

EXTERNAL REVIEW BREED4FOOD II

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Professor Graham Plastow

Dr Anna Campbell

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RECOMMENDATIONS

This review is based primarily on a series of interviews with key partners and stakeholders together with a review of Breed4Food documentation including the proposal for Breed4Food III. We were asked to identify main steps that could be implemented to further improve the scientific quality and impact (business and society) of Breed4Food in the next 5 years.

We found the program to be world-leading, particularly in terms of developing and implementing genomics (and associated technologies) to optimize genetic selection programs.

Our recommendations for improvement are based around three areas of challenge identified by the review, these relate to areas of shared culture, improving processes and addressing societal impact and social license.

These are summarized here with specific recommendations and detailed examples of options provided within the report.

1. Although Breed4Food is very successful in generating and adopting new tools as well as training and recruiting “High Quality Personnel” into the subject area (at WUR and in industry), there is an opportunity to create a more inclusive “shared culture” to support greater efficiency and effectiveness of the work undertaken.
This should be based around greater interaction within project teams and a formal training program that goes beyond technical skills to create leaders who can deliver “next-generation” businesses through multi-disciplinary and multi-cultural teams.
2. Weaknesses in project selection, management and leadership were identified that result in inefficiencies and the potential for frustration across the program. Formal processes should be established and documented and embedded within formal performance evaluation across Breed4Food and aligned with organizational procedures.
3. There are huge challenges facing livestock agriculture in the next 20 or 30 years. These are widely recognized and differ across individual countries, as well as the developed and developing world. These are therefore very complex issues that require approaches well beyond animal breeding and genetics in order to provide the desired societal impact. Although this need is identified within Breed4Food III, based on this review it is not deemed to go far enough to address the future challenges and create future businesses able to lead across this new terrain.

INTRODUCTION

Over the past 9 years the Netherlands Government and private companies have co-invested to create a world class capability in animal breeding and associated technologies, in order to progress performance and sustainability in livestock production. The culmination of this investment is Breed4Food which is soon to enter its third phase.

BREED4FOOD

Breed4Food is a consortium established by Wageningen University & Research and four international animal breeding companies:

- CRV (cattle);
- Hendrix Genetics (layers, turkeys, pigs, aquaculture and traditional poultry);
- Topigs Norsvin (pigs); and
- Cobb (broilers).

Breed4Food receives financial support from the Topsector Agri&Food and NWO.

The mission of the consortium Breed4Food is to develop novel genetics and genomics tools through innovative science, beneficial to the breeding, production and consumption of animal proteins with a strong commitment to responsible stewardship of animal resources.

TERMS OF REFERENCE FOR REVIEW

Focal Question

What are the main steps to take for the consortium Breed4Food to further improve the scientific quality and impact (business and society) of the joint research in the next 5 years?

PURPOSE

The external review contributes to answering the focal question by providing recommendations for improving the scientific quality and impact (business and society) of the joint research of the consortium Breed4Food. More specifically, the board requests the external reviewers to rate and give recommendations on the following aspects:

- The scientific relevance of the performed research;
- The business relevance (in terms of R&D) of the research;
- The societal relevance of the research;
- The overall functioning of the Breed4Food consortium.

The reviewers are also requested to give any other recommendations that will contribute to the focal question of the evaluation of Breed4Food II (2017-2020).

CONDUCT OF REVIEW

The external reviewers had online interviews with the following groups:

1. The program team (Roel Veerkamp, Mario Calus, Yvette de Haas) of the PPP Breed4Food II (and NWO-STW Breed4Food), 24th February.
2. The representatives of the industrial partners (Cobb, CRV, Hendrix Genetics, Topigs Norsvin) in the Working Group, 2nd March.
3. The funding agencies (TKI Agri&Food, Kees de Gooijer; and NWO, Lisette Krul) of the PPP Breed4Food II and III and NWO-TTW Breed4Food, 3rd March.
4. A group of Ph.D.s and other early-career researchers that participate in the project teams of both the themes 'Utilizing DNA information' and 'Precision Phenotyping,' 5th March.
5. The director Animal Sciences Group WUR (Jeroen Dijkman), 9th March.

In addition, summaries of interviews by the Manager of Breed4Food (Han Swinkels) with the Dutch Society for the Protection of Animals, the Ministry of Agriculture, Nature and Food quality, LTO Nederland (Dutch Farmers Organisation) and 'Vereniging Diervoederonderzoek Nederland (Dutch Society for Animal Feed Research)' were provided.

MAJOR FINDINGS AGAINST THE TERMS OF REFERENCE

World-leading program

Breed4Food is a world leading initiative in the area of livestock breeding, an initiative which has delivered a number of successful outcomes, both commercial and scientific.

There are few livestock programs internationally, which can boast successful collaboration of four commercial companies with a world-class university. The impact this has made on the livestock industry in the Netherlands, and internationally is tangible:

- The companies involved in Breed4Food have wide international reach - due to the nature of genetic improvement of livestock, improved genetics can be disseminated and scaled quickly around the world, creating considerable impact;

- The program has produced a good number of peer-reviewed scientific publications, lifting the international knowledge base around discovery and implementation of animal breeding scientific research;
 - Across these projects, 63 peer reviewed papers have been published, 86 conference contributions have been presented and 5 PhD theses have been successfully defended, while another 4 PhD students are ongoing.

The Breed4Food program has operated with a mindset of continuous improvement. This is evident in the changes to the structure of the program to incorporate industry needs in terms of the discovery pipeline. Specifically, the implementation of the “flexible zone” for the phenotyping program allows for companies to invest where they see the greatest return on their investment and it seeks to 'facilitate' cooperation between the involved Breed4Food partners and third parties (i.e. technical universities and other companies - high tech and in livestock production chain). This is working well so far, although there are some aspects still to be resolved regards intellectual property related matters and interests from non-investing parties once projects/products are realized i.e., how to integrate non-investing companies should they have interests in re-entering project/s.

A real strength of the program is the interactivity across the organisations at multiple levels, but particularly for students and early-career researchers who clearly value the collaboration. Given that 75% of graduates transition into commercial entities, this cross-pollination of ideas, thinking and implementation is vital.

“The work of the companies are more ‘goal-oriented’ whereas the academia are more hypothesis-driven. The orientation on goals has helped [researcher] to be more effective in his work as a scientist.”

Michael Aldridge, early-career researcher, WUR-ABG

Interview summaries

SUMMARY OF STRENGTHS FROM INTERVIEWS

- Breed4Food collaboration allows companies good access to talent and allows young talent to see a commercial path outside of academia;
 - Talent paths could be enhanced with more visits/secondments etc;
- Genomics work is closer to application so easy to make fast progress via successful implementation;
- Company cross collaboration and connectivity is very important;

- Covid has impacted this so important to redress and maintain;
- Unique situation internationally for four companies to be able to work with one university in one industry program; in other parts of the world, one company is often forced to work with multiple research providers (within collaborative science bid programs) which is challenging for commercial success;
- Success of pre-competitive innovation is recognized;
- Diverse consortium – different species, science and business;
- Strong network;
- Good success rate in follow-up of jobs: 75 % of the graduates work at WUR or one of the industrial partners;
 - Came also at a time (2012) when there was little public interest in breeding and genomics research - Breed4Food is recognized as a flagship for PPP in NL; this includes the strong cooperation of WU and former DLO within WUR-ABG;
- Large scientific output plus tools for companies which they did not previously have access to.

SUMMARY OF WEAKNESSES FROM INTERVIEWS

- Lack of alignment as to priorities, especially with longer term projects – not always equal interest across companies plus hard to manage timelines/expectations;
 - Flexible zone created to remedy this: however, could a better pre-project phase result in even stronger cooperation and better opportunities?;
- Less experienced project leaders had more challenges integrating/understanding commercial/company drivers;
 - Need to look to remedy with more company shared leadership;
- Past collaboration with Feed4Food not a success, yet may be worth exploring given challenges re future use of human-edible feedstuffs;
- Program hierarchy can slow down/impede communication;
- The companies often have international offices/ownership that want greater involvement – time zone challenges in this;
- Poor affiliation with social sciences which will need addressing as the program moves into complex issues around protein, society, climate change and new technologies, such as gene editing;
- Seeming lack of awareness of previous efforts to link to societal questions;
- Communication can be one-directional academic to commercial, not enough the other way.

GENERAL INTERVIEW COMMENTS

- More consideration needs to be given to training in non-scientific areas of project management, leadership and soft skills;
- Societal challenges as relevant to commercial companies as academia and discussion re social license should be happening at both levels;
- Has Breed4Food been passive/reactive regards societal challenges? How can they be more proactive?
- Is there suitable weighting on societal issues in the program?
- Greater creativity needed to incorporate more multi-disciplinary thinking;
- Involvement of societal panels for feedback would be useful;
- Scientists not always best people to consult and communicate around these issues – thinking around multi-sector groups;
- Explore greater co-operation across borders;
- Map where hot areas are – e.g., postdocs can have secondments to learn new technologies;
- Work with funding agencies to create new support for these activity gaps;
- Companies understand the need to move to more society/environmental traits, but the main drivers are still production and efficiency, is there sufficient strategic thinking?
- The general public are not aware of a lot of the good work that is being done in terms of balanced trait selection which could be a start point for a wider dialogue;
- Opportunities for greater international reach;
- Opportunities for animal breeding tools to be applied to insect breeding (for future food);
- Opportunities for tailored products – personalized food, small scale manufacturing – extend collaboration with e.g., microbial sciences.

SPECIFIC RECOMMENDATIONS

Breed4Food is a world-class program, and always when leading, seeking further improvement is vital to maintain relevance and a leadership position. The opportunities for improvement which we have identified, fall into three main areas:

1. Strengthening a shared culture across the partnership.
2. Improving processes.
3. Societal impact and social license.

Some of the recommendations identified, have the potential to address more than one of the three areas for improvement (Shared Culture, Improved Processes, and Societal Impact and social license). All recommendations are provided as examples to stimulate Breed4Food adapted solutions.

Challenge 1. Shared culture

A shared culture within Breed4Food has been created already and we believe this can be enhanced. We recognize the challenges in doing this, multiple organizations with differing drivers, project leaders with many pulls on their time and a societal environment which is less supportive of livestock production than it has been in the past. For these reasons, greater effort and energy needs to be placed into creating a shared culture than that required to do this within a single entity.

1a. Integrated training/leadership program

Generally, there is good technical training provided within the Breed4Food program, but there is less emphasis placed on incorporating the skills and training which go beyond technical skills, such as leadership, conflict management and project management which are needed for success in any organization.

There are different designs for this type of training program. We believe a program of multiple (e.g., 4) one-week, residential modules over 12 months with high quality external delivery would provide the opportunity for peer-networks to be created across the companies and WUR and would be of great value to individuals within the program as well as the partners.

The industry partners could also consider it for their top junior executives and not just the “genetics team”. The syllabus could include training in commercial management, such as processes that aim to improve the pipeline from ideation to application (see below under Improved Processes), especially given the majority of scientific graduates have little formal commercial/business training.

Business schools (e.g. INSEAD) may be able to provide a tailored program based on their work with multi-national companies to deliver multi-disciplinary and multi-cultural team building and training for the “leadership challenge”.

1b. Provide formal secondment opportunities

Many of the existing staff/student swaps - time spent outside of their main organization - are organized on a relatively informal basis. In some cases, young researchers were able to formally spend one day per week in their associated commercial organization which they

said contributed greatly to their understanding of that organization's culture and drivers and their project outcomes.

We would like to see more frequent and more formal secondment opportunities created for all involved (not just early-career researchers). These secondments could also be outside of the five core organizations and could be international – e.g., to learn specific skills in an internationally leading organization.

Ideally, secondments would be for a period of months and would be reciprocal, with secondments provided to move between academic and commercial environments and vice versa (as well as between parties and across borders). WUR-ABG has participated successfully in this type of scheme for trainees (can it be expanded with industry?).

Ideally, secondments would be within project frameworks (see below #2) that are supported by training programs (see 1a and it should include company staff in training held by WUR).

1c. Increase Woven Threads

Breed4Food should also consider developing opportunities to promote greater informal interactions (woven threads) across its structures and across outside organizations to stimulate problem solving, cross-disciplinary collaboration and the development of new directions (see also #2&3).

This may also help Breed4Food to explore new areas where interests may not be completely aligned across all partners. The "flexible component" of the consortium has been introduced to help address this aspect but it seems to treat the symptom rather than the cause. Improved planning prior to project selection (Challenge 2) may help address this and create a stronger program.

The Consortium Manager should proactively seek ways to stimulate interactions across Breed4Food, from organizing travel groups to meetings to arranging "dinner meetings" for all participants across Breed4Food with invited (external) speakers.

In addition to this, more cross-campus inputs into student supervisory and exam committees should be considered to widen networks and increase awareness of developments in other fields.

Challenge 2. Improving processes.

2a. Develop new processes around project selection and management that formalize and direct proposals to prepare for success.

There are differences in how project leaders are selected and how projects are managed. This is to be expected given different personal management styles, but processes can be optimized with a more formal management process (which links to training, see Challenge #1). Consistency is important in such a significant collaboration and particularly for integrating two-way communication between commercial and academic needs and the bridge into discovery and application/implementation.

One option would be to use a “contract” format (project management style) that identifies responsibilities beyond the research phase.

A simple template (no more than 2 pages and preferably 1 page) can set out the key elements of a project or initiative and most importantly who the key “sponsors” of the project are.

Different formats may be included where appropriate e.g., GANTT charts with the format best created (and refined) specifically for the program and links to budgets and timesheets (if used). A good project management, off-the-shelf software program, may be suitably incorporated.

The appointment of project co-leads may help address the weakness identified as one-directional communication or participation in projects. However, this should consider the entire pipeline from research to application. Involvement of “sponsors” responsible for application from the beginning of project creation can help drive research and development by keeping a focus on how results can be adopted. These individuals may be selected from project leads, however, the key is connecting the research and the application elements and creating active ownership of both performance and the outcomes. Project development begins with this in mind, so as to generate broad inputs at the beginning of a consortium project and so that the “receivers” of the outputs and their roles are identified. They are the “pull” to improve both efficiency and success in terms of impact (academic, commercial or societal). Such an approach can improve communication and team-working as well as reinforce a more strategic approach to project selection.

Such a framework can also support secondment and networking (see Shared Culture) as well as create opportunities for project members to take on “non-research” roles to develop

broader competences. The aim would be to improve team focus (across the partners involved in a project) and reduce time to implementation for successful research.

This type of approach would also be useful for initiatives that go beyond the “genetic engine” providing a framework to support collaboration with third parties.

2b. Formal performance evaluation

The majority of staff, if not all, within Breed4Food, should be incorporated within a formal performance evaluation framework at both WUR and the partner organizations.

We acknowledge that each organization will have their own mechanisms in place for doing this. As such, there will be an initial scoping exercise required to establish how to do this in a way which complements existing performance evaluation programs and is in the best interests of career development and outcome realization.

The projects within the consortium are too important to be regarded as “an extra task” that gets in the way of “priority roles for the employing organization.” Breed4Food projects should have equal weighting for participating staff together with their other roles and be recognized as such by their employment organization.

Challenge 3. Societal Impact and social license

The members of Breed4Food demonstrated strong awareness of the different challenges animal improvement faces in the future. This was particularly evident among the early-career researchers where some stated they were at times uncomfortable communicating what their work involved (livestock improvement) for fear of recrimination from those against animal protein production (for whatever reason).

Awareness of societal challenges were also clear amongst the commercial partners and there was some recognition that addressing these challenges is not easy from a commercial standpoint, without wider support from society and with the vexed question of “who pays?”

Awareness of the issues across the consortium did not lead to the issues being addressed or prioritized at the consortium level.

Examples include a failure to develop a coherent engagement strategy to address social license and a failure to broaden cross-disciplinary problem solving (within the core activity).

The “flexible component” of the consortium may be used to help address this, however, the partners may prefer to address this independently. If addressed independently by the

partners, that may miss an opportunity for a proactive collective effort that utilizes the strength of Breed4Food.

LEADERSHIP POSITION/OPPORTUNITY

Genetic improvement is positioned at the base of the value chain (or supply chain). As such, breeders understand that they must be “ahead of the curve” with regards to trait selection and improvement as it may take some years for changes to reach production parts of the value chain. For this same reason, those involved in genetic improvement are naturally able to take a leadership role in determining priorities for genetic improvement and determining alternate models (genetic/production or business models) for rolling out genetically improved livestock nationally and internationally. This leadership position can extend to incorporation of cross-disciplinary collaboration.

We would like to see the Breed4Food consortium consider how they might do this in Phase III with some suggestions as follows:

3a. Precompetitive collaboration for social license

As is the case for areas such as food safety and animal health, social license for genetic improvement may be regarded as “pre-competitive” rather than opportunities for competitive advantage; at least in terms of strategy.

- i. Expand connections with key groups e.g., the Ministry of Agriculture, Nature and Food quality, LTO Nederland, Dutch Society for the Protection of Animals and others (including other PPPs) to develop a truly functional forum to plan and address societal needs in the future. Develop new project activity focused on this area to include social scientists (including economists) as well as technical researchers. Review previous initiatives (e.g. Code EFABAR) to investigate results in terms of creating open dialogue and shared values with society (addressing both local and international perspectives).
- ii. Investigate how to develop communication vehicles to society by integrating different skillsets and approaches (including the arts) – NWO and TKI A&F support these aspects so that Breed4Food should make it a priority to survey what is available and relevant to address wider stakeholder engagement.
- iii. Once benchmarking is complete then the management group (board) should discuss a plan to win new funding from agencies to address this gap. (Note: A similar approach should be considered to create support for investment into “process innovation” (Challenge 2) required to enhance consortium effectiveness).
- iv. The Breed4Food WUR team needs to ensure they are at the centre of strategic planning within WUR and the future of agriculture in order to identify synergies, opportunities for cross-cutting programs, and alignment with society’s concerns. This

will help Breed4Food take a proactive approach to sector transition and the necessary social license.

3b. Urgency in future innovations

All Breed4Food people interviewed were acutely aware of the challenges facing animal protein production companies due to societal perceptions around climate change and animal welfare.

The early-career researchers were perhaps the most concerned and conflicted. It would be of value to have some of these early career researchers involved in society consultation, debate and development of new initiatives.

Key areas/activities which could be further developed are as follows:

- i. Assessing models by which commercial entities are rewarded for addressing societal values, e.g., slow growing poultry was cited as an example where consumers pay more for the shift in production efficiency on the basis of better welfare and eating quality. This model will not fit all improvement scenarios. What other supply-chain models, including government involvement, could be integrated to ensure initiatives are developed which lower environmental footprints, improve animal welfare and resilience (especially in the face of climate change) and enhance the healthiness/quality of animal protein in human diets?

This quote is taken from prior interviews with external stakeholders and helps illustrate the opportunity:

In the past, breeding companies have moved away from 'diversity and region' towards 'uniformity and global'. The added value chains in the NW European market provide opportunities for the breeding companies to focus again on 'diversity and region' in their breeding programs. An example is the slow growing broilers in the market segment 'Better Life Quality Assurance Label, 1 star'.

Interview Bert van den Berg and Marijke de Jong d.d. 29Sep'20. Dutch Society for the Protection of Animals, Den Haag.

- ii. Scientists often find it hard to incorporate more qualitative, social science activities into scientific programs and decision making. In terms of genetic improvement, the main area where social scientists were integrated into Breed4Food was in the area

of gene editing. This is an important inclusion, but gene editing is still a minor proportion of the livestock breeding industry and greater efforts need to be made to integrate social science into other parts of the program to help in finding animal breeding solutions which will be embraced by wider society and allow for greater transparency around production systems.

This quote is taken from prior interviews with external stakeholders and helps illustrate how animal production is perceived in society and the opportunity for greater co-design and transparency to address societal concerns:

The public view still is that breeding companies focus on maximum production f.e. the dairy cow with 10.000-15.000 litre milk per year that has to be culled at 3 years of age. Instead, the focus should be on efficiency of N-conversion in on-farm roughage and residual flows of the food industry, longevity and robustness of young livestock. "Interview André van Straaten d.d. 4DEC'20, Ministry of Agriculture, Nature and Food quality, Den Haag

- iii. Insects offer potential in both human and livestock diets. Existing and new livestock breeding tools and technologies can be applied to insect breeding to improve production efficiency and healthfulness. We would like to see a small pilot program within Breed4Food III which scopes out the opportunities, pathways and science required for integrated insect breeding and production systems.
- iv. Development of programs such as start-up/problem solving weekends to encourage early-career scientists, across multiple disciplines, to develop ideas and solutions which could be integrated into animal production systems to address societal concerns. In order to attract bright, young innovators (across disciplines) prizes/awards could be included as well as inclusion of the entrepreneurial business sector (outside of the well-established existing animal protein sector). The best idea/s could then be assessed by WUR/companies for commercialization feasibility.

SYNTHESIS AND THE WAY FORWARD

Animal protein has played an enormously important role in human diets for centuries. Animal protein consumption is starting to decrease in developed countries yet in parallel, increase in developing countries, correlated with increased GDP per person.

WE ARE AT AN INTERNATIONAL CROSSROAD REGARDS THE FUTURE OF ANIMAL PROTEIN IN HUMAN DIETS.

Breed4Food has been a highly successful scientific collaboration for nine years, producing world-class scientific outputs and driving commercial adoption of new technologies, such as genomic selection. As the third phase of Breed4Food is developed and implemented there are improvements and exciting innovations which can be incorporated into the program to ensure it remains world leading and becomes genuinely transformational.

We have identified a number of recommendations which might be incorporated into phase III, which fall into the three categories: strengthening a shared culture across the partnership; improving processes; and societal impact and social license.

We are under no illusion - some of the recommendations we suggest are challenging, especially with regards to societal consultation and thinking which falls outside of traditional livestock commercialization models. However, the culture and excellence of the people and leadership within the Breed4Food consortium mean that these challenges should be faced head-on and sometimes in a different manner to the development of past innovations.

International leadership by the Breed4Food consortium in leading best practice and innovation will be critical for transitioning to a future that addresses societal needs in both the developed and developing world and which continues to include livestock as an integral part of future society.

It is worth noting, that the FAO United Nations have developed a plan "Transforming the livestock sector through the sustainable development goals," and initiatives by Breed4Food should align with this plan in recognition of the important role of animal protein in human diets and the global challenges and opportunities for the livestock industry.

International leadership by the Breed4Food consortium in driving best practice in animal production and innovation can be instrumental in addressing issues associated with healthy diets, climate change and animal welfare. We should not hide from audacious targets.

APPENDIX 1: PROGRAM AND REVIEW PARTICIPANTS

Funding agencies

- Dr. Kees de Gooijer, TKI Agri&Food
- Dr. Lisette Krul, NWO

Program team

- Prof.Dr. Roel Veerkamp, WUR-ABG
- Dr. Mario Calus, WUR-ABG
- Dr. Yvette de Haas, WUR-ABG

Wageningen University & Research

- Dr. Jeroen Dijkman, WUR - Animal Sciences Group

Representatives of industrial partners in Working Group

- Dr. John Henshall, Cobb
- Dr. Erik Mullaart, CRV
- Dr. Marco Bink, Hendrix Genetics
- Dr. Egbert Knol, Topigs Norsvin

A 'random' group of (former) Ph.D.'s and other young researchers

- Ahmad Alsahaf, MSc., University of Groningen
- Dr. Michael Aldridge, WUR
- Dr. Martijn Derks, WUR and Topigs Norsvin
- Dr. Senna Middelveld, WUR and Utrecht University
- Malou van der Sluis, MSc., WUR
- Tomas Stevens, MSc., Topigs Norsvin
- Jordi Vila Teixidor, MSc., Hendrix Genetics
- Lianne Verschuren, MSc., WUR and Topigs Norsvin
- Lisette van der Zande, MSc., WUR

Representatives of industrial partners and WUR in the Board

- Dr. Johan van Arendonk, Hendrix Genetics
- Dr. Randy Borg, Cobb
- Dr. Lucia Kaal, WUR-ABG
- Hans Olijslagers, MSc., Topigs Norsvin
- Dr. Sander de Roos, CRV