

241. Genebanks for animal genetic resources in Europe: quality management system as a tool to improve their operation

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Abstract

In order to safeguard farm animal genetic diversity for current and future use, reinforcement of national genebank strategies is needed as an important complementary measure next to maintenance and improvement of live breeding populations. A Quality Management System (QMS) is an important tool to integrate the needs of various stakeholders into the genebank strategy, to mitigate risks associated with collections' management and to professionalize the genebank operations and protocols. A peer review system, where genebank staff visit and review other genebanks, was tested and appeared to be an effective tool to enhance the further development of the strategies of individual genebanks, their operations and impact. For instance the peer review was an opportunity to exchange about collection and freezing protocols, advises were given to better organize storage of genetic material and data management, or more general recommendation were done such as suggesting to develop a better communication strategy.

Introduction

The most remarkable advantage of cryoconservation of genetic material in genebanks is its capacity to store reproductive material without deterioration. Providing access to this stored material makes possible a large range of uses aimed at supporting *in vivo* conservation, as a backup in case of genetic or sanitary problems, for developing new lines/breeds, increasing the diversity in the living population, modifying and/or reorienting selection, or for research purposes. The relevance of genebanks is recognized by the FAO Global Plan of Action for Animal Genetic Resources, and by the United Nations in the 2030 Agenda, in relation to SDG 2 (Zero Hunger) and more specifically Indicator 2.5.1: 'number of animal genetic resources (AnGR) for food and agriculture secured in either medium or long term conservation facilities'.

In Europe, recent surveys showed that many countries have established national genebank collections of AnGR as a backup (see Leroy *et al.* 2019, Passemard *et al.* 2018) but still more work needs to be done. Meanwhile, EUGENA (<https://eugena-erfp.net/en/>), governed by the European Regional Focal Point (ERFP), was established to support *ex situ* conservation.

The development of genebanks in Europe will be overviewed in this article as well as how a QMS and a peer review systems will help further developing them.

State of development of genebanks in Europe

The analysis of SDG indicator 2.5.1 based on FAO online database (<https://www.fao.org/dad-is/>) shows that the cryopreservation status is known for two thirds of local breeds in Europe. Only 133 local breeds have sufficient material to allow reconstitution in case of extinction (3.5%). This proportion is coherent with findings of Leroy *et al.* (2020), who indicated that most breeds in European countries have either no or insufficient material in genebanks.

EUGENA is a network of nationally recognized genebanks for animal genetic resources. It aims to support the *ex situ* conservation and sustainable use of AnGR at European level. Exchange of knowledge and experiences as well as facilitating access to information about genebank collections in Europe are the main objectives of EUGENA. The participation in EUGENA is open to all institutions managing genebanks.

A specific ERFP *Ad Hoc* Action was launched to support the development of EUGENA, to identify candidate EUGENA genebanks, and improve the information about the genebanks in Europe. To do so, a survey was developed to collect information about genebanks in European countries, with questions related to the institution, its objective(s), the livestock species represented in the genebank, the type of biological material stored, and finally any link to communication tools such as a web page or social media channel.

The survey was sent via a large e-mailing to a wide array of stakeholders, including National Coordinators and experts within the ERFP network and the wider European animal breeding and reproduction sector in 34 European countries. A total of 103 answers were received from 26 European countries. Conservation was quoted as the main reason for establishing genebank collections by 58% of the respondents, followed by research (23%) and commercial purposes (18%). The majority of the responding genebanks are holding reproductive material (44 institutions) while 19 of them are specialized in genomic collections; 40 institutions are hosting both type of material. As already found in previous studies (Leroy *et al.* 2019, Passemard *et al.* 2018), cattle is the main species of interest (74 collections) and most collections are holding semen (83 genebanks). Beyond cattle, sheep, goat, pig, horse and chicken are regularly represented in the collections.

The combination of the results of the *Ad Hoc* Action and the study by Passemard *et al.*, 2018 allowed the ERFP network to build up an inventory of 126 different institutions operating as genebanks in the European region. Thus, collaboration and coordination between all these actors involved are needed to foster the *ex situ* conservation activities within EUGENA.

The EU H2020 GenResBridge project (grant # 817580) was a leverage that pushed the ERFP community to formalize an Animal Genetic Resources Strategy for Europe. This Strategy proposes a series of key recommendations with the objective to strengthen the EUGENA network. Recommendations include mapping of all *ex situ* conservation facilities and enlarging the EUGENA network, ensuring breed specific core collections, evaluating sanitary issues connected with stored material and its use, implementing QMS, initiating research on new cryopreservation technologies, and facilitating access to cryopreserved genetic material where possible. Finally, to secure continued funding of the *ex situ* conservation activities, the general public must be informed about the efforts, results and value of the genebanks.

Quality management system (QMS)

Genebanks must ensure high quality conservation by providing secure, long-term storage to guarantee future viability and biosecurity. Dedicated systems for quality management, be they formal or informal, are important tools that can assist genebanks managers to monitor their progress towards their targets and fulfil their mission.

A task performed within the H2020 IMAGE project (grant #677353) was a worldwide survey on QMS (Zomerdijk *et al.*, 2020). An online questionnaire was distributed through the FAO network of national coordinators. Ninety responses were received from 62 countries. It showed that 30% of genebanks have established a QMS, 17% have a formal certification (mainly ISO 9001:2015), 35% have formal cryoconservation goals, and 50% have identified the major risks to their collections. As far as collecting, processing, storage and documentation, 59% of genebanks use Material Transfer Agreements for (part of)

incoming samples, 88% follow specific Standard Operating Procedures for processing and freezing, 49% have a database for monitoring collections. The least compliance was for distribution of outgoing material since only 24% have formal procedures for distribution of the material.

FAO has developed Guidelines with the aim to give technical guidance on the design and establishment of animal genebanks (FAO, 2012), but without any specific reference to QMS. One important conclusion from the EU H2020 IMAGE project was that quality management principles should be better reflected in the FAO Guidelines. Therefore, in the updated version of the guidelines, a whole section is devoted to 'Quality management for improved organization and implementation' (FAO, 2021).

Another output of the H2020 IMAGE project was the design of a self-diagnostic tool to facilitate the uptake of quality management by genebanks which can be downloaded on the project website (<https://www.imageh2020.eu/>). The IMAGE survey showed that a significant number of European genebanks were interested in developing their QMS, up to the stage of being certified with reference to ISO 9001:2015 for instance. Yet, the development of a QMS is generally viewed as time-consuming and costly, so that few genebanks complete the exercise or hesitate to invest in it. The aim of the self-diagnostic tool is to help a genebank to assess its progress towards a full QMS, so that it can get a precise idea of where to focus its efforts.

Peer reviews to strengthen genebanks and their quality management

The H2020 GenResBridge project gave the opportunity to implement a 'peer review' assessment of genebanks. Peer reviews are based on the principle that genebank experts visit and review other genebanks, genebanks giving full transparency about the strategies, facilities and protocols, and having discussions about these. After each visit a report is written with observations and recommendations, in order to support further development of the genebank strategy and to improve the genebank management. Peer review visits of national livestock genebanks were organised in 2021, involving the French, Dutch and Slovenian National genebanks. After the visits, all reports were published on the ERFP website. Review reports are short and to the point, listing only major observations and associated recommendations.

The overall impression of the genebank review pilot was positive (Bojkovski *et al.*, 2021) and considered as a useful exercise, complementary to internal audits, both for the hosting genebank and its staff, as for the reviewers visiting the other genebank. The complete transparency of the participating genebanks resulted in excellent discussions about strengths and opportunities for improvements. Comparison of the three national livestock genebanks highlighted similarities as well as differences between the genebanks.

Sharing experiences and knowledge was beneficial for all three genebanks and resulted in new ideas and inspiration. These recommendations could be very practical, such as exchanges on collecting or freezing protocols, advises on how to better organize the gene bank, on how much and which material should be stored. QMS traceability documents were also compared. More general recommendations were also given; for instance it was suggested to a genebank to better develop its communication strategy; it was also stressed out the importance of drafting documents linked to the samples that clearly state the ownership of the material. The recommendations listed in the individual reports will help the genebanks to further develop their work and priorities.

The review team with different expertise and background consisted between one and three experts of the other two genebanks. The choice of three relatively different genebanks was very positive; two genebanks with long experiences but very different organizational structures versus one younger genebank; one genebank already with a certified QMS, the second in the process to obtain this and the third not having

this objective for the moment. A rotational system was suggested in case such a review system could be implemented on a larger group of genebanks.

Conclusions

The output of the IMAGE self-diagnostic tool and the peer reviews were both acknowledged of being a valuable experience for genebanks in Europe. A new ERFP *Ad Hoc* action is set to take place in 2022 that will combine both approaches. The expectation is that ten volunteer genebanks could use the tool and be assessed within this year. A cooperative and step by step implementation of a QMS approach is definitely a way forward to secure the gene pools that are conserved in the numerous genebanks from Europe. It is also hoped that this action will encourage genebanks to get involved in EUGENA.

References

- Bojkovski D., Duclos D., Neuteboom M., Hiemstra S.J., Schoon M. (2021). Livestock Genebank Peer Reviews. Available at: https://www.animalgeneticresources.net/wp-content/uploads/2021/12/20211123_AnGR_GB_Report_PeerReview_GENERAL_photos.pdf
- FAO. (2012) Cryoconservation of Animal Genetic Resources;Rome, Italy.
- FAO, Draft practical guide on innovations in cryoconservation of Animal Genetic Resources 2021. Available at: <https://www.fao.org/3/ng882en/ng882en.pdf>
- GenResBridge consortium (2021). Genetic Resources Strategy for Europe Available a: <http://www.genresbridge.eu/fileadmin/templates/Genres/Uploads/Documents/GRS4E.pdf>
- Leroy, G.; Boettcher, P.; Besbes, B.; Danchin-Burge, C.; Baumung, R.; Hiemstra, S.J. (2019). Cryoconservation of Animal Genetic Resources in Europe and Two African Countries: A Gap Analysis. *Diversity*, 11, 240. <https://doi.org/10.3390/d11120240>
- Passemard A.S, Hiemstra S.J., Tixier-Boichard M., and Danchin C.(2018) Proc. of the 10th WCGALP, Auckland, Canada.
- Zomerdijk F, Hiemstra S.J., d'Arbaumont M., Tixier-Boichard M., and Boettcher P. (2020). Biopreservation and Biobanking.244-253.