Final report summarising

The PRRS Area Regional Control Programme situated in the Cookstown Area, Northern Ireland.

PRRS Area Regional Control Programme

European Innovation Partnership (EIP)

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Operational Group: Area Regional Control Group

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PigRegen

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1- EXECUTIVE SUMMARY

Porcine Reproductive Respiratory Syndrome (PRRS) is a disease within the pig industry in Northern Ireland and globally. It effects the health and welfare of the pig, has financial implications for the producer and leads to condemnations at slaughter.

Pig Regen, a non-profit organisation funded via a pig levy, led this project with financial support from DAERA and The European Agricultural Fund for Rural Development through the European Innovation Partnership. The aim of this project was to control PRRS, in a five mile radius of Cookstown, the most densely pig populated area of NI. Within this area there were 29 breeding units the owners of which along with their vets agreed to co-operate with the requirements of the project.

The project was carried out during a 30 month period. An initial baseline of the level of PRRS infection in the area was quantified using analysis of blood samples prior to the start of the project. This indicated 17 of the 29 herds in the area were positive for PRRS. There were two key elements within this project to control PRRS: (i) improved biosecurity on individual units and (ii) synchronised vaccination i.e all producers vaccinated their breeding herds within a short time window.

By the end of the project the number of positive units was reduced by one third and the overall viral load was reduced by 20%. This resulted in a 70% reduction in pleurisy and a 40% reduction of pericarditis recorded at slaughter.

An estimation of return on investment for this project was greater than 7:1.

This project relied on all producers remaining committed throughout the duration of the project. This required behavioural change by producers in relation to biosecurity along with vaccinations and co-operation by the vets. Learnings from this project combined with the geographical software that was developed, to monitor the spread of disease, could be used by all pig producers in NI and across other sectors within agriculture.

The success of this project has been recognised in that the project has been shortlisted for the National Pig Awards 2023!

2- BACKGROUND

The Pirbright Institute (2018) stated that Porcine Reproductive respiratory Syndrome (PRRS) is one of the most economically important disease for the global pig industry. The estimated cost of PRRS within the EU is 1.5 billion euros i.e. approximately 5-10 euros/pig. Within NI, PRRS was first identified in 1997 and blood sampling carried out by PigRegen, the local levy body, over the last 10 years has shown its gradual spread to most of Northern Ireland. The disease is now considered endemic and has been estimated to cost between 35-37% of net margin per pig unit (Borobia, 2016). PRRS is an enveloped RNA virus which can live up to 4 days in favourable conditions, can carry air borne for 0.5km and can under certain circumstances travel up to 4km. PRRS is a complicated disease with no stable/long term vaccine as the PRRS virus undergoes rapid evolution showing antigenic, pathogenic and genetic variations (Meng, 2000). This has important implications for vaccine development but also highlights the importance of controlling the disease via strict biosecurity and management in conjunction with an effective vaccination programme.

2.1 Project Aims

The aim of this project was to facilitate communication relating to biosecurity solutions and synchronise behaviour among producers regarding the administration of vaccine to control disease. In addition, within this project health mapping software would be developed to notify producers and vets of where disease incidents are geographically, thus providing rapid identification and quantification of the risk of disease to any unit in the area under investigation. The overall aim of this project was to reduce the PRRS viral load in the geographical area which represented a 5 mile radius around Cookstown. Depending on the outcome, the ultimate goal was to use the findings, from this project, to expand the scheme to the entire pig herd in Northern Ireland.

2.2 The Operational Group

In November 2018, DAERA pig advisor, Dr Mark Hawe, organised a visit to Denmark where a group of around 20 producers and pig veterinarians had the opportunity to observe and learn about a PRRS Control and Eradication Scheme. This visit, in conjunction with the results of blood testing Pig Regen carried out in 2019, inspired both producers and vets to consider initiating a similar scheme in Northern Ireland. Pig Regen with a DAERA pig advisor (Dr Mark Hawe) met with DAERA regarding funding for this initiative. When the EIP funding opportunity became available Pig Regen, with the help of Dr Hawe, wrote the initial expression of interest.

Having achieved success in round one a full application was written and submitted in July 2020 **(Fig 1).** The latter application was also successful allowing the project to commence. The area chosen for this pilot study encompassed a 5 mile radius around a slaughter plant in Cookstown, Co Tyrone. This area has the highest density of pig units in Northern Ireland and was selected for the following reasons:

- Within this area there were progressive / forward thinking pig producers.
- Most producers in the area had co-operated previously on pig related initiatives.
- All units within the area received specialist pig veterinarian input.
- If PRRS could be controlled in this pig-dense area, then a national scheme could be launched with confidence.

Within the EIP project, the Operational Group (OG) was comparatively large, consisting of 29 producers, four vets, the project leader, DAERA pig advisor and Innovation Broker (IB). Hence it was decided to create four smaller subgroups known as "Pods". To encourage discussion and sharing of information, members were allocated to these subgroups according to their veterinary practice. Each Pod consisted of between four and eight producers along with their vet. The project leader, the innovation broker and the DAERA pig advisor attended each Pod meeting to ensure continuity. The composition of the Pods is presented in **Table 1 in Appendix A.**

The size of the OG meant it was impossible for all members to meet with the frequency and duration required to manage the project. Hence an Executive Management Group was formed consisting of the project leader, the IB, the DAERA advisor and a producer representative from each Pod.

All producers were assured of the confidentiality of all aspects of the scheme, the logical and professional nature of the Executive Management Group and that their involvement was voluntary. Producers signed a "Partnership Agreement" **(Appendix E)** allowing the data collected from their unit to be used to complete the initiative and not for any other purposes.

As this initiative commenced during the Covid 19 pandemic, most meetings had to be held virtually using a sharing platform. Although this initially proved challenging for some producers who were not familiar with "virtual communication", their perseverance and the success of this meeting format was testament to their commitment to the project. All meetings of the OG and producer Pods, either in person or virtually, took place in the evening to encourage greater attendance. Details of all meetings were sent by post, with each participant receiving 2 to 3 reminder texts and these forms of communication were followed up on the day with a phone

call, either from the broker or advisor encouraging attendance. Communication was both fundamental and critical to ensure that all members stayed motivated and committed to the project. Given the nature of the project, a loss of members would jeopardise any success. Within the first 9 months, three members left the OG all of whom had a small number of sows. All three of these members exited the pig industry due to the extreme financial situation at the time. One other member, again with a small number of sows, "left" the group. However, he continued to co-operate with all other aspects of the project including synchronised vaccination and adhering to biosecurity measures.

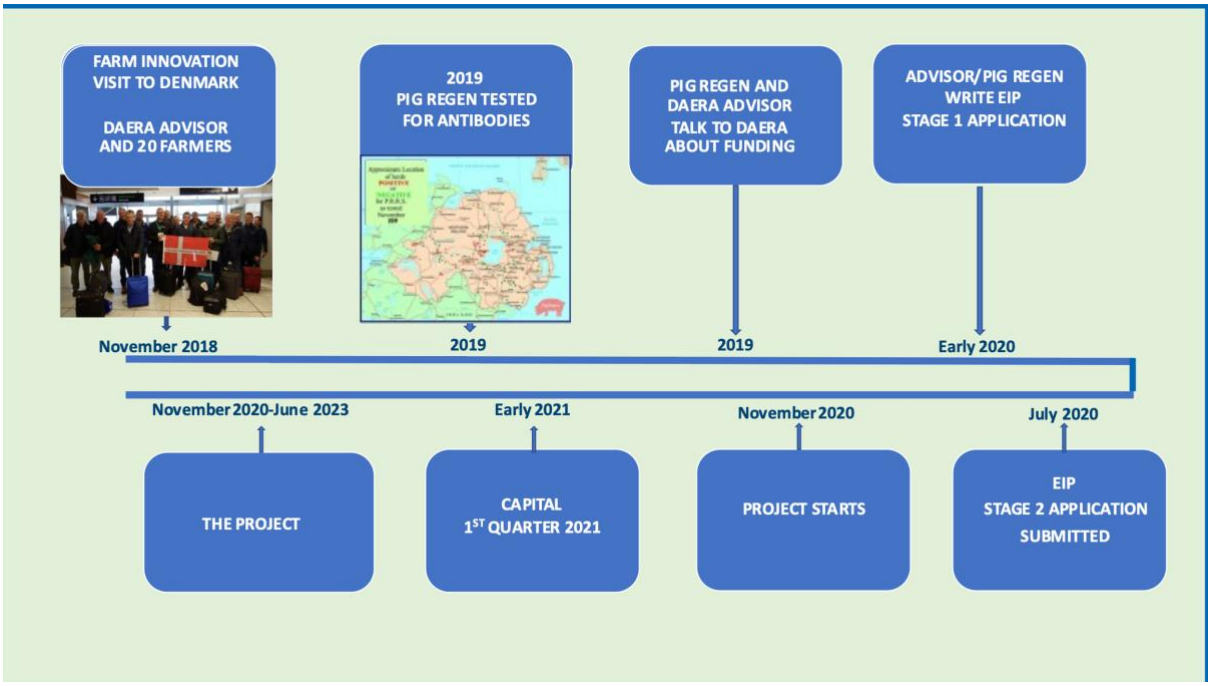

Figure 1: Timeline of how the Operational Group was formed and how the project commenced.

3- PROJECT DETAILS

A summary outline of the different areas within the project and their sequence and timing is presented in Figure 3.

3.1 Strategy

The first task of the Executive Management Group was to work out how to get 29 producers and four veterinary practices to work together, share information and cooperate. Methods of

communication were discussed in conjunction with confidentiality and willingness to share information. It was decided that the large group should be broken down into four smaller groups (Pods) as described previously. The initial meetings of the OG and of the Pods were held virtually, which provided an effective vehicle for communication.

3.2 Capital

This EIP group received an allocation of £30k to spend on capital. As there were 29 members in the OG, the Executive Management Group decided to allocate £1,000 per member. A list of eligible items to improve biosecurity and hence PRRS control was drawn up and approved by DAERA. To facilitate the members and to improve buying power, the Innovation Broker obtained two quotations for each of the items that producers expressed an interest in. A second set of quotations were obtained, from the same suppliers, prior to the items being purchased. This was a cumbersome and frustrating process as the IB had to go back to suppliers, asking them to submit paperwork a second time whilst knowing they were not going to be awarded the tender to supply items. In practice it proved difficult to get the producers to go to the relevant suppliers and purchase their items. However, the most challenging aspect was ensuring producers filled in their claim forms correctly and submitted them to DAERA. As the IB was not involved directly in this aspect of the claim process, they were unaware of which producers had submitted their claim forms and this aspect required a lot of communication between individual producers and the IB and between the IB and DAERA. Due to the complexity of the claim process, only 14 producers availed off the capital grant funding. The Executive Management Group did offer the remaining money to the members of the OG to purchase more items and two members did exploit this.
Overall, this was a very protracted process taking 19 months to complete. It distracted from the main project and used resources of both time and effort.

3.3 Action Plans

COMBATS (Comprehensive Online Management Biosecurity Assessment Tool) had been carried out, on each producer's unit, in late 2019/early 2020 by PigRegen. The results of COMBATS were analysed and 2 to 3 areas were selected in each of the categories, internal biosecurity, external biosecurity and management. The areas were prioritised on the basis of most important biosecurity issue where something could be achieved (**Table I**), and areas were something simple could be done with minimum effort (**Table II).** The IB highlighted the areas that required attention and the affiliated vet suggested what could be carried out to

address the biosecurity issue on the farm. Hence an Action Plan, specific to each unit, was created for each producer within the OG **(Appendix B).**

Q.10	Boot and clothing restrictions on people moving between areas of production (e.g.breeding/gestation, farrowing, nursery)
Your Answer	Not required to change clothing or boots
Optimal answer	Employees are restricted to their area of production
Action	This is now in place by organising manpower to areas

Table I: Example of an important area selected within Internal Biosecurity on an Action Plan

Q.10	Indirect transmission – Fomites, needles, utensils, equipment are shared between all age groups
Your Answer	Yes
Optimal answer	No
Action	Now guns and syringes are restricted to each area.

Table II: Example of an area selected that required minimal effort within Management on an Action Plan

As indicated in **Tables I & II** the Action Plans were developed to focus attention on specific areas. The actions that were highlighted gave most return for investment. Only a small number of actions were highlighted so not to overwhelm the producer hence create negativity. The aim of the action plan was to select actions that would improve biosecurity that were discrete and achievable **(Appendix B).**

3.4 Health Mapping Tool

Software, based on GPS, was developed which could help identify the precise geographical location of pig herds, in the 5 mile radius centred on Cookstown, Co. Tyrone, indicating their Porcine Reproductive Respiratory Syndrome status. This software was available online and was accessible via computer, tablet or smartphone for each producer to see his/her own data whilst vets and administrators can access all data. The programme also recorded the PRRS status of each unit using the most recent blood results, the various aspect of the COMBAT analysis as well as the vet associated with the unit. This data was presented using colour coding on a map with each individual screen showing a different monitoring category.

The software was developed in a pre-planned and logical manner. Firstly, the Executive Management Group wrote a specification which was sent out for quotation. Only the Agri-Food and Biosciences Institute quoted for this work and they were awarded the contract.

The Executive Management Group worked closed with Mark Browne (AFBI) and regular meetings were held to discuss modifications, additions etc. A pilot program was supplied to the Executive Management Group to use to identify any issues and to suggest areas for

improvement. Before the final program went live the latest available data from the project was uploaded by the project lead and a series of training sessions were held with the vets to teach them how to use the program. When the four vets involved saw how useful, practical, and simple the program was to use they agreed to share all data among each other. This meant any of the four vets could see the disease status of all producers, even those that were not their clients. This was important as it enabled the vet to "protect" their producers if they were located beside a unit that was positive for wild type virus.

3.5 Synchronised Vaccinations

PRRS virus continually undergoes rapid evolution showing antigenic, pathogenic and genetic variations. Hence the risk of new strains of wild type virus (or field virus) emerging is high (Charleston and Graham, 2018). Also, as PRRS vaccines employ a live attenuated virus it also causes animals to shed the virus. Therefore, it was important to synchronise the vaccination process across all producers within the 5 mile radius. This meant that all sows were vaccinated within a short time window so there were no breeding animals unprotected at any time. In addition, synchronisation meant that all producers carried out "blanket" vaccination of their sows every three months. Historically, with the everyday pressures on a farm, this vaccination could slip to four months or even longer leaving the herd unprotected. This level of producer cooperation and coordination had never been achieved within the local industry.

Initially the IB rang each producer to record their vaccination policy and the date their sows were last vaccinated. The majority of producers had vaccinated in August 21 hence it was decided to have the first synchronised vaccination in November 2021 **(Fig 2).** This was achieved by some producers vaccinating before their planned three months hence committing to an extra vaccination of their breeding herd. In practice, producers who were vaccinating in either June or July had to vaccinate every two months for the next two vaccination cycles rather than in three months to come into line with the rest of the group **(Fig 2).** This meant extra vaccination costs and extra time and labour input and the other OG members are indebted to the affected producers and BI for their support.

From November 21 vaccination was synchronised every three months until the end of the project.

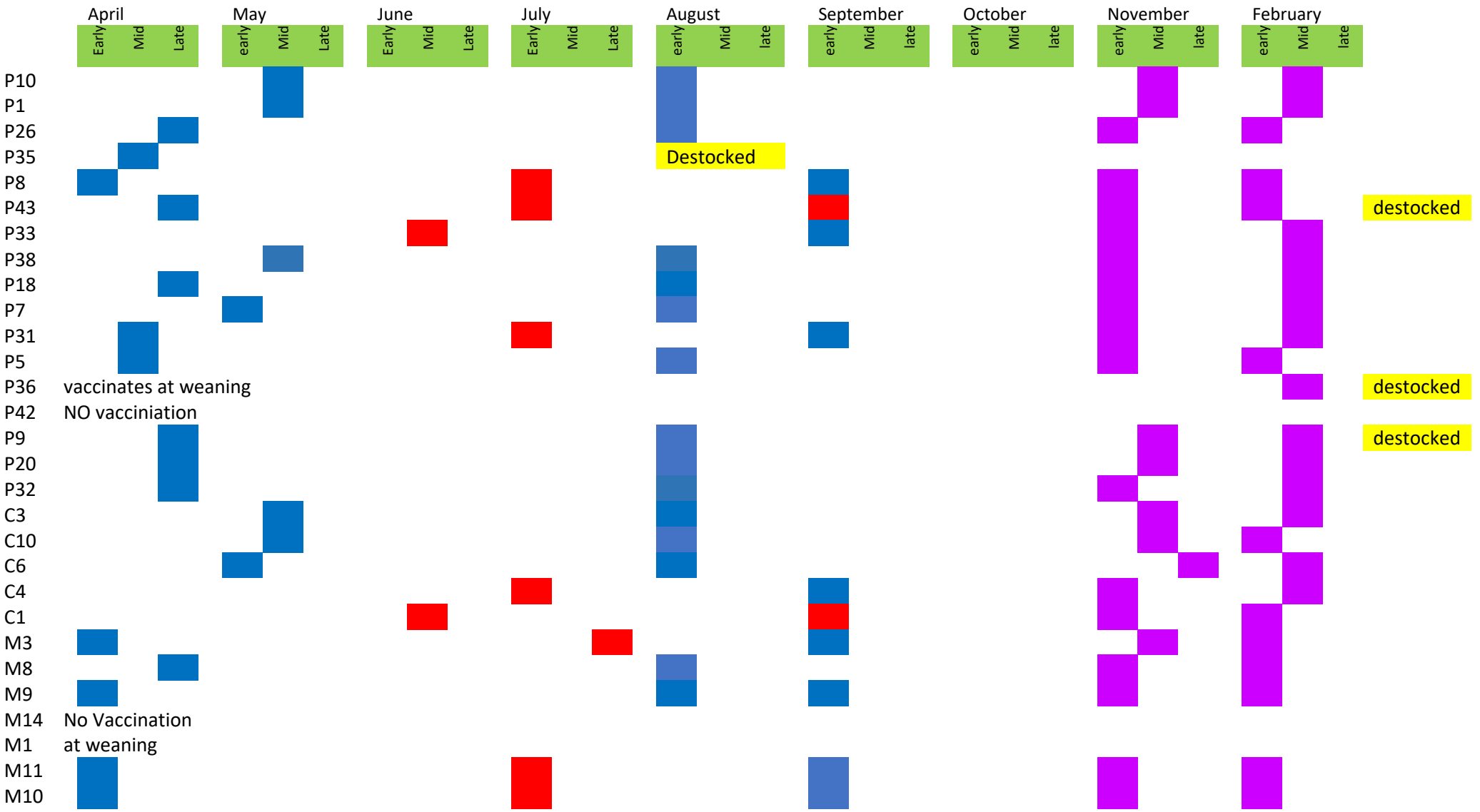

Figure 2: Outline of how vaccination of the breeding herd was synchronised

3.6 Sampling

3.6.1 Bloods

During the periods, January to March 2022 and January to March 2023, the four vets blood sampled pigs which were between 10-12 weeks old (at this age, pigs are away from breeding herd vaccine and are most susceptible to shedding the virus if infected) on the 25 breeding units. Thirty pigs were bled on each farm and every five samples were pooled into one sample. This resulted in six pooled samples being sent to the laboratory for each pig unit within the group. The blood analysis protocol was as follows:

1. If piglets were vaccinated for PRRS then a Polymerase Chain Reaction (PCR) test was carried out on the pooled blood samples to identify if the sequence of the genetic material of the virus was vaccine strain or wild type virus. If the sequence was vaccine strain this unit was categorised as vaccinated stable/negative. If the sequence was not the vaccine strain the unit was described as having wildtype or field virus and hence was classified as positive.

2. If piglets were not vaccinated the blood was tested first using an ELISA to check for antibodies for the virus. If this test was negative then the unit was classified as negative. If antibodies were identified, then a PCR test was carried out to identify the sequence of the virus and the unit was classified as positive.

3. Ct values were obtained for each sample as an indicator of viral load. Ct stands for "Cycle Threshold" and indicates how many times is required to try to copy a particular virus's genetic material before being able to detect that material on a PCR test. The Ct value can be used as an indirect indicator of the amount of viral genetic material detected from a particular specimen on a particular test at a particular time. In general, a lower Ct value indicates a higher viral load in that specimen, and a higher Ct value indicates a lower viral load.

The results for each unit were sent to the owner and their vet via email after notification by text that the results were available. In addition, the average of the OG was presented to enable benchmarking and quantify overall progress. Follow up conversation were carried out via phone calls by the IB for any units that had changed status. These communications served to motivate those that had improved their status to maintain the changes they had

implemented and to encourage those whose status had deteriorated to speak to their vet and concentrate on the biosecurity of their unit.

3.6.2 Flu

Whilst carrying out the second round of blood sampling, the vets, also performed nasal swabs on the pigs in 16 of the units. These samples were taken for Dr Ken Lemon at Veterinary Science Division (AFBI) who has been researching the genetic sequences of different flus. This process greatly assisted with the collection of samples from commercial units for his research study. Dr Lemon identified Flu A and Flu D in some of the samples and these results were fed back via the IB to the producers concerned and their vets.

3.6.3 COMBATS (Comprehensive Online Management Biosecurity Assessment Tool)

Two rounds of COMBAT surveys were carried out by the vets. The first round was undertaken during April to June 2022 and the second round one year later during April to June 2023. A PDF version of all the questions within the COMBAT is available in **Appendix B.** Within a COMBAT there are seven questions relating to geographic location of the unit, 15 questions on internal biosecurity, 20 questions concentrating on external biosecurity and final 13 questions on management. Internal biosecurity questions covered areas such as size of herd, restriction of personnel between areas and movement of sows. External biosecurity questions were concerned with anything coming in or out of the unit e.g. animals, vehicles, manure and visitors. Finally, management questions covered practices such as cross fostering, frequency of changing needles and adherence to “all in all out” polices.

The vets completed paper copies of the COMBAT surveys and these were collated by the IB who transferred them into a digital format before sending them to Dr Lysan Eppink (research veterinarian for BI). Dr Eppink had the task of inputting the surveys into the COMBAT software. Between the first and second round of COMBAT analysis the software associated with how the COMBATS were scored was updated. This was an issue for the project as a direct comparison between the two rounds of COMBAT scoring was essential. To address this a significant amount of additional work was required by the vets as well as Dr Eppink. However comparative COMBAT input was achieved this allowing quantitative comparison between the pre-project COMBAT assessment and the two COMBATs carried out during the project.

3.7 Dissemination

A list of all dissemination events is listed in **Appendix A.** Dissemination took the form of meetings with the industry and veterinary conferences. In addition, Business Development

Groups involving DAERA advisors allowed individual producers speak to other pig producers who were outside the scheme. Written communication was circulated to all producers in Northern Ireland and the project has been promoted through the GrowIN platform. Submissions have been made to two more veterinary conferences, to the National Pig Award competition and to i2Connect advisors forum. The latter competition recognises the contribution of the DAERA pig advisor, Dr Mark Hawe, and encompasses agricultural advisors across Europe.

3.8 Management and Operation Group Meetings

There were 11 Operational Group Meetings where all 25 participating producers in the group were invited along with the IB, vets and DAERA advisor. However, the management of the project was carried out by the Executive Management Group. This group met a total of 34 times to manage all areas from capital and software development to the actual logistics of managing sampling, feedback and procurement. In addition, it was the Executive Management group who attended all contract meetings with DAERA. A list of Operational Group meetings, Executive Management Group meetings and Contract meetings are presented in **Appendix A.**

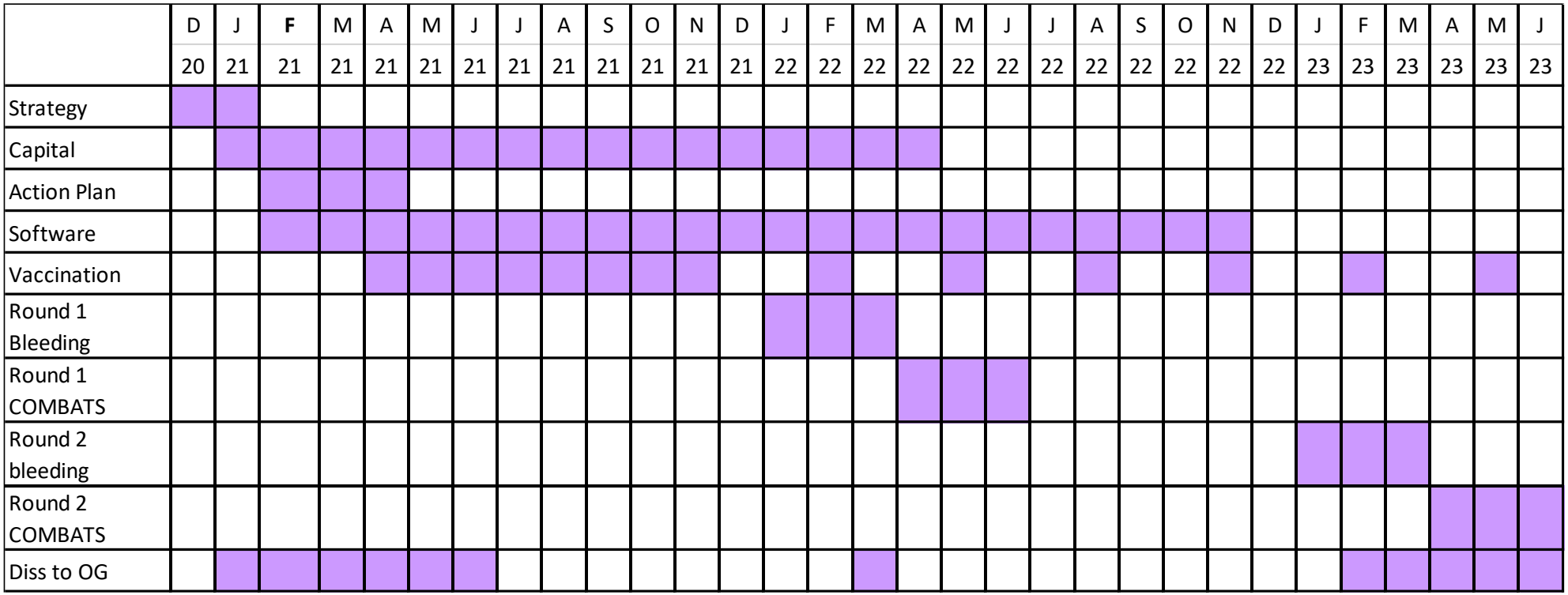

Figure 3: GANTT Chart showing time periods for each area

3.9 Funding

The European Innovation Partnership was the main source of funding for this project. The project was awarded a total of £110,605. The scheme was jointly funded by the European Agricultural Fund for Rural Development and DAERA. This main use of this funding was to support running costs i.e. the cost associated with the Innovation Broker and the Project Leader. In addition, this money was used to remunerate the vets for blood sampling, undertaking COMBAT surveys and mentoring producers regarding biosecurity. The Health Mapping Tool was developed using part of this funding award and the award also covered the laboratory costs. A small part of the award went to facilitating meetings and dissemination.
The producers covered the costs of vaccination both for sows and where necessary piglets which over the period of the project was estimated at approximately £220K. Boehringer Ingelheim supported the project both financially and in time and resources. They covered the costs of postage of samples to the laboratory in Germany and they covered the cost of food when the EMG met with them on several occasions. Dr Lysan Eppink gave her time to speak to the OG on four occasions, co-ordinate all the laboratory analysis and COMBAT input and she was available at all times to support the IB in result interpretation. Her contribution to this project must be recognised and indeed the successful outcome could not have been achieved without her invaluable support.

3.10 Results and Outcomes

Within this results section there are four main categories. The viral load from the blood samples, the biosecurity status of the units, physical performance of breeding herds along with carcass quality of slaughter pigs and welfare parameters recorded *post-mortem* in the abattoir. In addition, the analysis of samples collected to record incidence and type of flu are presented.

<u>Blood results</u>

Arguably the most relevant outcome from the project was the dramatic improvement in PRRS status within the group between Round 1 (pre-project) and Round 2 carried out in spring 2022 (approximately 18 months into the project). In Round 1, 17 units were positive for field strain PRRS and only five units were negative **(Fig 4).** By Spring 2022, Round 2, 11 units were negative and 11 positive for PRRS. There was no improvement in the number of units testing negative in Round 3. However, the number of positive samples from the units with wild type PRRS was reduced **(Table III).** As outlined previously, six pooled samples were tested per unit and in Round 2 the average number of samples testing positive per positive unit was 3.9 while in Round 3 this was decreased to 3.3. This suggests a reduction in the amount of

circulating virus and this finding was supported by the improved Ct values **(Table III).** Indeed in Round 2 the Ct value was 31.6 i.e. it took 31.6 cycles to detect the genetic material of the virus and this had increased by one cycle to 32.6 in Round 3, indicating there was less viral load in the samples in Round 3.

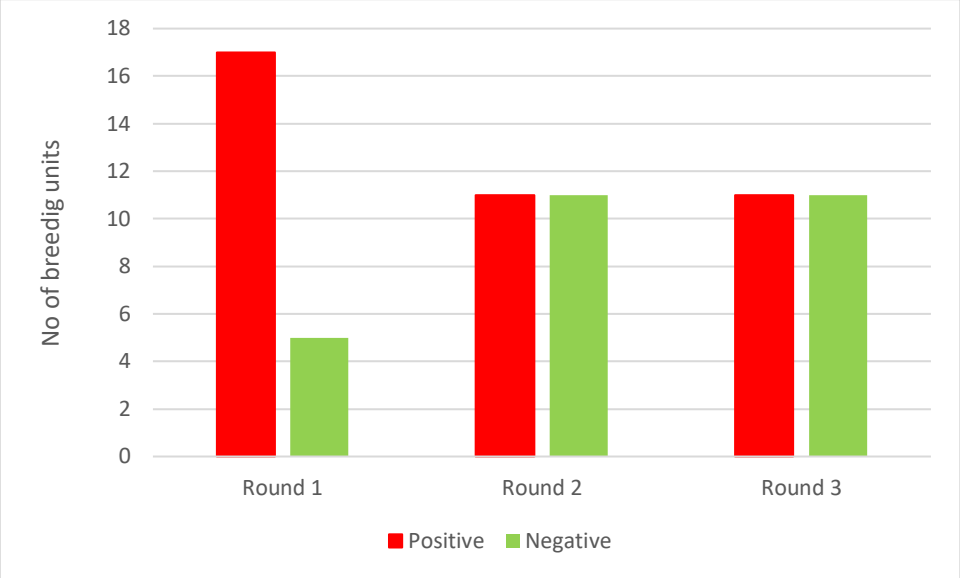

Figure 4: PRRS status of breeding units at three time points

Table III: Viral load in samples from breeding units taken at three time points

	Round 1	Round 2	Round 3
No. of positive samples	45.9	42.9	36.3
Ct score of samples	NA*	31.6	32.6

*Analysis in Round 1 did not report Ct values

3.10.1 Biosecurity results

The COMBAT results showed a large improvement in biosecurity scores between Round 1 and Round 2. This is tangible evidence of the success of the action plans. The action plans were developed and deployed to give most return for input i.e. simple actions that were either easy to implement or yielded most return for actions that were more difficult and required more effort. Between Round 2 and Round 3 there was a slight deterioration in both internal biosecurity and management of biosecurity while the improvements in external biosecurity were maintained **(Table IV).**

Table IV: Biosecurity scores from breeding units taken at three time points

	Round 1	Round 2	Round 3
Internal biosecurity	40.4	29.9	34.2
External biosecurity	49.4	39.7	39.3
Management	42.8	28.8	35.4

During the period between Round 2 and Round 3, producers were under severe and prolonged financial pressure and were continuing to experience staff shortages. Quantitative analysis of biosecurity via COMBAT highlights the outcomes of this prolonged pressure on a unit in terms of biosecurity. Retaining and increasing motivation to maintain changes in times of financial pressure can be difficult. However, it is reassuring to see that even with all the pressure producers were experiencing at this time biosecurity scores did not revert to pre-project levels and indeed decreased only slightly. It is envisaged that the veterinary input during the 2023 COMBAT assessments would refocus producers in relation to improving internal biosecurity and management. Indeed, the timing of the COMBATS, followed by individual communication regarding blood results, along with the final meeting, where scheme achievements were presented, did lead to renewed motivation by producers to ensure the project was successful. In addition, the pig market strengthened easing some of the financial pressures.

The COMBAT results illustrate how situational factors can influence behaviour driven by personal factors. In models of behavioural change, it is well recognised that personal factors i.e. motivation will lead to a change in behaviour. In this project the producers were motivated to change their management practice to improve biosecurity. However, behavioural theory states situational factors can overrule personal factors. This is exactly what happened between Round 2 and 3 COMBATs within this project i.e. financial pressures and work load surpassed the motivation to maintain good management practice.

Changes that had been made regarding external biosecurity were predominately physical changes or involved instructions to those coming onto the unit eg. instructions for drivers etc. These changes were carried out before the financial pressures occurred hence these changes remained in place. The internal and management changes are actions that have to be carried out routinely by personnel. Producers have to remain motivated to maintain this extra level of effort and input. A situation where there is no financial return for the business, combined with having an increasing workload is not conducive to maintaining behavioural change.

Communication with producers since the Pigs R US pig producers' conference combined with the final Operational Group meetings has been encouraging with regard to their motivation to

increasing PRRS control biosecurity. It is envisaged that this will be reflected in improvements in biosecurity on the units.

3.10.2 Performance

Physical performance parameters for both breeding herd output and carcass characteristics are presented in **Figure 5** and **Table V** respectively. Although data was not available for all units breeding herd performance data was available for eight units and carcass data for 17 units. It is accepted that comparison of the data is not definitive as this before and after comparison can be influenced by many factors unrelated to disease. However, this data is included as it provides a worthwhile benchmark indicating that performance overall was improving. The average number of pigs weaned per sow per year increased by 1.3 in the herds analysed whilst empty days was reduced by 0.4. The other interesting observation was that probe or back fat depth was reduced by 1mm while slaughter weight stayed relatively similar reducing by only approximately 2 kgs. Previous work has shown that there is an increase of approximately 1mm back fat with every 8-10kg increase in deadweight (Beattie et al, 1999). This reduction in backfat suggests that pigs were exploiting their lean deposition capacity which indicates improved health status (Connolly, 2022).

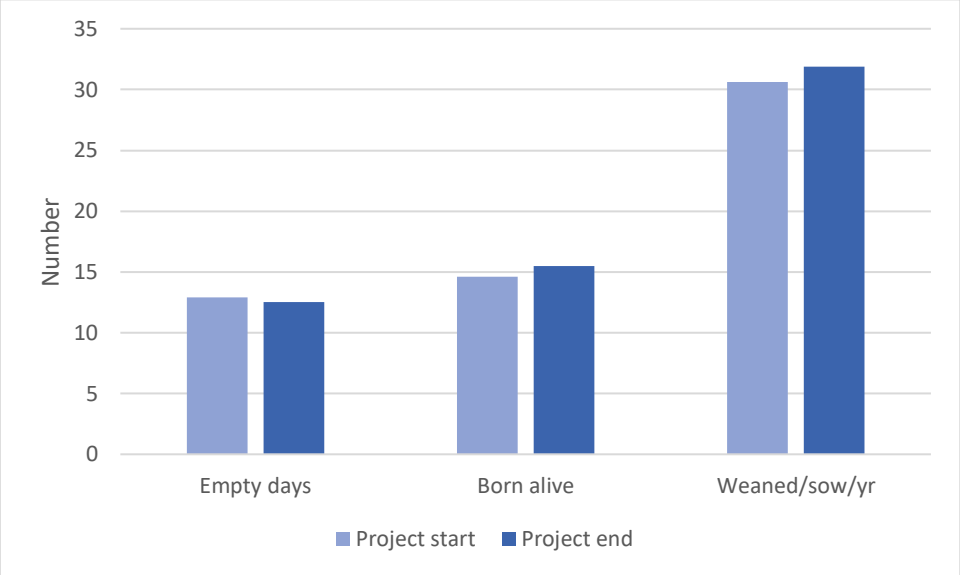

Figure 5: Comparison of breeding herd performance (8 farms) between start and end of project

Table V: Comparison of carcass weights and fat depth (probe) between start and end of project (17 farms)

Start of Project		End of project	
Carcass wt (kg)	Probe (mm)	Carcass wt (kg)	Probe (mm)
92.9	12.5	91.0	11.4

3.10.3 Health Mapping Program

The advantages of the “real time” Heath Mapping tool is that at any point administrators and vets could see the live heath status of any of the pig units in the catchment area and the geographical location of any units identified as having wild type virus. This allowed the vet to advise units at potential risk of infection, because of location, to ensure biosecurity protocols were sufficiently robust and strictly adhered to.

Figures 6 and 7 are screen shots of the Health Mapping Tool at the beginning and the end of the project. The circles around each specific farm indicate the area of risk for infection. The difference in the area of risk can be easily observed using this software.

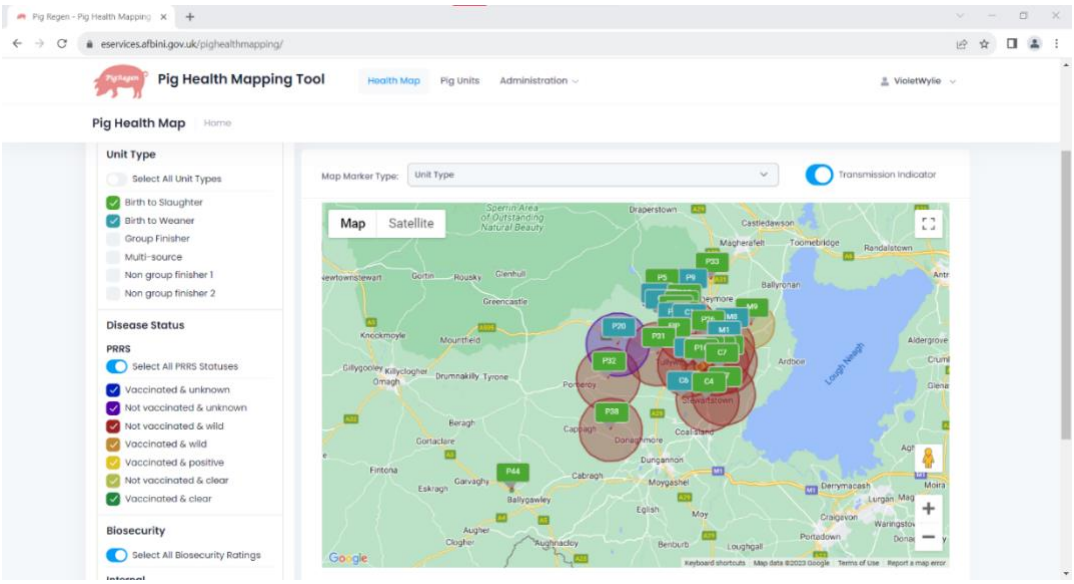

Figure 6: Screenshot of Pig Health Mapping Tool showing the disease status during Round 1

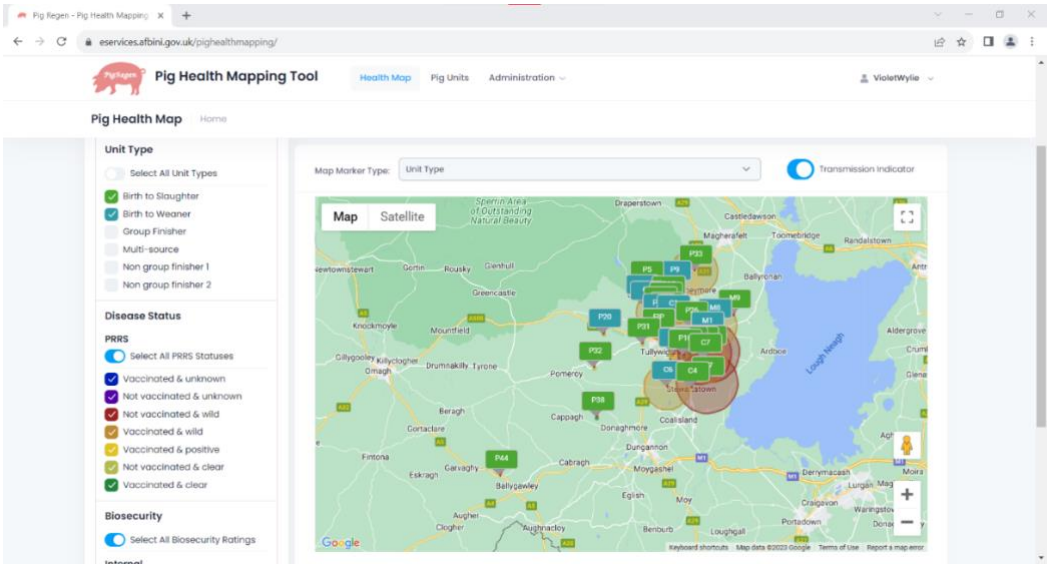

Figure 7: Screenshot of Pig Health Mapping Tool showing the disease status during Round 3

3.10.4 Welfare parameters

The issue with PRRS is not only the clinical impact of the virus itself, but the fact that the PRRS virus multiplies inside the macrophages in the lungs. Hence, instead of the macrophages destroying the virus they become the replication ground for PRRS. Up to 40% of macrophages can be destroyed and signalling to the immune system affected thus allowing bacteria and other viruses to proliferate and do damage especially in grow/finish units (Muirhead and Alexander, 1997).

Two conditions, pericarditis and pleurisy are very common in pigs and account for considerable loss through partial and total condemnation at slaughter. Both these conditions can be caused by bacterial and/or viral infections. The pericardium is a clear sac-like membrane that encloses the heart and Pericarditis adversely affects this protective layer. Pericarditis occurs as a result of infectious agents which cause respiratory diseases. These include Pasteurella, mycoplasma, haemophilus, actinobacillus, streptococci and salmonella bacteria along with viruses such as flu and PRRS. Pleurisy occurs when the shiny membranes that cover the surface of the lungs and the inside of the chest wall get infected and inflamed. Viruses such as flu, PRRS, swine fever and the bacteria *Actinobacillus pleuropneumoniae, Haemophilus parasuis* and *Pasteurella m*ultocidia can cause pleurisy. Both these conditions impact on the welfare of infected pigs.

The incidence of both Pericarditis and Pleurisy, recorded at slaughter, was reduced by the end of the project compared to when the project commenced (**Fig 8**). There was a 40% reduction in pericarditis and a 70% reduction in pleurisy.

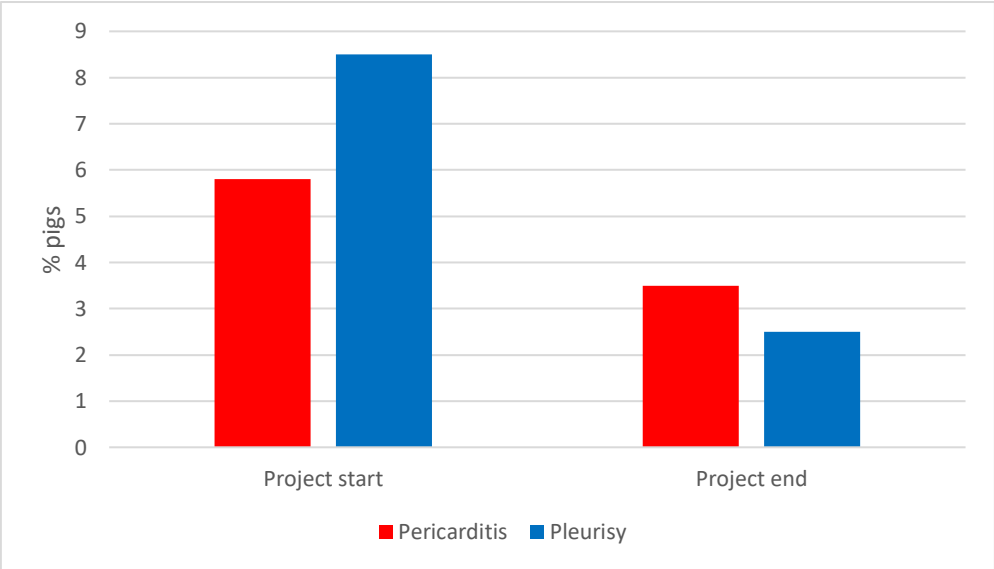

Figure 8: Incidence of pericarditis and pleurisy in slaughter pigs from breeding units at start and end of the project

Figures 9 and 10 show correlations between the number of pools of blood that were positive for PRRS virus and the two conditions observed in the factory i.e. pericarditis and pleurisy. The R value for these correlations indicate that there is a weak relationship between PRRS and pericarditis and a moderate relationship between PRRS and pleurisy. The R values suggest approximately 25% of the variance for pericarditis is explainable by the PRRS status and half the variance for pleurisy is related to the PRRS status.

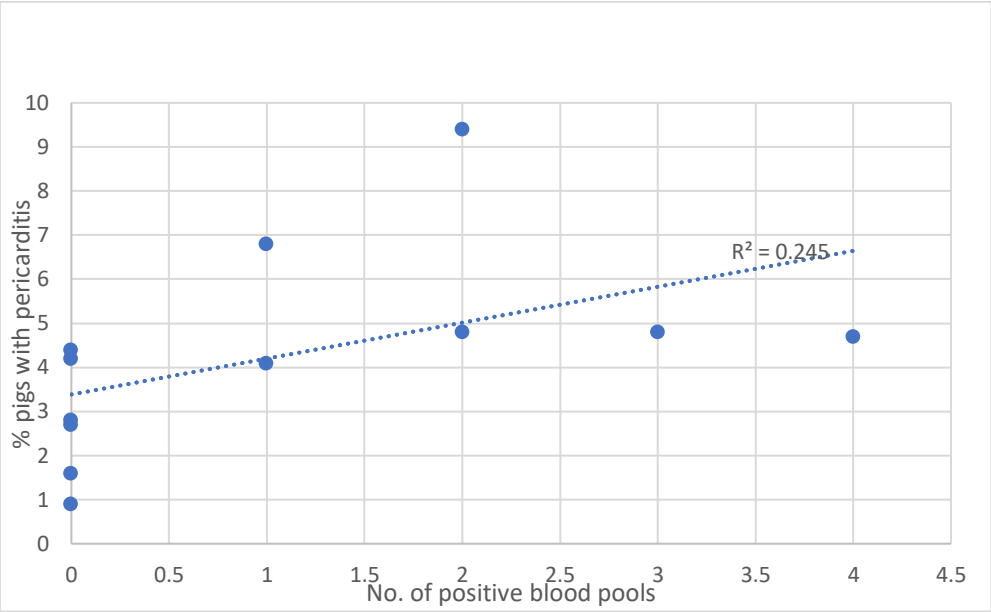

Figure 9: Correlation between incidence of pericarditis in slaughter pigs and number of positive blood pools

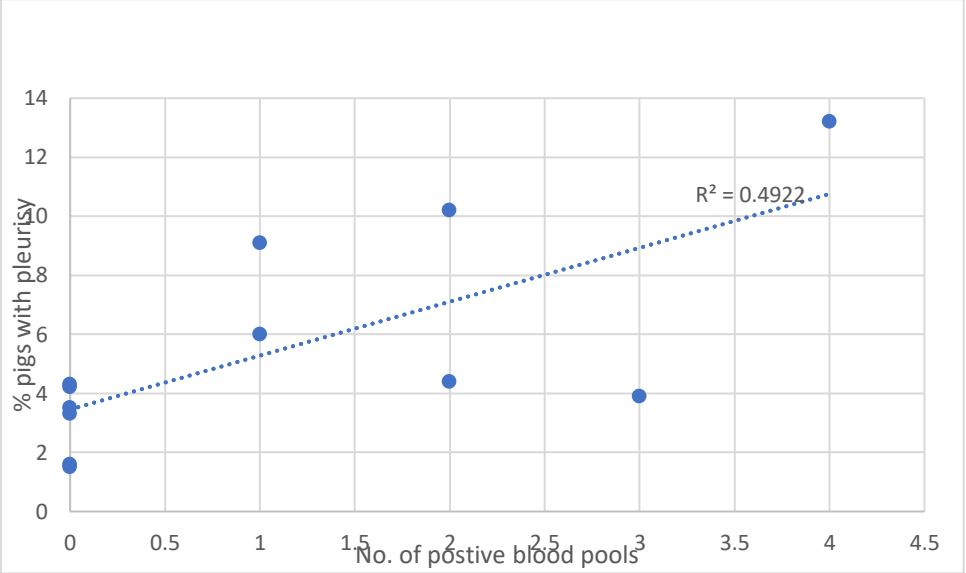

Figure 10: Correlation between incidence of pleurisy in slaughter pigs and number of positive blood pools.

These conditions have implications for the welfare of the pig, the profitability of production for the producer and the carcass quality for the processor. Welfare issues for the pig include lethargy and discomfort. For the producer pigs with these conditions grow slower leading to lighter carcasses or an increase in the number of days to slaughter. Moderate cases of pleurisy will reduce dead weight by 1.5-2kg at slaughter (AHDB 2023). The value of the carcass is reduced to both the producer and the processor as affected carcasses have to be trimmed to remove damaged tissue. Disposal costs are also increased for the abattoir and line speeds have to be reduced which leads to increased processing costs. Finally, the poorer growth rates aligned with these conditions necessitate greater feed requirement to grow the pigs to slaughter weight. This has a significantly negative effect on both ammonia emissions and the carbon footprint associated with the unit and the industry.

3.10.5 Flu A and Flu D

There are four types of influenza viruses: A, B, C, and D. Influenza A is widespread in pigs and vaccination can help to control the incidence of the disease. Influenza D is the only type of influenza virus that mainly affects cattle with frequent spillover to other species (Liu et al. (2020). Since the initial description of influenza D virus (IDV) in 2011, the virus has been found to circulate among cattle and swine populations worldwide.

Dr. Ken Lemon (AFBI) analysed nasal samples from 16 of the farms participating in the EIP project. Influenza A virus was identified on four of the farms, two of which had a high proportion of positive pigs **(Fig 11)**. Ct values for farm 6 **(Fig 12)** ranged between 26.7 and 36.2 and for farm 8 Ct values ranged between 29.1 and 33.8 **(Fig 12).**

However, the incidence of Flu D was higher across participating farms with 6 of the 16 farms being positive for Flu D **(Fig 11)**. Ct values on two of these farms, farms 9 and 14, averaged 24.5 and 28.4 respectively indicating high viral load **(Fig 13).** These two farms reported symptoms and poor performance **(Appendix C, Table 17).**

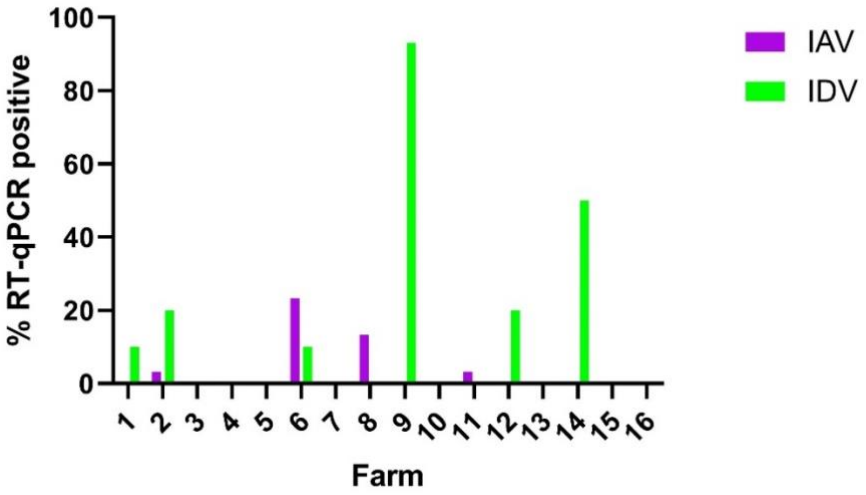

Figure 11: Percentage of samples positive for Flu A and Flu D on 16 farms

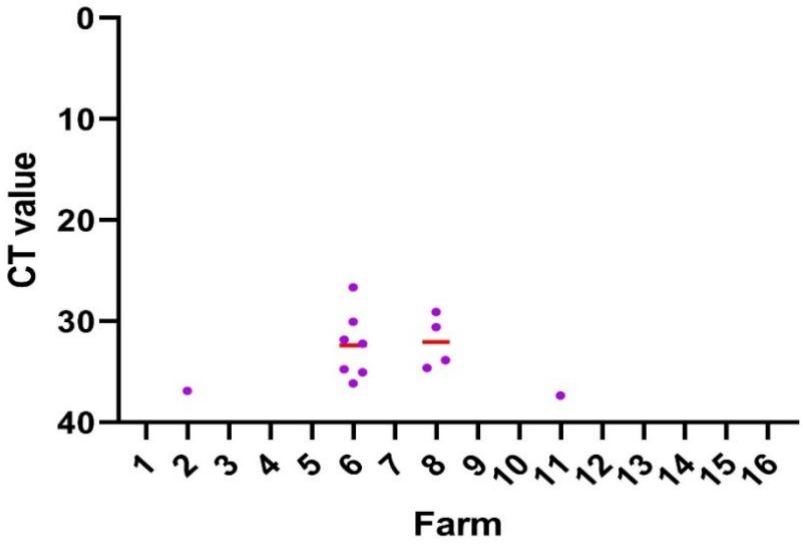

Figure 12: Ct values for Influenza A

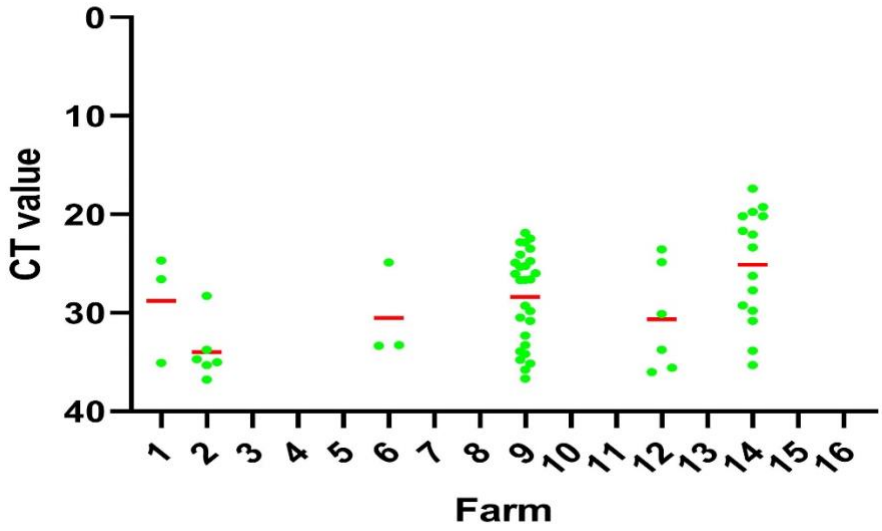

Figure 13: Ct values for Influenza D

3.10.6 Outcomes

A summary of the tangible outcomes associated with this project include:

Number of infected (positive) units reduced by greater than one third.

A conservative estimated financial return for the duration of the project is approximately £790K (**Appendix F).** If extrapolated to the sow herd in NI the annual return would be greater than £3.3M

Viral load decreased by 20%

Overall breeding performance improved

Carcass quality improved

Overall health and welfare of the pigs improved as measured by a 70% reduction in pleurisy and a 40% reduction in pericarditis.

Software developed for easy identification of risk of infection from neighbouring herds.

Flu D identified in NI pig herd - consequences of this not yet processed.

3.11 Links Formed

This project required many different disciplines and bodies to work together **(Figs 14 & 15).** Trust was fundamental to this approach. It was evident as the project progressed that trust increased amongst all stakeholders. This was because the Executive Management Group adhered strictly to the premise that only necessary information was shared. This increased the confidence of both producers and vets. In addition, to this, the information that was derived from the project was valuable to all concerned therefore everyone could see the value of their contribution and of co-operation at all levels.

As producers received results on a real-time basis, they began to realise the complexities of analysis. Through phone calls with the IB, they began to learn about retests and the number of different tests required to differentiate the disease status of their pigs. This created a greater appreciation for their veterinary input on farm and for the complexities regarding vaccine development and administration. In addition, producers began to realise the importance of biosecurity on their farm. Again, this improved the relationship between veterinarian and producer as the producer began to understand and appreciate the onus the vet placed on them.

One very obvious failure in communication was between the capital team in DAERA and pig producers. Office based personnel do not realise how electronically based communication is challenging on a pig farm. Emails cannot be read on phones in dim, humid, dusty environments. Pages do not scroll on phones when hands are dirty or gloves are worn! Some producers do not have access to laptops and printers and/or do not have the ability to operate them effectively. In addition, it is extremely onerous for a producer to leave his/her work on the pig unit to travel to the nearest town and visit a bank branch in person to obtain the required documentation to satisfy DAERA requirements. As time progressed through the project, the capital team in DAERA began to realise the issues. Unfortunately, the rules for the scheme were set and had to be adhered to and the required flexibility was not available within the scheme. It is hoped the awareness gained during this project will be useful to the DAERA capital team going forward.

One unexpected “bridge” that was built was between AFBI and the vets. Over the years, as resources have been cut and personnel changed, AFBI veterinary division has been by passed by commercial vets, in favour of European laboratories. During this project a tentative link has been developed between virology and the commercial vets through the dedicated work of Dr Ken Lemon and his team involving Flu D research. It is hoped that this new relationship can be built on to the benefit of producers, vets and the research community. Also, the link created with the IT department within AFBI is invaluable. Mark Browne and his team who developed the software program behind the Health Mapping Tool has an admirable

ability to grasp the complexities of disease and what that means in terms of the requirement of a program to help producers. The ability of the IT department within AFBI is an asset that requires greater exploitation by the agricultural industry in general.

Another welcome bridge is between the processors and Pig Regen. The processors collect levy funding for Pig Regen and in some cases are unaware of the benefit of Pig Regen to the industry. This project highlighted what Pig Regen can achieve at relatively little cost and how it can benefit the processor as well as the producer. Tangible evidence of this improved line of communication is the commitment of one processor to supporting this type of work in the future.

One of the most impressive outcomes in terms of strengthening linkages among stakeholders was the co-operation of the commercial vets. By the end of this project, the vets willingly shared disease information relating to their clients' herds for the good of the producers in the group. At the start of the project, the vets agreed to do the work for less than cost and made every effort to get work done within the timeframes required. The professionalism of the vets was evident throughout the project. In many aspects they worked for no financial gain but incurred costs in terms of personal time and resources. It must be remembered that these vets are answerable to the commercial organisations they belong to. They did extra sampling in their own time for the research work in Flu D and some of them are continuing to maintain the cooperation and enhanced biosecurity now that the project has ended. It is worthy of note that BI supported every producer whether they were purchasing BI vaccine or not.

This project identified what could be achieved by tapping into many individual "silos" within the pig industry. It was very obvious that individuals in different areas were unaware of what others were doing or how their work area could be beneficial to the pig industry. This project used many resources from different sources and brought stakeholders together who had never interacted before. Hopefully these linkages will remain and proliferate through additional cooperation to the benefit of the pig industry in Northern Ireland.

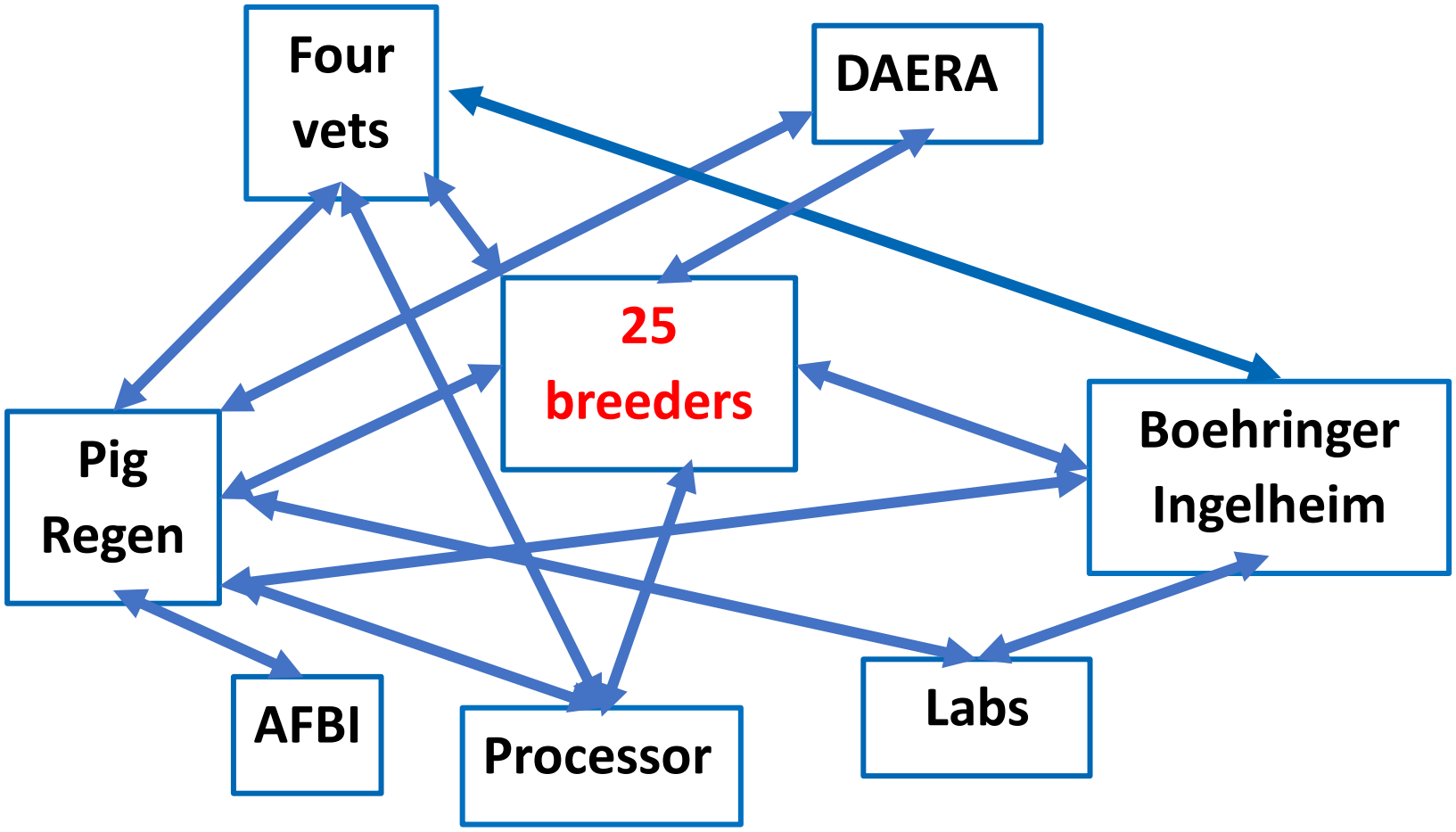

Figure 14: Schematic representation of the co-operation required to achieve the Area Regional Control of PRRS

Figure 15: Some of the Operational Group at their final meeting (including producers, vets, BI, DAERA).

3.12 Additional Benefits and Consequences

The lines of communication between different organisations created during this project has been and will be invaluable to the pig industry.

The ability of the group to facilitate the Flu D research in AFBI was unintended and has opened up possibilities of continued research.

The capability of the software program allows it to be used to map any disease in Northern Ireland.

The link with an international company (BI) provides knowledge of what and how other counties have achieved or failed when controlling PRRS. Hence, we can learn from other's experience.

3.13 Conclusions

Much more can be achieved when there is true co-operation.

Even a virus that mutates easily and frequently (PRRS) can be controlled in a pig dense area.

Biosecurity is key to the control of PRRS within and between units.

Producers can achieve behavioural change if they have some form of external management and they receive specific communication in a format that is convenient or them.

To achieve behavioural change there has to be a “filter” that can decipher what is important to each producer and apply it to the producer’s situation. Communicating generic information does not work.

3.14 Recommendations

A national scheme for the control of PRRS needs to be implemented within the Northern Ireland pig industry. All the information should be uploaded to the Health Mapping Tool and be available to all vets within the industry. This process should be actioned as soon as possible to harness the success and enthusiasm emanating from the current EIP pig project.

Ultimately an all-Ireland scheme needs to be developed if PRRS is to be eradicated in the long term.

To maintain behavioural change and ensure that **all** producers remain committed to a national scheme there needs to be an individual to manage the scheme who understands the needs and capabilities of producers. This is an essential requirement in conjunction with the buy in and co-operation of vets.

Research into the gene sequencing of circulating viruses that affect pigs needs to be supported.

Consideration needs to be given as to how any successful pilot initiated through the EIP programme can be continued long term.

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The EMG would like to extend their appreciation to Dr Lysan Eppink for her unwavering support, her time and her patience. Thanks goes to Boehringer Ingelheim for their assistance especially Mr Colin Henry (BI).

A special thank you is extended to the Pig Regen committee who have supported this work from the beginning and who gave of their time to attend meetings.

Although we may not have appreciated it at the time the EMG would like to express their gratitude to the EIP team. We would like to thank Norman, Russell and Nigel for holding us to milestones and deliverables especially regarding finance and of course to Katherine who stayed with us throughout the project.

APPENDICES

Appendix A

Table 1: Breakdown of Operational Group into PODS

POD 1	Vet P	8 producers
	Project leader	(Started with 9 producers)
	DAERA advisor	
	Innovation Broker	
POD 2	Vet P	7 producers
	Project leader	(Started with 9 producers)
	DAERA advisor	
	Innovation Broker	
POD 3	Vet C	6 producers
	Project leader	
	DAERA advisor	
	Innovation Broker	
POD 4	Vets M	5 producers
	Project leader	(started with 6 producers)
	DAERA advisor	
	Innovation Broker	

Table 2: List of Contract meetings

Date	Description
8.12.20	Admin meeting
7.01.21	Capital meeting
12.01.21	Contract meeting
23.01.21	Contract meeting
23.02.21	Contract meeting
25.03.21	Contract meeting
29.04.21	Contract meeting
8.06.21	Contract meeting
19.08.21	Contract meeting
27.09.21	Contract meeting
9.11.21	Contract meeting
13.12.21	Contract meeting
7.02.22	Contract meeting
7.03.22	Contract meeting
11.04.22	Contract meeting
11.05.22	Contract meeting
22.06.22	Contract meeting
20.07.22	Contract meeting
30.08.22	Contract meeting
3.10.22	Contract meeting
7.11.22	Contract meeting
7.12.22	Contract meeting
24.01.23	Contract meeting
1.03.23	Contract meeting
5.04.23	Contract meeting
10.05.23	Contract meeting
7.06.23	Contract meeting
19.07.23	Contract meeting

Table 3: List of Operational Group Meetings

Date	Description
25.01.21	Pod 1
27.01.21	Pod 4
2.02.21	Pod 2
4.02.21	Pod 3
7.03.21	Full group
20.05.21	Pod 1
27.05.21	Pod 3
3.06.21	Pod 4
10.06.21	Pod 2
30.03.22	Full group update with invited pig industry representatives
24.05.23	Full group final meeting with invited pig industry representatives

Table 4: List of Executive Management Meetings

Date	Description
27.11.20	Capital
8.12.20	Capital
20.01.21	Project
10.02.21	Veterinary advice
11.02.21	Software development
15.02.21	Project
18.02.21	Capital
5.03.21	Project
25.03.21	Project
20.05.21	Capital
14.06.21	Capital
27.07.21	Scheme Evaluation
11.08.21	Scheme Evaluation
18.08.21	Software development
11.11.21	Software development
23.11.21	Project
16.12.21	Software development
28.02.22	Project
27.02.22	Project
7.07.22	Feedback meeting
13.09.22	Project
3.10.22	Software development
13.10.22	Feedback
10.11.22	Project
11.01.23	Project
6.02.23	Project
25.02.23	Project
16.03.23	Project
29.03.23	Project
10.05.23	Project
18.05.23	Project
2.06.23	Project
22.06.23	Project
19.07.23	Project

Table 5: Information and training meetings with veterinarians

Date	Description
6.05.21	Information meeting
6.12.21	Information meeting
25.10.22	Software training meetings for three practices
8.11.22	Software training meeting for one practice

Table 6: Proposed capital items to improve biosecurity

Description	Estimated cost
Fridge of vaccines/meds	£1100
Slurry hoses for tankers with couplings	£150 for 1ft
Blow pipes for feed lorries with couplings	£160 for 8ft
Perimeter fencing/gates	£22/m chain link 6ft high
Cabin on perimeter of unit for deliveries	£1750
Medication trolley	£1500-£2500
Needleless vaccine gun	£3000-£4500
Detergent/disinfectant trolley	£1000-£1500
Misters/soakers	£1550
Stainless steel boot washer	£1095
Stainless steel whitewash applicator	£1390
Portable petrol power washer, 3000psi, 21l/min, hose and lance	£1100
PTO tractor driven power washer, 540 shaft, reel plus 100ft hose, 4ft lance	£1000
Electric 3 phase pump and motor for plumbed in washing system	£1500
Large diesel space heater 379,000BTU	£1400
Bird netting (approx. 1400m^2)	£1000

Table 7: Capital items applied for within project

Producer Code	Item	Cost	Supplier	Purchased	Claimed	Reason
P1	Whitewash applicator	£1167	Jetwash	Yes	Yes	
	PTO driven power washer	£1100	McCord Machinery	Yes	Yes	
P5	Petrol pressure washer	£1130	Booth	No		
P7	PTO driven power washer	£1100	McCord Machinery	Yes	Yes	

P8	3 phase pressure washer	£1180	Booth	Yes	Yes	
P10	Perimeter fencing	£4375	Greer	Yes	Yes	
P18	Diesel pressure washer	£1725	KDM	Yes	Yes	
	Space heater	£1350	KDM	Yes	Yes	
P20	Diesel pressure washer	£1725	KDM	Yes	Yes	
P26	3 phase pressure washer	£1180	Booth	Yes	No	Submitted claim but Dundonald House never received it
P32	Perimeter cabin for deliveries	£2400	KDM	No		Unable to get second quotation
P33	3 phase pressure washer	£1180	Booth	Yes	No	Submitted claim but Dundonald House never received it
P38	Whitewash applicator	£1167	Jetwash	Yes	Yes	
	PTO driven power washer	£1100	McCord Machinery	Yes	Yes	
P44	PTO driven power washer	£1250	Stinson	Yes	Yes	
	Slurry hoses	£1128	Rea Bros	Yes	Yes	
C1	Whitewash applicator	£1167	Jetwash	Yes	Yes	
	Perimeter fencing	£4075	Greer	Yes	Yes	
C3	3 phase pressure washer	£1180	Booth	Yes	Yes	
	Space heater	£1350	KDM	Yes	Yes	
C4	Whitewash applicator	£1167	Jetwash	Yes	Yes	
	Petrol pressure washer	£1130	Booth	Yes	Yes	

C6	3 phase pressure washer	£1180	Booth	Yes	Yes	
	Whitewash applicator	£1167	Jetwash	Yes	Yes	
C10	PTO driven power washer	£1100	McCord Machinery	Yes	Yes	
	Whitewash applicator	£1167	Jetwash	Yes	Yes	
M3	PTO driven power washer	£1100	McCord Machinery	Yes	Yes	
	Whitewash applicator	£1100	McCord Machinery	Yes	Yes	
M9	Space heater	£1350	KDM	Yes	Yes	

APPENDIX B

COMBAT

Combat Q and Q.pdf

Below example of an Action Plan

PRRS AREA REGIONAL CONTROL PROGRAMME

Producer P44: Action Plan

Action required in the next six months (July 2021 – December 2021)

Vaccine Status	**Mass vaccination**
Next vaccination	**1st week August**
Synchronised with rest of group	**1st week November**

COMBAT SCORE	**INTERNAL**	**EXTERNAL**	**LOCATION**	**MANAGEMENT**
	42	53	27	34

Disease status	PRRS positive unstable
PCR	Positive (2/6)
ELISA	Not tested
Next blood test	November

COMBAT	**Comprehensive Online Management Biosecurity Tool**
Risk status	AMBER
Internal	Questions 1-15
Q.5	Replacement gilts are in contact with PRRSV infected live animals before entry to the sow herd
Your Answer	Yes
Optimal answer	No
Action	Gilts brought away for growing and vaccination. Brought back in afterwards, no contact anymore.
Q.10	Boot and clothing restrictions on people moving between areas of production (e.g.breeding/gestation, farrowing, nursery)
Your Answer	Not required to change clothing or boots
Optimal answer	Employees are restricted to their area of production
Action	No movement of people between areas
Q 11.	Movement of employees between areas of production (e.g. breeding/gestation, farrowing, nursery)
Your Answer	Not restricted
Optimal answer	Not Applicable
Action	Employees stay in there area of work
Q.12	Movement of nurse sows between batches
Your Answer	Yes
Optimal answer	No

Action	No use of nurse sows
External	**Questions 1-20**
Q.6	Flow restrictions on vehicles used to transport animals to market or collection points
Your Answer	No restrictions, the same vehicle used to move PRRSV positive, negative or naive animals
Optimal Answer	Vehicles are dedicated to this site and are not used in other sites
Action	One road where lorry drives in and out – no moving about
Q.8	Disinfectant use on vehicles used to transport animals to market or collection points
Your Answer	No disinfectant used or unknown
Optimal Answer	Disinfectant used
Action	Vehicles come clean and disinfected.
Q.9	Drying time following wash of vehicles used to transport animals to market or collection points
Your Answer	No requirements to dry vehicle
Optimal answer	Assisted drying technology is used to dry washed vehicles
Action	Vehicles come dry
Management	Questions 1-13
Q.6	Handling of pigs at/after weaning
Your Answer	All pigs due to wean are weaned, but at weaning sized
Optimal answer	All pigs due to wean are weaned, but litters are kept together as far as possible
Action	
Q.10	Indirect transmission – Fomites, needles, utensils, equipment are shared between all age groups
Your Answer	Yes
Optimal answer	No
Action	Not anymore
Q. 12	Placement of gilts
Your Answer	Gilts are introduced directly into the sow herd
Optimal answer	Gilts are placed in a quarantine site and acclimatised before introduction to the sow herd
Action	Gilts are home bred and grow in quarantine site
Q. 13	Quarantine time for gilts (weeks)
Your Answer	0-4 weeks
Optimal answer	>12 weeks
Action	8-9 weeks.

Funded by DAERA and EU

APPENDIX C

Table 8: Status of breeding units at three time points

	Round 1	Round 2	Round 3
P1	POS WTV	Vacc Stable	Vacc NEG
P4	POS WTV	NEG	NT
P5	NEG	NEG	NEG
P7	POS WTV	POS WTV	Vacc NEG
P8	Vacc NEG	POS WTV	POS WTV
P10	POS WTV	Vacc NEG	Vacc NEG
P18	POS WTV	POS WTV	POS WTV
P20	NT	NEG	NT
P26	POS WTV	POS WTV	POS WTV
P31	POS WTV	NT	ABs
P32	POS WTV	POS unknown	Vacc NEG
P33	POS WTV	Vacc stable	POS WTV
P36	NEG	NT	NT
P38	POS WTV	NRG	POS WTV
P40	ABs	NT	NT
P42	NT	NEG	NT
P44	POS WTV	Vacc NEG	Vacc NEG
C1	POS WTV	POS WTV	POS WTV
C3	POS WTV	POS unknown	POS unknown
C4	POS WTV	NEG	NEG
C5	POS WTV	NT	NT
C6	NEG	NEG	POS WTV
C10	POS WTV	Vacc stable	Vacc NEG
M1	POS WTV	NEG	NEG
M3	POS WTV	POS WTV	POS unknown
M8	NT	Vacc stable	POS WTV
M9	POS WTV	Vacc stable	Vacc NEG
M10	Vacc NEG	POS WTV	POS WTV
M11	Vacc NEG	POS WTV	POS WTV

Table 9: No. of positive blood pools of breeding units at three time points

	Round 1	Round 2	Round 3
P1	1	0	0
P4	2	0	NT
P5	0	0	0
P7	3	5	0
P8	0	5	1
P10	2	0	0
P18	1	6	6
P20	NT	0	NT
P26	2	5	1
P31	6	NT	0
P32	4	0	0
P33	1	0	3
P36	0	NT	NT
P38	1	0	3
P40	0	NT	NT
P42	NT	0	NT
P44	2	0	0
C1	6	6	6
C3	2	1	2
C4	6	0	0
C5	1	NT	NT
C6	0	0	3
C10	4	0	0
M1	3	0	0
M3	1	3	1
M8	NT	0	2
M9	1	0	0
M10	0	6	5
M11	0	6	6
Average	**1.69**	**1.95**	**1.77**

Table 10: CT scores of breeding units at three time points

	Round 1	Round 2	Round 3
P1	NA	NEG	NEG
P4	NA	NEG	NT
P5	NA	NEG	NEG
P7	NA	30.8	NEG
P8	NA	28.7	30.6
P10	NA	NEG	NEG
P18	NA	32.2	28.2
P20	NA	NEG	NT
P26	NA	34.1	31.9
P31	NA	NT	NEG
P32	NA	NEG	NEG
P33	NA	NEG	34.0
P36	NA	NT	NT
P38	NA	NEG	34.0
P40	NA	NT	NT
P42	NA	NEG	NT
P44	NA	NEG	NEG
C1	NA	33.0	31.7
C3	NA	36.7	37.8
C4	NA	NEG	NEG
C5	NA	NT	NT
C6	NA	NEG	33.8
C10	NA	NEG	NEG
M1	NA	NEG	NEG
M3	NA	33.5	31.3
M8	NA	NEG	35.6
M9	NA	NEG	NEG
M10	NA	28.0	32.3
M11	NA	27.6	29.7
Average		**31.6**	**32.6**

Table 11: Internal biosecurity scores of units at three time points

	Round 1	Round 2	Round 3
P1	28	17	26
P5	47	22	25
P7	66	20	32
P8	37	47	30
P10	41	22	35
P18	36	10	24
P20	31	30	26
P26	39	42	29
P31	60		
P32	56	29	44
P33	34	39	38
P35	48		
P36	28		
P38	56	31	50
P42	47	20	
P43	38		
P44	42	42	43
C1	41	31	42
C3	35	48	45
C4	47	43	33
C6	22	26	37
C10	31	23	24
M1	47	33	29
M3	24		42
M8	34	30	29
M9	54	45	45
M10	35	19	30
M11	19	19	28
Average	**40.4**	**29.9**	**34.2**

Table 12: External biosecurity scores of units at three time points

	Round 1	Round 2	Round 3
P1	51	30	46
P5	30	32	21
P7	50	38	21
P8	45	44	43
P10	67	30	64
P18	41	43	27
P20	35	48	45
P26	50	43	46
P31	59		
P32	58	62	63
P33	55	28	43
P35	42		
P36	48		
P38	56	44	45
P42	44	27	
P43	37		
P44	53	60	63
C1	32	38	34
C3	59	38	26
C4	53	44	52
C6	63	55	36
C10	49	43	39
M1	29	25	20
M3	53		36
M8	49	26	26
M9	26	24	24
M10	64	46	42
M11	63	46	42
Average	**49.4**	**39.7**	**39.3**

Table 13: Management biosecurity scores of units at three time points

	Round 1	Round 2	Round 3
P1	31	15	51
P5	65	23	44
P7	51	23	41
P8	49	31	25
P10	68	16	56
P18	55	55	30
P20	47	62	54
P26	55	19	42
P31	63		
P32	63	50	64
P33	62	30	44
P35	48		
P36	43		
P38	14	37	22
P42	31	17	
P43	57		
P44	42	26	34
C1	20	24	19
C3	47	38	51
C4	35	26	33
C6	39	48	55
C10	25	27	31
M1	23	8	14
M3	40		20
M8	39	13	19
M9	48	8	21
M10	33	40	22
M11	33	40	22
Average	**42.8**	**28.8**	**35.4**

Table 14: Breeding herd performance in the 12 month period up to March 2021 compared to the 12 month period up to June 2022

	March 2021						June 2022					
	Farrowing rate %	Empty days	Born alive	Weaned	Litters/ sow/yr	Weaned/ sow/yr	Farrowing rate %	Empty days	Born alive	Weaned	Litters/ sow/yr	Weaned/ sow/yr
P1	88.5	11.9	14.7	13.4	2.37	31.9	86.2	16.6	15.5	13.9	2.29	31.8
P10	90.5	14.7	14.8	13.3	2.36	31.3	91.3	14.6	15.7	13.7	2.37	32.5
P38	93.0	17.0	15	13.2	2.38	31.4	90.0	17.0	16.0	13.8	2.31	31.8
C3	87.2	9.3	14.2	12.4	2.36	29.3	91.0	9.0	15.0	12.8	2.34	29.9
C6	87.2	14.2	13.3	11.5	2.32	26.6	86.9	13.5	15.1	12.7	2.33	29.6
C10	86.0	17.0	13.4	11.9	2.28	27.3	88.7	10.7	13.9	12.6	2.38	30.1
M1	93.8	6.5	16.5	15.0	2.44	36.7	95.0	6.4	17.1	15.4	2.46	37.9
Average	**89.5**	**12.9**	**14.6**	**13.0**	**2.4**	**30.6**	**89.9**	**12.5**	**15.5**	**13.6**	**2.4**	**31.9**

Table 15: Comparison of slaughter weight data for the periods Aug 20-Feb 21 and Aug 22- Feb 23

	Average Wt (kg)			Probe (mm)			Condemned	
P1	98.6	94.6		14.0	12.8		0	0.4
P5	94.4	88.3		13.7	13.4		0.0	1.1
P7	90.4	91.0		12.9	13.7		0.4	0.2
P8	86.7	83.1		12.0	13.2		0.5	0.5
P10	92.9	96.2		12.5	1.7		0.3	0.3
P26	92.2	85.9		11.8	11.7		1.0	1.0
P33	92.2	85.9		11.8	11.7		1.0	1.0
P38	95.1	92.2		12.2	10.8		0.6	1.4
P44	90.3	88.2		11.7	12.5		0.7	1.1
C1	98.7	94.8		12.4	11.7		0.6	0.9
C3	91.8	80.0		11.8	10.0		0.5	0.7
C6	99.7	96.5		13.4	11.8		0.3	0.4
C10	90.6	92.4		11.8	11.5		0.2	0.1
M1	93.3	102.2		12.8	13.7		0.9	0.0
M8	89.5	87.1		11.9	9.6		0.2	0.6
M9	92.8	96.2		11.9	11.7		0.4	0.3
M11	89.9	91.9		13.2	12.3		1.4	0.7
Average	**92.9**	**91.0**		**12.5**	**11.4**		**0.5**	**0.6**

Table 16: Raw data for welfare parameters

			2021				2023	
Code	**Month**	**No. of pigs**	**Pericarditis**	**Pleurisy**	**Month**	**No. of pigs**	**Pericarditis**	**Pleurisy**
	Jan 21	1337	51	173	Jan 23	1405	40	20
P1	Feb 21	705	38	74	Feb 23	565	15	26
	Mar 21	1260	46	53	Mar 23	1378	38	63
		3302	135	300		3348	93	109
			4.1%	9.1%			2.8%	3.3%
	Jan 21	771	40	77	Jan 23	110	7	3
C1	Feb 21	87	9	7	Feb 23	175	6	2
	Mar 21	138	20	27	Mar 23	433	9	12
		996	69	111		718	22	17
			6.9%	11.1%			3.1%	2.4%
	Jan 21	1394	29	131	Jan 23	470	24	5
P10	Feb 21	1641	133	195	Feb 23	1368	52	38
	Mar 21	2076	82	195	Mar 23	717	37	67
		5111	244	521		2555	113	110
			4.8%	10.2%			4.4%	4.3%
	Jan 21	239	9	8	Jan 23			
C3	Feb 21	158	17	9	Feb 23			
	Mar 21	213	18	4	Mar 23			
		610	44	21				
			7.2%	3.4%				
	Jan 21				Jan 23			
P5	Feb 21	43	7	8	Feb 23	12	1	0
	Mar 21	66	6	2	Mar 23			
		109	13	10		12	1	0
			11.9%	9.2%			8.3	0%

			2021				2023	
Code	**Month**	**No. of pigs**	**Pericarditis**	**Pleurisy**	**Month**	**No. of pigs**	**Pericarditis**	**Pleurisy**
	Jan 21	1281	78	84	Jan 23	1549	62	31
M9	Feb 21	1196	74	48	Feb 23	866	37	7
	Mar 21	1485	118	106	Mar 23	829	38	12
		3962	270	238		3244	137	50
			6.8%	6.0%			4.2%	1.5%
	Jan 21	680	23	98	Jan 23	1073	59	66
M11	Feb 21	651	35	81	Feb 23	544	19	20
	Mar 21	700	54	95	Mar 23	677	7	10
		2031	112	274		2294	78	88
			5.5%	13.5%			3.4%	3.8%
	Jan 21				Jan 23	307	11	3
P38	Feb 21				Feb 23	48	3	2
	Mar 21	151	20	12	Mar 23	242	17	4
		151	20	12		597	31	9
			13.2%	8.0%			5.2%	1.5%
	Jan 21	210	20	39	Jan 23	224	12	0
P26/P33	Feb 21	72	12	9	Feb 23	86	6	0
	Mar 21	512	25	73	Mar 23	85	8	8
		794	57	121		395	26	8
			7.2%	15.2%			6.6%	2.0%
	Jan 21	406	6	30	Jan 23	759	19	8
M8	Feb 21	373	16	14	Feb 23	402	13	0
	Mar 21	430	6	36	Mar 23	202	6	2
		1209	28	80		1363	38	10
			2.3%	6.6%			2.8%	0.7%

			2021				2023	
Code	**Month**	**No. of pigs**	**Pericarditis**	**Pleurisy**	**Month**	**No. of pigs**	**Pericarditis**	**Pleurisy**
	Jan 21	33	2	7	Jan 23			
P31	Feb 21	40	2	5	Feb 23			
	Mar 21	87	4	17	Mar 23	16	1	0
		160	8	29		16	1	0
			5.0%	18..1%			6%	0%
	Jan 21	103	6	6	Jan 23	104	3	1
P7	Feb 21	182	11	3	Feb 23			
	Mar 21	234	8	11	Mar 23	78	2	2
		519	25	20		182	5	3
			4.8%	3.8%			2.7%	1.6%
	Jan 21	1517	129	35	Jan 23	1359	69	6
C6	Feb 21	1368	119	17	Feb 23	301	20	5
	Mar 21	1111	66	10	Mar 23	1276	53	8
		3996	314	62		2936	142	19
			7.9%	1.6%			4.8%	0.6%
	Jan 21	400	20	43	Jan 23	253	2	11
C10	Feb 21	245	15	48	Feb 23	121	2	13
	Mar 21	440	16	52	Mar 23	293	7	4
		1085	51	143		667	11	28
			4.7%	13.2%			1.6%	4.2%
	Jan 21				Jan 23	25	0	4
P44	Feb 21	51	5	6	Feb 23	101	0	3
	Mar 21	108	10	1	Mar 23	103	2	1
		159	15	7		229	2	8
			9.4%	4.4%			0.9%	3.5%
C3, P5 and P31 excluded because of low numbers in one period								

Table 17: PRRS and Flu D

Farm code	Flu D	Flu A	PRRS*	Symptoms	Proximity of cattle	Vaccination
P44	+ve	-ve	-ve	None	Cattle graze beside unit and one worker works on cattle farm	Doesn't vaccinate piglets for flu
P1	+ve	-ve	-ve	None	Cattle graze beside unit and one worker works on cattle farm	Vaccinates piglets with FLUpan
P26	+ve	+ve	+ve field virus	Mortality and slow growth	Keeps cattle	?
P7	+ve	-ve	-ve	None	Keeps cattle	Vaccinates piglets with FLUpan
C1	+ve	-ve	+ve field strain	Mortality and slow growth	Keeps cattle	Vaccinates piglets with FLUpan
M8	+ve	-ve	+ve field strain	Mortality and slow growth	Keeps cattle	Wasn't vaccinating piglets for flu but has started since testing

* PRRS is recorded as negative if field strain of PRRS has not been found – some do have vaccine strain if piglets are being vaccinated with MLV, these are recorded in this table as negative.

Appendix D

Table 18: Publicity

Date	Description
8 December 2021	Update meeting with Regen
30 March 2022	Update with invited pig industry representatives
30.05.22	Update to Mark Hawe's Business Development Group
30.05.22	Update to Liz Donnelly's Business Development Group
September 2022	Circular to all pig producers in NI
September 2022	GrowIN Monthly web based update
September 2022	Submission to NIVA
September 2022	Submission to AVSPNI
6 December 2022	Update to Mark Hawe's Business Development Group
8 December 2022	Update to Liz Donnelly's Business Development Group
15.03.23	PigsRUs
23.03.23	Pig Veterinary Society
24.05.23	Final meeting with invited pig industry representatives
June 2023	Submission for National Pig Award
June 2023	i2Connect
August 2023	Update to all pig producers (Regen)
Autumn 2023	Shortlisted for National Pig Award
Autumn 2023	National press coverage of those shortlisted for National Pig Award
20 November 2023	National Pig Award Ceremony

Appendix E

Partnership agreement signed by each member of the Operational Group

Partnership Agreement

This partnership agreement applies to:

1. **Group name:** Area Regional Control Group

2. **Scope of group:** The aim of the group is to reduce the level of PRRS virus and associated secondary infections on pig farms within an approximate 5 mile radius of Cookstown. This group will work together on biosecurity, management and vaccination policy to reduce the viral load on pig units. This agreement covers the period 1st November 2020 to 30th September 2023.

3. **Members**

Name	Address

4. **Membership role and responsibility:** Each member will allow their own veterinary surgeon to visit their pig farm; this will involve blood testing and biosecurity questionnaires. Each member will be responsible for the implementation of biosecurity measures, management and vaccination policy as recommended by their vet. Each member will permit the results of biosecurity assessments and blood test results from their unit to be shared within the group. Each member will be responsible for the maintenance of any capital items purchased under the capital grant scheme, associated with this initiative, for a period of 5 years.

5. **Governance:** This initiative will be managed by an Executive Management Group consisting of the Project Leader, four producers representing all producers in the Operational Group and an Operations Manager. All members' details will be held within the group and will not be used for any other purposes except what is necessary to complete the initiative.

6. **Joining or leaving the Group:** Criteria for joining the group will be to operate a sow breeding unit within the geographical area around Cookstown or to operate a sow breeding unit which supplies pigs to a finishing unit within the previously defined area. Members within the group shall remain within the group unless they no longer keep sows. If a unit changes ownership the new owner will be requested to take the place of the original owner as a member of the initiative. No member can leave the group if they are subject to an audit or investigation in relation to the group.

7. **Financial arrangements:** The project will be funded by Regen until the grant is received from the European Innovation Partnership. Expenditure will be authorised by the Executive Management Group and banking and accounting will be carried out through Pig Regen. Members of the Operational Group will have full transparency of all financial dealings within the project on request and details of all financial dealings will be shared with the Operational Group at annual meetings. All blood testing, biosecurity questionnaires and necessary mentoring on members' pig units relating to this scheme will be paid directly by PigRegen hence no reimbursement to Operational Group members is required.

8. **Outputs:** Each member of the Operational Group will have full knowledge of all results via quarterly meetings. There will be no Intellectual Property.

9. **Findings:** The findings of the Operational Group will be shared with all producers across NI.

10. **Contract Management:** The contract will be managed by the Project Leader who is a member of Pig Regen. Therefore, the Project Leader will be replaced by Pig Regen if for any reason he cannot complete the project.

11. **Resolution of Disputes:** Disputes will be resolved by the Executive Management Group.

Appendix F

Financial estimate of return on investment in the project

Six units (approximately one third of positive units at start of project) successfully moved from a positive PRRS status to a negative status due to participation in this project.

Cost of PRRS on a unit is between 35 and 37% of net margin (Borobia, 2016).

Calculation

Six successful units had among them 3600 sows

Using performance of 29.7 sold/sow/year[1] = 106,920 pigs/year

Project duration 2.5 yrs = 267,300 pigs

Margin in year 1 & 2 = £0/pig

Margin last 6 months ≈ £40/pig

Average margin over period = £8/pig

37% of margin (benefit of negative status) = £2.96

267,300 pigs x £2.96 margin = £791,208

Return on funding: £791,208/£110,605 = **7.2:1**

Extrapolating project outcome to NI sow herd

Approx 47,000 sows in NI

One third of herd improved PRRS status[2] = 15,510 sows

Using NI average of 26.7 pigs sold/sow/year = 414,117 pigs/year

Average margin £8/pig (based on period of project)

Return in 12 month period = 414,117 pigs x £8 margin = £3,312,936

[1] Based on 31.9 weaned /sow/yr, for producers that recorded within the group, with 7% post wean mortality (Table 14)

[2] One third based on success rate within project