Data driven decisions in potatoes

Final Report

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1. PROJECT TITLE

1.1 Title

Data driven decisions in potatoes

1.2 Lead Organisation

SAOS

SAOS delivered the project on behalf of the Scottish Potato Co-op and its members.

SAOS are Scotland's experts on farmer co-operation and supply chain collaboration, it provides a range of specialist information, development and consultancy services. Our work allows Scotland's farming, food and drink businesses to benefit from the commercial advantages that can be achieved by working together more effectively, enabling them to contribute to the success of Scotland's food and drink industry and its rural economy.

SAOS is itself a co-operative founded in 1905 and owned by 60 Agricultural co-ops who have a combined turnover of over £1.6bn and 24,600 members. Its work spans agriculture, aquaculture, forestry and their marketing chains with the aim of increasing competitiveness and responsiveness through 'smart' solutions and innovation. SAOS employs a team of 18 specialist project managers qualified, experienced and trained in co-op and collaborative development, delivering a range of strategic national projects as well as specialist co-op advice

SAOS's work today includes thought leadership on more complex challenges than ever before, identifying and helping to develop innovative solutions for farming and food production on topics such as climate change, carbon sequestration, technology and the use and translation of data.

The purpose of SAOS is to ensure that Scotland's farming, food and drink businesses and supply chains benefit from the commercial advantages that are achieved through co-operation and collaboration, enabling them to contribute sustainably to the success of Scotland's food and drink industry.

For further details see www.saos.coop

2. EXECUTIVE SUMMARY

The project's primary aim is to improve the productivity and competitiveness of Scottish ware growers through a combination of benchmarking their financial and environmental performance and improving information flows. All to support potato growers to become more productive and sustainable, reducing their impact on the environment /biodiversity.

Scotland is famous for the quality of potatoes it produces, but the continued success of the Scottish potato sector depends on its ability to adapt to an ever changing operating environment. In particular, reducing the carbon footprint and improving the sustainability of potato production.

Agriculture has typically lagged behind other industries in utilizing data to enhance productivity and competitiveness, when it comes to advances in data capture, storage and analytics allowing powerful insights and improved decision making. There is a low level of awareness among many Scottish farmers as to the real value of farm data, therefore a risk that growers loose out in the data revolution. Growers are foregoing the insights and opportunities afforded by effective data management and analysis.

What have we learned:

- Although the benefits of benchmarking are well proven, there is a real challenge to get more farmers involved in business benchmarking. The number of potato growers who know their actual production costs is unknown, however, it is considered to be low, circa 10-20%.

- Even with good training and support, it takes time for participating farmers to produce accurate data for benchmarking. Experience shows it probably takes individuals 2-3 years before they are producing accurate robust data. Having an experienced facilitator who can engage with the group and lead them through the process is crucial for success.

- The sharing of information and experiences amongst a closed trusting group has huge potential to drive performance improvements. One thing that would help capture and facilitate learning is through the creation of standard operating procedures (SOPs).

- Some participating farmers, for a variety of reasons, were reluctant to conduct a carbon audit. The project team needed to spend more time on the importance and value of conducting a carbon audit and how it can be a useful management tool as well as simply an external auditing function. There is a close relationship between the information required for benchmarking and for a carbon audit. It should therefore be relatively easy for participating farmers to provide the necessary data for completing a carbon audit.

- The challenge of improving the data flow back to grower members proved more difficult than envisaged. Growers themselves were unsure what precise information they wanted to receive back. There is a huge opportunity to improve the information grower members receive to support their decision making but it was unclear where to start. There was also a resource issue, in terms of time and cost to invest in improving data management, plus clarity on the benefits it would provide growers. This whole area needed further work.

Whilst the project has encountered challenges the co-op and participating farmers all agreed real progress has been made. There is real commitment to continue the project, as it is widely recognised that the need for this type of work will only grow in the future.

3. PROJECT DESCRIPTOR

This section in the report aims to provide an overview and context for the project.

What was the project setting out to achieve?

The project seeks to improve the productivity and competitiveness of Scottish ware growers through a combination of benchmarking and improved data flows. All to support potato growers to become more productive and sustainable, reducing their impact on the environment /biodiversity. The project also looked to support Scotland's ware potato growers following the demise of AHDB Potatoes. This was phase 1 in hopefully a multi-year project.

Why - the need?

Scotland is famous for the quality and high health status of potatoes it produces, but the continued success of the Scottish potato sector depends on its ability to adapt to changing circumstances. In particular, reducing the carbon footprint and improving the sustainability of potato production. Due to the associated high level of inputs required, potatoes are a crop with a considerable impact on the environment and associated GHG emissions. The challenge is to improve the productivity of the potato sector, reducing its GHG emissions and impact on the natural environment through improved decision making.

Agriculture has typically lagged behind other industries in utilizing data to enhance productivity and competitiveness, when it comes to advances in data capture, storage and analytics allowing powerful insights and improved decision making. We are now seeing advances in the technologies (precision farming, smart sensors, etc) used to collect data across agriculture and the supply chain, meaning there is an urgent need to harness the power of this information in order to benefit farm practices and lower carbon emissions. There is a low level of awareness among many Scottish farmers as to the real value of farm data, therefore a risk of growers loose out in the data revolution.

When – Timescale

The project took place over 10-months from 1 June 2022 – 31 March 2023. This allowed sufficient time for the linked activities to be properly planned and implemented to ensure successful outcomes.

How the project was delivered

The project was delivered by working closely with 8 potato growers who were looking to improve their business performance. It involved forming a benchmarking group, training on how to use AHDB's online *FarmBench* tool, holding group meetings, conducting farm carbon audits, and conducting a review of the current data provision by their co-op – Scottish Potato Coop (SPC).

Who

This is a bottom-up approach, growers themselves taking responsibility for action through their co-op. The project was led by SAOS on behalf of the Scottish Potato Co-op (SPC) and wider Scottish potato ware producers. SPC is a ware marketing co-op involving 21 large professional growers, producing 90,000t of potatoes. The benchmarking group was facilitated by an experienced independent consultant using AHDB's *FarmBench* benchmarking tool.

Where

The project was undertaken by potato growers from across Angus, east Perthshire and Fife. These are the main growing regions of potatoes in Scotland.

4. FINANCE

4.1 Grant Award

To deliver the project a KTIF grant award of £21,244 was successfully secured, under the Knowledge transfer and skills development element (grant rate of 75%).

4.2 Project Expenditure

The project was budgeted to cost £28,325, with a grant award at 75% of £21,244. The table below shows actual expenditure and claims across various elements of the project. It shows the actual eligible expenditure incurred was £25,294.6. The net result is that £2,274 of grant was left unclaimed.

Item Description	Claim 1	Claim 2	Overal Claim	Grant awarded KT @ 75%	Total Grant Approved	Budget remaining
A) Project development costs	£ 5,743.44	£ -	£ 5,743.44	£ 4,307.58	£ 4,613.00	£ 305.42
B) Project management costs	£ 5,113.53	£ -	£ 5,113.53	£ 3,835.15	£ 3,806.00	-£ 29.15
C) Fees for speakers/facilitators	£ 6,683.40	£ -	£ 6,683.40	£ 5,012.55	£ 4,950.00	-£ 62.55
D) T&S for speakers/ facilitators	£ 552.58	£ -	£ 552.58	£ 414.44	£ 743.00	£ 328.57
E) Event venue costs	£ 1,627.20	£ -	£ 1,627.20	£ 1,220.40	£ 945.00	-£ 275.40
F) Materials costs	£ -	£ -	£ -	-		
G) Publicity	£ 3,174.43	£ -	£ 3,174.43	£ 2,380.82	£ 2,438.00	£ 57.18
H) Other approved external costs	£ 2,400.00	£ -	£ 2,400.00	£ 1,800.00	£ 3,750.00	£ 1,950.00
	£25,294.58	£ -	£ 25,294.58	£ 18,970.94	£ 21,245.00	£ 2,274.07

4.3 Reasons for variation from budget.

The actual project costs were close to those budgeted in the application.

"Project development" had a slight underspend of £305
"Project Man" had a slight overspend of £29
"Facilitators" had a slight overspend of £62
"T&S" had an underspend of £328
"Venue and catering" had an overspend of £275
"Comms" had a slight underspend of £57
"Other" had an underspend of £1,950. There were less carbon audits completed than planned, four compared to ten budgeted.

The total project grant claim was £18,970 against a grant award of £21,244.
The net impact was an underspend of **£2,274.**

5. PROJECT OBJECTIVES

The project's overall objective is to improve the productivity and competitiveness of Scottish ware production. This will be achieved through a combination of benchmarking and improved data flows, all of which to improve the decision making of ware growers. As a result, growers should become more efficient in their use of inputs, reduce their waste, which will all contribute towards a shift to a lower carbon and a reduction in the environmental impact of potato production.

Anecdotal experience suggests, that for a variety of reasons, Scottish potato growers are failing to make use of the data generated on-farm and from the supply chain. Growers are foregoing the insights and opportunities afforded by effective data management and analysis. The project will focus on tackling this through the improved use of data; leading to an improved awareness of the carbon footprint, inefficiency, and importantly a lower impact on the environment.

Benchmarking is a widely adopted approach to improve the performance of a business. It is the process of measuring and evaluating the performance of an enterprise, to identify areas that need to be improved. By comparing the physical and financial performance of a group of similar potato growers, individual members can see how they compare with others; what they are good at but more importantly, identify areas of weakness that need to be tackled.

We know from experience many farmers don't really understand their production costs, enterprise performance, breakeven cost, and what to focus their efforts on. By the process of measuring the key performance indicators (KPIs) and the carbon footprint of their enterprise, growers will develop a better understanding of their potato enterprise, be more able to ask the right questions and identify what needs to be improved.

In life and in business, we tend to make decisions subjectively. Benchmarking helps train individuals to make, evidence-based objective decisions. Investing in skills development – human capital – is widely regarded to be the most effective use of limited resources. Interest in benchmarking and data usually comes from younger members in the farm business, so it is a good route to support the "next generation".

Specific Objectives

1. The target was to recruit and engage with 8-12 ware growers representing a variety of farm systems.
2. To determine the cost to produce a tonne of ware potatoes, the different elements of the main costs, the key performance indicators, all across a range of potato growers and farm systems.
3. To estimate the average carbon footprint for ware potatoes, the range across various farm systems and the sources of GHG emissions.
4. To undertake a review of the current data information provided to growers, identifying areas how the information could be improved to support growers decision-making
5. To Increase the awareness and understanding amongst farmer growers and their advisers, of the role and importance of data.
6. To deliver an effective communications strategy to share the information and learning from the project widely throughout the Scottish potato sector.

6. PROJECT OUTCOMES

6.1 Project Outcomes

The approach used to deliver the project involved a series of linked activities, each of which contributed to the overall project aims and objectives. Key project activities and outcomes achieved are shown in the following table.

ACTIVITY	OUTCOME
1. Recruit 8-12 ware growers to form a benchmarking group.	• An open invitation went out to all SPC members to join a benchmarking group. 10 growers indicated their interest and joined the introduction meeting. • The benchmarking was undertaken using AHDB's 'FarmBench', a web based benchmarking tool. It takes a whole-farm approach and ensures the figures produced use a standard methodology which is very important. Support and training was provided for growers on how to use the programme. • The benchmarking group meet three times during the year. The first meeting was a training meeting on the benefits and value of benchmarking and how to complete *FarmBench*.
2. Conduct carbon footprints on each farm in the benchmarking group	• The carbon footprint was calculated (post harvest) using SRUC's Agrecalc. • For consistency, one adviser was commissioned to conduct the farm audits • Having established the whole farm's carbon footprint, an estimate was calculated per tonne of ware potatoes produced for each farm.
3. Benchmarking Group meetings	• The benchmarking group (8 members) meet three times during the project. • The first meeting (6 June 2022) was a training meeting on the benefits and value of benchmarking and how to complete FarmBench. • The second meeting (17 Jan 2023) was post-harvest to share and discuss the group's benchmarked figures and what it all means. • The third meeting (8 Mar 2023) was a learning journey visiting two of the group's farms, discussing the carbon audit results, and conducting a session on personal development and the importance of self-awareness (personality test).
4. Conduct review of the current data provision	• A review of the current data gathered by SPC was conducted. • Growers were consulted to establish what additional data would they find of value. Currently member information is provided through a secure online portal using a bespoke software programme. • Work is ongoing to scope out a brief of exactly what additional information and its format, to provide to a software company to update the current program.

5. Hold open meeting with all SPC members	• This stage of the project was about sharing the project's aims, the results and learning amongst the wider SPC membership. • An open meeting was held on 15 January 2023 at the Landmark Hotel, Dundee, attended by 23 people. • Following the meeting, another 3 members indicated they wished to join the benchmarking group.
6. Deliver an open webinar to share project results with wider farming audience	• A webinar was successfully delivered on 30th Mar 2023 at 7.30pm. Promotion of the webinar was achieved through the co-operation of wider stakeholders, including; AHDB, NFUS, all other potato co-ops, SAC-Consulting, amongst others. • The webinar had 46 registrations with 25 attending on the night • The webinar was recorded and openly available to view. https://us02web.zoom.us/rec/share/HVVReQK2aONqN_QqRTSYDShEaC_BJaJ3SuiD0e0n_sTZCJymBFWsJIllQMqSjjjc.n9Dq5gDP3qGjg-_Z Passcode: #vt3D3mT
7. Produce final report	A project report has been produced.
8. Place materials on the FAS and project partners websites to ensure lasting legacy and open access	The materials are ready to be shared with the FAS website.

6.2 Milestones

Activity	Jun-22	Jul-22	Aug-22	Sep-22	Oct-22	Nov-22	Dec-22	Jan-23	Feb-23	Mar-23
Operational Group Meetings										
Recruitment Growers (8-12)										
Benchmarking Group meetings										
Carbon Footprints										
Scope data provision and growers needs										
Open Grower Meeting - project summary										
Deliver online webinar										
Project evaluation & Final Report										

7. LESSONS LEARNED

7.1 Issues /Challenges

There were four main issues associated with achieving the objectives set, namely:

1. **Recruiting farmers to join a benchmarking group**. Although the benefits of benchmarking are well proven, there is a real challenge to get more farmers involved in business benchmarking. Although the project is working with a closed group of 21 growers, only 10 showed an initial interest with eventually 8 growers joining the Benchmarking Group. The precise reasons why some farmers are reluctant to participate in benchmarking are unknown. Potential reasons include:

    - a lack of awareness and understanding of the benefits of benchmarking
    - fear of sharing personal confidential information
    - a lack of time. We know farmers are increasingly time constrained
    - a lack of self-confidence
    - fear of coming bottom in terms of performance compared to the Group.

    The number of potato growers who know their actual production costs is unknown, however, it is considered to be low, circa 10-20%. This is not a criticism of potato growers, as benchmarking is difficult and complex, particularly the allocation of fixed costs between different enterprises in the farm business.

2. **Providing accurate data for benchmarking.** Even with good training and support, it takes time for participating farmers to produce accurate data for benchmarking. Experience shows it probably takes individuals 2-3 years before they are producing accurate robust data. This is part of the learning process. Farming is a complex business, involving multiple enterprises (e.g. cereals, potatoes, vegetables, soft fruit, cattle, sheep, etc.) Allocating costs such as labour, machinery, fuel, etc which are shared across multiple enterprises is not easy.

    The solution is to develop initial simple allocation rules (e.g. 25% of the labour cost is spent on potatoes), then over time and experience, to consider how to make the allocations more accurate. This is the reason why it is so important that the farmer themselves are involved in the process – they know the farm and its operations better than anyone else. Often new technology will play a role e.g fuel meters in tractors, electric meters in cold stores, simple timesheets.

    It is only when the results from individual participants are collated and displayed in a spreadsheet that any anomalies and errors become obvious. This is all part of the learning experience. There has to be considerable trust and openness between participating members, which only comes with time. Having an experienced facilitator who can engage with the group and lead them through the process is crucial for success.

3. **Conducting Carbon Audits**. Although there were 8 members in the group, only 4 farms actually completed a carbon audit for the 2022 harvest (two additional audits were completed post the deadline). There was a variety of reasons for the low completion rate, this included: some growers had completed a carbon audit in the past so were reluctant to complete another one; one grower attempted to do it himself online but never managed to compete it on time; others were simply too busy to spend time with the consultant to provide the necessary data.

A key factor, however, was simply that the project team never spent enough time explaining to the participants why conducting a carbon audit was important. In addition, to make meaningful comparisons, the carbon audits must be completed for the same harvest year. We know there is considerable variations between years, principally due to a variation in final yields, which does impact on the carbon emissions per unit of output.

There is a close relationship between the information required for benchmarking and for a carbon audit. It should therefore be relatively easy for participating farmers to provide the necessary data for completing a carbon audit. The participating farmers didn't really appreciate this at this early stage. In terms of the presentation of the data for both exercises, in the future the intention is to link the benchmarking data with the carbon emissions data to demonstrate how the two sets of figures are closely dependent on each other. Again, this is part of the learning process for participants.

4. **Provision of data to Members**. This was another key task that provided lots of learning. The aim was to review the current data information provided to member growers' by SPC, identifying areas how the information could be improved to support growers decision-making. SPC had invested in a bespoke software whose function is the inventory management of members potatoes in real time, and importantly is linked with their financial accounts package (Zero). This has turned out to be a great asset and worthwhile investment, however, there is considerable scope to improve the information flow back to members.

   A review of the current data system was successfully completed. Appendix 3 provides an overview of SPC's online member portal and the data gathered and provided to grower members.

7.2 Impacts and anything that could be done differently?

The Operational Group and participating farmers have learned a great deal during the first year of the project. The priority was to successfully establish a Benchmarking Group, to get a group of grower members committed to working together and to regularly meet throughout the year. That has been successfully achieved, largely due to the experience and ability of the facilitator involved. It takes time to establish a new group. We now feel we can move on and deliver real value to the group, to help them improve their business performance.

In designing the project, we intentionally wanted to ensure that it would adopt a bottom-up approach, with farmers taking the lead role in finding solutions. Consequently, it is unrealistic to expect that all the project's objectives would be met in year one.

The challenge of improving the data flow back to grower members proved more difficult than first envisaged. It is more complex involving a range of factors such as: what information do members want; some members having unrealistic expectations; who should analyse and process the information; how can this be more automated, what is the cost of doing that, is there a software developer who can do it…… amongst other factors.

8. COMMUNICATIONS AND ENGAGEMENT

As a means of highlighting the "Data driven decisions in potatoes" project to the wider agricultural community a variety of communications channels and activities was undertaken. This extended across several platforms and used the immediate and extended networks of the project partnership.

Webinar
A key activity of the project was the online webinar which was delivered on the 30th March 2022. This was open to anyone with an interest in the project. Effective promotion of the webinar was achieved through the co-operation of wider stakeholders, including NFUS, AHDB, all potato co-ops, SAC- Consulting, amongst others.

The event involved three speakers, namely:

1. **Jim Booth, Head of Co-op Development, SAOS Ltd**. Jim was the project lead and presented the need for the project, the range of activities undertaken and why SPC got involved.

2. **Gavin Dick, Independent Farm and Rural Business Consultant**. Gavin shared the results from the financial benchmarking and carbon audits exercise from the participating farms, the learning to date and future project plans.

3. **Fraser Malcolm, Marketing Agent, the Scottish Potato Co-op (SPC).** Fraser is widely regarded as one of the most knowledgeable and experienced players in the Scottish fresh potato supply chain. He discussed the value of good data systems, the investment undertaken at SPC, and how customers are increasingly looking for evidence of climate friendly production.

The event was recorded and openly available for viewing on the following link:

https://us02web.zoom.us/rec/share/HVVReQK2aONqN_QqRTSYDShEaC_BJaJ3SuiD0e0n_sTZCJymBFWsJIllQMqSjjjc.n9Dq5gDP3qGjg-_Z
Passcode: #vt3D3mT

Press & PR
Several newsletter articles were produced, appearing as follows:

Article in the SAOS Update Newsletter, Autumn 2022. *"KTIF for Scottish Potato Co-op to Help Data-driven Decisions".* The Newsletter is distributed to 670 Co-op farmer directors, co-op managers and wider stakeholders, plus openly available on the SAOS website.
https://saos.coop/assets/media/files/newsletters/SAOSAutumn2022Web.pdf

Article in the SAOS Update Newsletter, Winter 2023. "Cabinet Secretary visits SPC to learn more about KTIF project". The Newsletter is distributed to 670 Co-op farmer directors, co-op managers and wider stakeholders, plus openly available on the SAOS website.

In addition, now the project has been completed, a press release will be produced for all Scottish agricultural press, to share the project's lessons and findings amongst the wider farming community.

This final project report is available to share with the "*Farm Advisory Service"* (FAS) and the "*Farming for a better climate*" websites.

9. KEY FINDINGS AND RECOMMENDATIONS

To discuss the project's key findings , the following provides a reminder of the specific study objectives and the project's achievements

Specific Project Objectives

1. The target was to recruit and engage with 8-12 ware growers representing a variety of farm systems.

This was achieved. There are 8 farm businesses involved in the Benchmarking Group. It is pleasing to note this also included three younger family members. It is important the next generation get involved in benchmarking and the general management of the business. The success of the group has spread and there will be two additional new members joining in the coming year.

2. To determine the cost to produce a tonne of ware potatoes, the different elements of the main costs, the key performance indicators, all across a range of potato growers and farm systems.

The production cost of growing ware potatoes in 2022 was achieved. Appendix 1 provides the group average benchmarking figures for Maris Piper and White potatoes (plus other cereal crops).

For Whites, the group average data was from 7 growers. The average area of Whites grown was 32 ha, the yield was 49.8t/ha and the average price £183/t. Total sales came to £9,096 per ha. Appendix 2 shows the various variable costs and overheads (before rent and finance). Production costs = £145 /t (before rent and finance). The net margin is £1,850 /ha

For Maris Piper, the group average data was from 6 growers. The average area of M. Piper grown was 31 ha, the yield was 52.8t/ha and the average price £193/t. Total sales came to £10,205 per ha. Appendix 2 also shows the various variable costs and overheads (before rent and finance). Production costs = £146 /t (before rent and finance). The net margin is £2,501 /ha.

Note, these are from only one year's results.

3. To estimate the average carbon footprint for ware potatoes, the range across various farm systems and the sources of GHG emissions.

The carbon footprint was calculated using Agricalc, but as highlighted earlier, only on 4 of the 8 farms completed a carbon footprint. Appendix 2 provides the group average carbon audits for ware potatoes plus winter wheat and spring barley from the same 4 growers for comparison.

The figures show that the carbon footprint for potatoes was 4,467kg CO2e per ha. This is nearly double that for a ha of spring barley, however, on an output basis it was only 0.08kg CO2e /kg potatoes. The estimate of carbon footprints per ha or per tonne are meaningless at present, as most people do not think in terms of Kg CO2e and are unfamiliar with emission values for other products. This will change over time as increasingly customers (and consumers) will be asking for evidence of actions taken to reduce GHG emissions.

This is the start of the journey to better understand the carbon footprint of ware potatoes. The key factors are crop yield, fertiliser and energy (tractor fuel and electricity to operate cold

stores) use. Fertiliser and energy use accounted for 95% of the source of emissions in ware potatoes.

4. To undertake a review of the current data information provided to growers, identifying areas how the information could be improved to support growers decision-making

As reported earlier, a review of the current data information was successfully completed – see appendix 3. Key learning from this activity include:

- Although this SPC have a relatively new bespoke data system, there is still a lot of data entered manually. This is both time consuming plus prone to human error in data entry.
- Not all the members use the portal, the use varied considerably. There has been little effort put into training and supporting members to use the portal. This is an area that needs to be improved.
- The foundation of the data system is what information members first provide following planting - the area planted and the different varieties. There is a concern this information is not as accurate as it should be. There needs to be clearer instructions provided to members to ensure there is a consistency of approach and that members understand the importance of providing accurate information. For example, is it the area actually planted in the field or the area of the field?
- There is a chronological record of all movements /sales over the marketing year. However, there is no summary data or analysis of the information gathered. This can be done manually by downloading a copy of the sales into excel but currently few members would do this.
- At present there is little data analysis on an individual member basis, for example, average price, average yield, pick-off per variety or field basis. Equally there is no aggregated data across the whole membership to enable benchmarking across the whole membership to highlight how an individual compares to the group average across a range of metrics. This represents a future opportunity to provide improved information to help members make more informed decisions, plus a motivation for growers to improve their performance.
- There is considerable scope to improve the information /data provided back to members to help support their future decision-making. The first priority is to identify the information that would be most helpful to growers and explore how best to collate and present that to members.

5. To Increase the awareness and understanding amongst farmer growers and their advisers, of the role and importance of data.

This process has started with the successful member meeting held on the 15th January attended by 23 participants. However, this is only the start of the process. Further awareness raising and reinforcement is required on an ongoing basis to ensure this is embedded and growers fully appreciate the potential value derived from improved data /information.

6. To deliver an effective communications strategy to share the information and learning from the project widely throughout the Scottish potato sector.

This was partly achieved through the online webinar delivered at the end of the project (30th March 2023). However, this is an area that needs to be improved in the future. That said, the project is only in its first year. There are some reservations concerning the results produced from year 1, which may have hindered the confidence in highlighting the project and its results more widely. How accurate is all the information gathered and is it truly represented of the wider potato growing sector? The Operational Group are unsure with only one year's results and experience.

10. CONCLUSIONS

The project has made great strides as evidenced by the progress in terms of the improved understanding of the challenge of improving the productivity and competitiveness of ware production. A good benchmarking group has been established of progressive growers who are open to change and the sharing of information. That said, it is only year 1, the robustness and accuracy of the data generated by the group will only improve with experience. It is pleasing to note that there will be two new members who now wish to join the group. This auger well for the future.

Although benchmarking is at the heart of the project it is about much more than that. The project focused on real practical issues, so included comparisons of growing systems, variety performance, the efficient use of inputs, and cold store management. There is scope to broaden this further into other areas such as: disease control, irrigation management, sensor technology, machinery replacement policy, storage design, ventilation systems, managing people, new technology, amongst other things. These are critical issues for the successful operation of a potato enterprise. The sharing of information and experiences amongst a closed trusting group has huge potential to drive performance improvements. One thing that would help capture and facilitate learning is through the creation of 'standard operating procedures' (SOPs). SOPs record the detail from every grower on how they grow and manage their potato enterprise, from the planting of seed right through to the sale of the produce out of the cold stores. This is a proven route to fast track the comparison and learning between growers.

Growing ware potatoes is expensive, £7,880 /ha (£3,190 per acre), margins are being squeezed, therefore growers need to improve their performance and marketable yield (potato quality). At the individual grower level, the project will help improve their bottom line, enterprise profitability. In addition, the project has also provided SPC with more accurate production costs data allowing it to negotiate future contracts with customers more effectively. This has already paid dividends, as SPC were able to renegotiate a two-year contract based on the benchmarking information which provided evidence of increased production costs.

Carbon Audits. As previously mentioned, the project only managed to gather data from four farmer growers who completed their carbon footprint. The information generated on the GHG emissions and the variability between growers is therefore limited. The project team accept some responsibility for this for failing to make the case strong enough of the value and benefit of regularly measuring carbon footprints.

It is noted, the majority of the multiple retailers and potato processors have ether set their own net zero carbon targets or have signed up to the 'Courtauld Commitment'. The Courtauld Commitment 2030 is a voluntary agreement that enables collaborative action across the entire UK food chain to deliver farm-to-fork reductions in greenhouse gas (GHG) emissions, food waste and water stress. With respect to carbon, to deliver a 50% absolute reduction in GHG emissions associated with food and drink consumed in the UK by 2030 (against a 2015 baseline). Increasingly, SPC will be asked by their customers what is the carbon footprint of the potatoes they produce and what they are doing to reduce their GHG emissions? SPC need to be proactive (as all ware growers must) and start preparing for that now.

Currently potato growers are facing a crisis in terms of rocketing input prices, particularly with respect to fertiliser and energy costs. Modern potato stores all have refrigeration to control the quality of the potatoes as their stored through the season. The cost is particularly high to hold potatoes through the early summer period until new season crop is available. Although potato growers are aware of the need to take action on the climate crisis, this has dropped down their agenda due to economic pressure and market volatility. The risk of not doing anything means we will have even less time in the future to take action.

Improved Data Flow. As previously mentioned, the challenge of improving the data flow back to grower members is more complex and harder than first envisaged. Activity on the information generated and how it can be improved is still at an early stage. We know that there is an issue in general with information overload. There is a need for critical analysis and interpretation to translate the information generated into useable data that influence farmers actions. The Operational Group now have a better understanding of what is required and how the improved use of data can be supported. In addition, part of the challenge is presenting the data in a farmer friendly format. The real test of the value of data is as a result, what action is taken?

The project's benefits to date:

- Provision of real farm data showing the production costs to grow a tonne of ware potatoes. This has been segmented across White, Red and Maris Piper varieties.
- The carbon footprint was estimated using Agricalc to produce a tonne of ware potatoes and the main sources of GHG emissions identified. This is the start of the journey to better understand the carbon footprint of potatoes and the sources of GHG emissions.
- Greater awareness of the challenge of improving the information flow back to farmer growers and what information is required to support decision making.
- Increased awareness and understanding amongst farmers and their advisers, of the role and importance of data.

The benefits for the wider agricultural community include:

- The project showcases to the wider farming community what can be achieved by farmers themselves taking proactive ownership and action.
- It demonstrates the value and benefits of farmers working co-operatively together. Since producer members own their co-operative, it innately self-empowers producers to coalesce around a tangible delivery model, to take the initiative, and unlock ambition. More confidence can be taken in shared commitment to projects that would not be feasible by an individual business.
- Increased awareness and understanding amongst farmers and their supply chains, of the role and importance of collaborative data sharing.
- Producer co-ops improve industry engagement, support delivery, manage resulting data for greater scheme efficiency, and to unlock value-add opportunities for producers and their supply chains.

The role and contribution of the 8 farmers was unquestionably integral to the project's success. Whilst the project has encountered challenges, SPC and participating farmers all agreed real progress has been made. There is a commitment to continue the project, as it is widely recognised that the need for this type of work will only grow in the future. The aim is to build on this foundation and to progress into Year 2.

APPENDIX 1

SAOS/SPC Benchmarking Group - Harvest 2022 - Group Averages by Crop

Per hectare	Winter Wheat	Winter Barley	Spring Barley	Oats	Potatoes (Piper)	Potatoes (Whites)
Technical Performance						
Total area grown (ha)	145	43	111	57	31	30
Total production (t)	1,391	399	869	434	1,595	1,471
Yield (t/ha)	9.9	8.7	7.7	7.6	52.8	49.8
Price (£/t)	244	230	271	224	193	183
Inorganic nitrogen (N) (kg/ha)	197	162	134	128	187	175
Inorganic phosphate (P) (kg/ha)	49	39	34	62	72	78
Inorganic potash (K) (kg/ha)	85	59	58	86	287	207
Inorganic sulphur (S) (kg/ha)	57	37	34	44	258	154
Income						
Crop sales	2,418	1,339	1,713	1,714	10,205	9,096
Total income	**2,488**	**2,036**	**2,127**	**1,714**	**10,205**	**9,096**
Variable costs						
Total seed costs	80	84	82	51	605	828
Total fertilisers	390	354	287	235	648	549
Total crop protection	193	135	99	102	692	504
Total other variable costs	6	11	13	18	16	90
Total variable costs	665	583	475	399	1,957	1,946
Gross Margin	**1,823**	**1,453**	**1,652**	**1,316**	**8,248**	**7,150**
Overheads						
Total labour	162	130	154	202	1,148	774
Total machinery and equipment	340	403	363	456	2,309	1,893
Total property and energy costs	75	80	76	76	2,266	2,329
Total administration costs	77	103	75	76	204	304
Total overheads excl. rent & finance	641	716	657	742	5,927	5,300
Cost of production and margins Excluding rent & finance						
Cost of Production / hectare	**1,306**	**1,299**	**1,132**	**1,141**	**7,884**	**7,246**
Net Margin / hectare	**1,182**	**737**	**995**	**574**	**2,501**	**1,850**

APPENDIX 2

SAOS/SPC Benchmarking Group - Harvest 2022 - Carbon Audits

AgreCalc Outputs	Winter Wheat	Spring Barley	Potatoes
Crop area (ha)	194	102	78
Enterprise Resource Use & Emissions			
Physical Performance			
Yield (t/ha)	9.5	7.9	56.5
Straw yield (t/ha)	1	2	
Fertiliser use (kg/t output)	80	70	22.5
Fertiliser use (kg/ha)	830	545	1,233
Electricity use (kWh/t output)	11	1	30
Diesel use (lt/t output)	15	17	7
Diesel use (lt/ha)	153	130	372
Water use (lt/t tubers)			1,422
Enterprise Emissions (kg CO2e/kg tubers/grain)			
Manures & Fertilisers	0.28	0.21	0.06
Pesticides	0.00	0.00	0.00
Lime	0.04	0.05	0.00
Fuel	0.05	0.05	0.02
Electricity use	0.00	0.00	0.01
Crop Residues	0.03	0.03	0.00
Other	0.00	0.00	0.00
Total Emissions / kg of Output (kg CO2e/kg tubers/grain)	**0.41**	**0.34**	**0.08**
Total Emissions / Hectare (kg CO2e/ha)	**3,882**	**2,624**	**4,457**
Whole Farm Sustainability Indicators			
Nitrogen use (kg/ha)	121	121	121
Phosphate use (kg/ha)	34	34	34
Potash use (kg/ha)	81	81	81
Waste (kg)	2,575	2,575	2,575
Water use (lt)	12,943,750	12,943,750	12,943,750
Stocking density (LU/ha)	0.00	0.00	0.00
Sequestration (t CO2e)	61	61	61
Renewable energy used (kWh)	161,425	161,425	161,425

APPENDIX 3

The Members Portal

The following is an overview of SPC's online Member portal.

The information system has been produced via bespoke software to fit SPC's specific needs for a potato marketing co-op. Each member has a specific log in and password to ensure confidentiality. The co-op's marketing agent's key staff have full access to all the member information in the portal, which is crucial to the effective marketing and management of members ware potatoes. Having accurate information, available in real time, is the life blood of the business. Without this the business would be unable to function effectively.

Having a bespoke software system that is linked to the co-op's cash book and financial software (Zero) is also a major advantage to the business. It means a lot of the office functions and operations are automated, saving considerable admin time and importantly cost to the business. It is hard to estimate but it could be as much as half a person.

Having an automated system also helps ensure there are less errors in the system. We know from experience one of the greatest sources of error in any recording system is from human error.

The Members Portal
Opening dashboard page, has a number of options:

- "Manage Stores"
- "My Trades"
- Remaining stock level

Store Records
This is the foundation of the whole system. It is vital that each member provides accurate data on the area planted across the different varieties.

Once planting is complete (May /June), each member passes the key information to the marketing agent, who enters it into the information system manually.

Key information at this stage includes:

- Planting Area
- Variety
- Field name /No

At harvest (Sept/Oct), as stores are being filled, key information is gathered and again entered into the system:

- Variety
- Field
- No of boxes
- Store loaded
- Comments – irrigated, etc.

Again, this information is manually entered by the marketing agent who gathers the information from individual members. The provision of accurate information from members is critical.

The quality control (QC) assessment of each stock of potatoes into storage is another key activity. Having an accurate assessment of the quality of the potatoes is crucial as it influences

whether the co-op can meet its obligations in terms of contracts agreed and when stocks are moved out of store. Having early awareness of yields, tonnes and quality is essential.

In general, good quality potatoes, stored in good stores can be safely held until later in the season. Conversely, potatoes with any health /skin finish issue needs to be marketed earlier to minimise the risk of further deterioration.

All potatoes are sampled at harvest, washed, measured for size, quality assessed for a range of disease / skin finish – as part of the QC control. This is a costly time-consuming exercise but is essential to better understand the quality of stocks across every member /store /variety. Without this accurate crop assessment, the co-op could not function effectively. The risk resulting from any misinformation is potentially enormous.

The crop protection chemicals applied to each growing crop is kept in a separate system, which all farmer growers keep to comply with the legislation regarding the safe application of pesticides. These are normally held in a range of different crop software packages eg Gatekeeper

Manage Stores

A list of all the stores the members has is provided.
For each store, details of the current stock levels are provided – number of boxes for each variety. This is real time information.

My Trades

Lists all the trades conducted in the current marketing year
Parameters include:

- Date
- Ref No
- Contract /Free buy
- the Invoice – can be downloaded
- the Passport– which is downloaded. Generated largely automatic. This is required by the haulier to accompany all despatched loads.
- the Remittance.

Each transaction is colour coded as follows:
Blue – Processor /Packer Information not available yet
Green – Grower returns received
White – Payment received

Information provided from customers includes:

- Date
- Intake weight – number of boxes
- Pick off % (brock)
- Net Yield - Tonnes
- Price £ /t
- Total Value
- Deductions
    - Marketing fee
    - Co-op Levy
- Net Amount £

There is a chronological record of all movements /sales over the marketing year. However, there is no summary data or analysis of the information gathered. This can be done manually by downloading a copy of the sales into excel.

Currently there is little data analysis on an individual member level for example average price, yield, pick-off per variety or field basis.

Equally there is no aggregated data across the whole membership to enable benchmarking of data cross the whole membership and how an individual compares to the group average across a range of metrics. This represents a future opportunity to provide improved information to help members make more informed decisions, plus a motivation to improve their performance.