessart et al 2019). However, influences on farmer behaviour are more extensive than this, with literature on why farmers do or do not adopt changes showing complex influences comprising social, material, and individual factors (Inman et al 2018). Financial concerns are often central but are not the only or always primary influence (Inman et al 2018). To make a change such as introducing plant crops, the ability to adopt the change must intersect with willingness to adopt it (Mills et al 2013). The ability to change can be impeded by multiple barriers; many which others highlight coincide with those in our findings (Midmore et al 2001). Factors limiting farmers' investment in climate responses overlap considerably with those cited by our participants: impacts of changing conditions are uncertain and a low priority, whilst farmers have poor levels of business planning and limited investment capacity (Wheeler and Lobley 2021). Deciding to change is mentally demanding, which can be a deterrent from diversifying even when this step is seen as beneficial in relation to the pressures farmers experience (Davies et al 2019). In face of these barriers farmers can find it easier to do what they have always done.

The dominance of livestock, particularly sheep, in Welsh agriculture represents a regime supported by complex socio-technical conditions, against which innovations such as the move into horticulture struggle to extend beyond niches (Mylan et al 2019). The study of innovations has found that whether they become more widespread depends on the nature of the innovation: will it bring relative advantage, is it compatible with current values, how complex is it, can it be trialed, and can the results be observed

(Rogers 1983). Farmers are more likely to adopt innovations which are not overly complex, and are compatible with the existing farm system and skills (Jones 1963). These would be what our participants termed the 'low hanging cherries' such as agro-forestry, PYO, and supplying buyer groups or processors. But farmers also consider how an innovation affects prestige amongst their peers (Jones 1963). This could prevent a move into horticulture due to its perception as the 'poor man' of Welsh agriculture, and associations with alternative, incomer communities. Social norms are influential, meaning that where mixed cropping is not in the majority farmers are discouraged from introducing it (Bonke and Musshoft 2020).

A key theme in our findings is that changing what Welsh farmers produce needs to come with a refresh of their thinking about what it is to farm and be a farmer. Different ways of doing agriculture require a new farmer identity (Padel et al 2019). Social norms seems to be particularly influential within farming communities, tending to perpetuate the status quo. Attitude change has therefore been suggested as a key step to changing farmer behaviours (Inman et al 2018; Mills et al 2013). This is not straight forward: some farmers attitudes are more open to influence than others (Barnes and Toma 2012; Midmore et al 2001). Our participants suggested some people are simply more open to change and innovation, and this may be associated with age. Those who have a successor may also be more likely to invest in change (Sottomayer et al 2011). But prompting changes in personal disposition is otherwise challenging, particularly for external influences such as policy (Dessert et al 2019; Inman et al 2018). Farmers need to perceive information and advice as coming from a neutral source, within their community (Heffernan et al 2008; HSE 2009), hence preferences for peer to peer knowledge exchange (Inman et al 2018).

The positive side to the power of social norms is that observing farmers implementing a practice can motivate others to adopt it (Dessart et al. 2019). This is borne out by participants' proposal that successful cases of horticultural and mixed farming in Wales need to be promoted within farming communities. In part this is about reducing the level of uncertainty (Bonke and Musshoft 2020), and showing how benefits relate to the farmer (Mills et al 2013). But raising awareness of plant producers is also part of broadening perceptions of how to be a successful Welsh farmer. Awareness raising can also be a step in building peer support networks which farmers rely on when making changes (Padel et al 2019). To have most impact, the pioneers who are promoted should be people that traditional Welsh farmers identify with and respect.

To adopt new behaviour farmers need to know about it, understand the risks, and see it as aligned with their personal values and community norms, hence a need for policy solutions which address multiple behavioural factors (Dessart et al 2019). Making sure the option is profitable can help (Barnes and Toma 2012), but may not be sufficient to influence the complex factors beyond rational economics (Dessart et al 2019). Encouraging Welsh farmers to produce more plant crops requires multiple mechanisms. The enabling factors supported by our participants echo those suggested for prompting action on climate change: improved industry collaboration, farmer-to-farmer learning, and better communication of context-specific information about responding to risks (Wheeler and Lobley 2021). Our participants were also keen to emphasise another key message in previous studies: farms are all different so there is no one size fits all solution.

By examining the experiences of those who have introduced plant production to their farm, and how others perceived this step it is possible to identify what circumstances need to come together to enable this transition. Discussions identified various mechanisms and modes of support which help shape the

context to provide these conditions. The key conditions which enable a farmer to make such a change are identified in Table 4, listed chronologically to reflect the approximate stages of the process. As emphasised in our findings, it is not feasible or desirable for all livestock farmers to begin growing plant crops; the enablers outlined here apply for farms with some suitable land or buildings.

Table 3 What will enable more Welsh farmers to produce plant crops?

Conditions enabling diversification	Support Required	Considerations
1. Farmer open to change.	- Peer networks promote opportunities and successes. - Organisations communicate that change is required soon.	Promote change as return to historic patterns of mixed farming. Need to counter negative perceptions of horticulture.
2. Understanding of the opportunities and how to implement them.	- Advice, data and case studies from trusted organisations. - Engagement with new entrants and innovative farmers.	Communication needs to penetrate farmers' busy lives and information overload. Organisations need to collaborate across the traditional-newcomer divide.
3. Risks to the business are understood and mitigated.	- Whole farm business planning. - Producer organisations / cooperatives guarantee a market.	Surety of supply chain is key. Plan needs to align with farmer's values and priorities.
4. Farmer confident and skilled to work in different ways.	- Collaboration with people skilled in other operations. - Financial support to attend training.	May not suit everyone.
5. Financial resources to invest in new infrastructure, and to ride out payback period.	- Capital grants. - Revenue funding for establishment and running of cooperatives / food hubs.	Need flexibility in funding mechanisms – scale and type of farm.

7. Conclusion and Recommendations

This research suggests potential for farmers in Wales to produce more plant foods, but that this is not an option for all farms, and will not be easy to achieve. It shows that there are some who are optimistic about the potential to feed people differently as diets change, but they are presently outnumbered by

those who are more pessimistic or expect to continue relying on meat consumption. The discussions enabled during this project demonstrate that these issues can be explored in a constructive, forward looking manner. By considering the experiences of innovative farmers who have moved beyond meat, and reflecting on how others may follow similar paths, it was possible to identify what can enable this transition.

A key limitation of the research is the relatively small sample of farmer participants, and difficulty engaging significant numbers of 'conventional' livestock farmers. Participation in the workshop and interviews was skewed towards those already open to the potential to introduce plant crops. It is possible that the identity of the two researchers - women working for an urban institution, potentially perceived as affiliated with alternative communities - also affected how farmers responded. To some extent this was balanced by hearing from stakeholders with good insights to livestock farmers and their communities. However, there is a clear need to engage a broad range of farmers in research on this topic, particularly as producer perspectives are currently missing from the literature on plant based diets. It is notable that some participants were skeptical that consumer diets will continue changing significantly, suggesting a need to communicate reliable data on this.

Future research should be mindful that this is a contentious topic in which terminology is very loaded and divisive (Lonkila and Kaljonen 2021). In light of this challenge, and informed by early discussion with stakeholders we chose to de-emphasise the topic of plant based diets when recruiting participants. This aligned with our intention to move beyond conflict and the well versed disagreements over dietary trends, by exploring opportunities for farmers. Alternative terminology may have attracted more participants by playing the potential for conflict to gain attention – we can only speculate. But we are convinced that there is value in shaping contexts for constructive discussion on tricky topics, and that academics can provide relatively neutral facilitation. An unexpected outcome of the research, particularly the workshop, was the benefits participants reported of engaging in this. They described gaining energy and inspiration from the discussions, and welcomed the chance to connect.

The research and experience of delivering it provides a basis for recommending actions to progress understanding of the potential for more Welsh farmers to produce plant crops, and to shape conditions conducive to this transition. These are the views of the report authors, informed by consensus which emerged from research participants. Several of the recommended measures are currently available through time- and place-bound offers such as funded projects. The degree of risk farmers face in responding to change warrants greater certainty in offering this kind of support. Many of the recommended actions require collaboration between Government and other stakeholders, and depend on action by multiple actors.

Recommendations:

- Government and stakeholders to enter honest, productive conversation about the prospects for livestock producers.
- Government and stakeholders to effectively communicate robust and credible projections of dietary trends, including consumption of animal products.
- Agree a national strategy towards a farming industry centred on 'more than meat': mixed farming and plant crops in the right places.

- Trusted voices in the farming community to promote examples of successful plant producers around Wales.
- Cooperation between organisations (advisors, membership bodies, networks) to embed promotion of horticulture and plant crop production in mainstream advice and support systems.
- Support for forward looking farm planning which considers diverse produce and business models.
- Invest in supply chain development and support, including funding to facilitate cooperative structures.
- Support farmers to make land available to new entrants and others interested in growing plant crops.
- Offer financial assistance (loans, grants) for establishing new crops, and support applicants through the process.

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