Barriers and opportunities in intercropping supply chains: a review of findings from workshop discussions

Introduction to the SEAMS project:

The SEAMS project (Sustainability in Education and Agriculture using Mixtures) aims to develop, promote and implement crop species mixtures as a sustainable crop production system for Scotland. The project has six core sites and a wider group of network sites - mainly working farms - where crop mixture trials are run by local farmers. SEAMS is an Esmee Fairbairn Foundation funded project coordinated by the James Hutton Institute (JHI). The project partners of the SEAMS project include LEAF (Linking Environment and Farming), the Game and Wildlife Conservation Trust, NFU Scotland and Scottish Agronomy.

Picture 1- image of an intercropping site from the SEAMS project. Image from https://www.hutton.ac.uk/research/projects/seams-sustainability-education-and-agriculture-using-mixtures

On the 5th of October 2021 a workshop, organised and hosted by LEAF and JHI, was conducted on the topic of "Intercropping Supply Chains". The workshop was attended by close to 30 farmers, advisors, suppliers, researchers and manufacturers. The aim of the workshop was to collect ideas on how to improve the reach and appeal of intercropped products. This is important since one factor that often concerns farmers/businesses considering the use of intercropping and the resulting products is the lack of surety that there will be a market for their products.

The first segment of the workshop consisted of an introduction to the project by Rob Brooker (JHI) followed by two presentations on using the products from intercrops, given by Josiah Meldrum (Hodmedods) and Kirsty Black (Arbikie Distillery). This was followed by a presentation by Clare Mike (LEAF) on scaling up intercropping supply chains from specialist producers to larger businesses and supply chains.

Small-group discussions then took place in breakout rooms. These enabled different actors in the supply chain to discuss intercrops, their benefits, and the barriers to increasing their use. The outcomes of these discussions are summarised below.

Question 1: Had you come across intercrops before today, and if so, what was your perception of them?

Awareness of intercropping:

Farmers across the discussion groups were often very familiar with intercropping, and indeed often regarded intercropping as a traditional technique (with barley / grass and triticale / beans being mentioned as historical Scottish intercrops). The recent increase in nitrogen (N) fertiliser prices also seems to have catalysed many farmers to take more interest in intercropping and other alternative farming methods. The increase in government policies that aim to reduce the usage of fertilisers and plant protection products (PPPs) may also have a similar effect in the future.

Farmers who are using more alternative or niche approaches to farming such as organic farming or farmers using heritage varieties also appear to be more likely to informed about intercropping. This is possibly because these approaches to farming require novel solutions to problems, since standard solutions (e.g. PPPs) aren't applicable. One example discussed during the workshop was farmers growing heritage cereal varieties who are often interested in the ability of intercropping with upright crops to support cereal varieties with poor standing ability. It was also suggested that organic farmers may be more likely to be open to intercropping due to their lower expectations of 'clean fields'. When trialling intercropping systems, farmers often initially find a higher prevalence of weeds than might be present in more conventional systems, which can often discourage further trialling.

Many of the suppliers and manufacturers present were also familiar with intercropping, having come across it when sourcing supplies. As with farmers, farm advisors, suppliers and manufacturers who work with alternative farming systems appear more likely to be better informed about intercropping due to its increased use in these systems. It was also suggested that advisors, farmers and other members of the supply chain who have worked with tropical agriculture are also more likely to have encountered intercropping; in tropical regions farmers often have low levels of expendable income and low yields, which encourages the use of intercropping as potential yield boosting technique that can naturally boost soil fertility (reducing the need for inputs).

Perception of intercropping:

Farmers in the discussion groups were often excited by the potentially vast range of benefits that intercropping could bring to their farm; however, hand in hand with this was often an understandable apprehension about taking the leap and trialling intercropping. Carbon (C) sequestration, integrated pest management (IPM) benefits (such as potential for reduced application of PPPs), biodiversity increases, and generally being 'better for the environment' were often mentioned as potential benefits for farmers and will be discussed further within the next question. Farmer's apprehension about trying intercropping was often linked to the view that it would be difficult and would require large amounts of experimentation which might be a risk to their incomes. This in turn was linked to the feeling that farmers lack information

about intercropping. An example of this was one farmer being unsure about the proportions of seeds needed in a mixture, noting that there was no clear source that could definitively tell him this. Concerns over being able to effectively control weeds were also common.

Farmers frequently perceived intercropping products as better suited for use as animal feeds rather than for human consumption. A major benefit with this use is that the intercrops often don't have to be separated, avoiding both cost and extra labour. A second perceived benefit of the use of intercrop products for animal feed is that there is no need for them be marketed for human consumption.

The perception that intercropping products are difficult to market was shared by other members of the supply chain. Manufacturers and suppliers also perceived intercropping products as being difficult to work with due to issues in processing, such as separation. When discussing consumers' perceptions, the LEAF Marque assurance system was mentioned as a successful force improving consumer perceptions of integrated practices such as intercropping.

Picture 2- image of an intercropping site from the SEAMS project

Question 2: What do you believe could be the benefits of intercropping for your business?

On-farm benefits:

The major benefit of intercropping highlighted by farmers was the opportunity for intercropping with nitrogen fixing legumes. In organic systems this is often done to boost yields in the following crop (given that organic farms are restricted in their ability to use non-organic fertilisers). In mainstream farming systems the benefit of this is usually the avoidance of costs, both financial and environmental, through reducing the use of nitrogen fertilisers. One example given was the intercropping of vetch and triticale as a high-protein whole crop forage. Another advantage mentioned was the uplift in the quality of crops intercropped with legumes due to an increase in their protein content, although high relative N content can sometimes be a concern in barley crops for brewing and distilling. On the same theme of the soil benefits of intercropping, the potential soil benefits of deep rooted crops (such as beans and red clover) were also mentioned, including breaking up compacted soils which can be particularly important in no-till farming systems.

Another frequently mentioned benefit of intercropping was an increase in the overall range of crops that can be grown. This was perceived as especially beneficial in Scotland, where some crops that can be successfully grown as an intercrop may not be practical (either financially or agronomically) as a monocrop, such as some heritage varieties. This can help ensure the continuity of supply for relatively minor crops such as peas. Crop diversification through intercropping was also seen to be beneficial for the stabilisation of yields, since yield declines in one intercrop component (due to pest damage, weather, etc) may be compensated by yield

stability/increases in the other component. It was also emphasised that variety mixtures should play a larger part in the intercropping discussion, as they can have similar effects to intercropping different crop species, including reduced pesticide use and stabilising yields and yield quality.

Reducing pest pressure was seen to be an important benefit of intercropping for farmers. The main examples discussed were the beneficial effects of intercropping on insect pests such as weevils, as well as increasing the general resilience of a crop and its competitiveness against weeds. This also links to farmers interest in intercropping due to the potential for reduced inputs, with a potential reduction in the use of PPPs offering farmers the opportunity to avoid costs, both financially and environmentally.

Supply chain benefits:

One benefit of intercropping that farmers, suppliers and manufacturers were keen to discuss was the potential for intercropping to add value to their products. One option raised was the potential for adding value through the carbon benefits of intercropping. Marketing the carbon benefits of intercropping was considered by some to be a more likely route for adding value because it can be hard to separate regeneratively farmed products from other products and so market the wider environmental benefits. While there is often no separate shelf space for regen products and no separate processing units, there can more easily be a carbon audit trail through the supply chain.

Picture 3- image of an intercropping site from the SEAMS project

Beyond its potential for adding value, the potential for intercropping to reduce the carbon footprint of a farm through reducing inputs and potentially sequestering carbon was also seen to be highly beneficial. However, it was also noted that the benefits of intercropping go far beyond carbon, with the potential future value in schemes involving environmental credits (in schemes such as ELMS) for farmers using intercropping being the main option discussed. One highlighted barrier is that many of the environmental benefits (such as soil functions, boosting biodiversity etc) of intercropping have yet to be reliably quantified. It was emphasised that more research into the environmental benefits of intercropping needs to be conducted in order to make this approach to adding value feasible.

Lastly, farmers, suppliers and manufacturers were also excited about the ability for intercropping projects to build local businesses, facilitate local processing and create new value chains, benefiting and linking together local communities.

Question 3: What do you think are the barriers to intercropping, and what would help your business overcome these?

The most frequent barrier to intercropping raised by farmers was the lack of an adequate knowledge and skill base. However, in some cases this lack of knowledge seems to more of a perception barrier, since many farmers reported that when they actually started trialling intercropping, they were left wondering why they had not started earlier. Education and knowledge exchange between farmers were seen as essential in order to give farmers access to evidence of the business benefits of intercropping, to improve the efficacy of intercropping (through sharing tips), and to link together farmers who are using intercropping. Linking together farmers trialling intercropping may also help to prevent these farmers from feeling too isolated, since they often stated that a barrier to adopting intercropping was feeling that they were being too experimental by breaking from traditional techniques.

Bringing together farmers to discuss intercropping is also likely to reduce their concern that trialling intercropping is a financial risk. As was previously discussed, extra research quantitatively testing the benefits of intercropping would also help to reduce this perception of risk. Areas of research that were highlighted were ideal variety/species combinations for intercropping, how to achieve good establishment and germination of all crops in a seed mixture, and how to make viable products from novel crop combinations. Another factor likely to reduce the perception of risk and increase the uptake of intercropping was assistance in financing and investment, which would likely need to come from government. It was also perceived to be important to ensure that farmers' incomes are protected in their relationships with supply chains, since yields and quality can fluctuate as farmers begin to trial intercropping.

Aside from knowledge barriers and apprehension about risk, there are also significant technological barriers to farmers adopting intercropping. Concerns about technological limitations were frequently raised, particularly with respect to crop separation. Most farmers in the discussions use/would use contractors for separation and can therefore only use the equipment that their contractors possess, which may not be suitable for intercropping products. Farmers are faced with either having to build/invest in their own separators (which links to previous discussions around investment) or find a specialist contractor with the appropriate equipment. The problems relating to separators can be bypassed by not separating intercropping products. However, the value of separated products is usually higher than that of mixed products, meaning that unseparated crops may be less financially viable. Other concerns linking to technology were quantities of intercropping products being low and therefore insufficient to go to standard processors.

Lack of confidence in demand for intercropped products was perceived to be an important barrier to the increased uptake of intercropping, with farmers stating that it was often difficult to find buyers for significant volumes of harvested intercrop products. It was debated whether larger grain merchants could play a role in helping to create a greater 'pull' for intercrops. However, it was also suggested that the only members of the supply chain with a great level of influence over the demand for intercropped products are large scale manufacturers (such as animal and aquaculture feed manufacturers), retailers and consumers. Using barley as an example, it was suggested that one strategy to reduce this demand barrier is to encourage distillers and maltsters to use variety/crop mixtures. This could be done by persuading them that using intercrops can deliver added value to their products by increasing their sustainability.

Examples of companies already doing this, such Arbikie Distillery, are likely to help to convince other companies of the benefits of introducing intercrops into their supply chains.

However, any attempts to encourage manufacturers and retailers to increase their use of intercropped products are likely to be met by concerns about consumer demand. It was recognised within discussions that consumer awareness of intercropping is low, with solutions to this issue being much discussed. It was suggested that the more nuanced benefits of intercropping compared to other approaches such as organic farming can make it difficult to know how to promote these farming approaches to retailers and consumers in a way they easily understand. It was also suggested that the organic label can actually be a barrier to promoting the understanding of other approaches like intercropping, since there is only a limited amount of shelf space for 'alternative' products. A multi-faceted approach is required for boosting consumer awareness of intercropping including traditional methods like advertising and press coverage, as well as more informal and modern approaches such as garnering social media attention. Premium retailers were proposed to be best placed to lead public awareness and appreciation of intercropping, since their consumers may be more likely to pay an extra cost for the benefits associated with intercropping. However, if intercropping is to achieve mainstream appeal, the efforts of premium retailers must be seen as only a first step towards wider consumer understanding, rather than the end goal. The LEAF Marque accreditation system was also mentioned as option for farmers using intercropping to add value to their crops through their sustainable farming. The LEAF Marque system was also highlighted as a positive force helping to make consumers more aware of integrated practices like intercropping. However, for farmers searching for solutions that specifically market the intercropping aspect of their farming, the options appear to be limited unless public understanding of intercropping is increased significantly.

Overall takeaway messages and next steps:

- Farmers, researchers, manufacturers and suppliers in the workshop found it extremely refreshing to be connected to likeminded people from the agricultural industry. This indicates that people interested in intercropping benefit greatly from being introduced to each other and being provided with a space to discuss their thoughts.
- Similar workshops with a space to discuss ideas should therefore be organised by LEAF/JHI in the SEAMS project in the future. These discussions seemed to be especially beneficial for farmers, who often felt that they were viewed as experimental in their own communities, and therefore felt isolated.
- A proposed solution was that more effort be made to link up farmers using/trialling intercropping with apps like WhatsApp, allowing them to exchange advice and offer support to each other. Organising group chats within the SEAMS project may be a good start to achieving this. Groups of farmers that are working together to farm using intercropping may then be successful in convincing mainstream farmers that intercropping is an effective and practical technique.
- Another clear takeaway from the workshop is that many farmers are not confident that they have adequate knowledge and skills to adopt intercropping. One step that can be taken to improve this is to highlight intercropping more in the farming press, which would both inform farmers about intercropping and may also help intercropping be perceived as more mainstream. This has recently been carried out within LEAF, with

the most recent issue of IFM (integrated farm management) Quarterly, a LEAF member publication, including an article on intercropping, and with plans for another in a future issue.

- When planning resources for farmers, it should be highlighted that farmers stated that they like to receive information that is based on scientific research but has been synthesised into shorter reports that can be read more easily. It was also discussed that many farmers encounter these resources due to conversations with other farmers, which supports the previously discussed idea to increase connectivity between farmers.
- Away from the focus on connecting and supporting farmers directly, a key step is to promote the varied benefits of intercrops to consumers and food and drink producers in order to enhance the "pull" side of the systems.
- Another key area for action is to support intercrops as part of sustainable farming policy – generating income from the wider benefits of intercrops through appropriate farmer support mechanisms will also help lower the perception of risk associated with intercropping, and so will encourage more farmers to trial intercropping.

Lastly, what was most clear from the workshop is that we are at a critical time point for intercropping, with many factors presenting a wealth of new opportunities to capture the attention of both farmers and the public. With increased fertiliser prices, new policies being launched like the environmental land management schemes and changes to the farm subsidy system, and the momentum of COP26, projects like SEAMS have the potential to make it clear that intercropping is a lower-input, climate friendly solution that deserves increased investment and attention. To help achieve this the SEAMS project will take the main messages from this workshop and report and seek to address them in our work plan for the coming year.

For more information on the SEAMS project please contact SEAMS@hutton.ac.uk or visit the SEAMS webpage.

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