Covid-19 pandemic and its impact on the breeding world

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Introduction
Since the end of 2019, the COVID-19 pandemic, also known as the coronavirus pandemic, has been an ongoing pandemic of coronavirus disease (COVID-19) caused by the SARS-CoV-2 virus. The disease was first identified in December 2019 in Wuhan, China. The World Health Organization declared the outbreak as a Public Health Emergency of International Concern in January 2020, and COVID-19 was recognized as a pandemic in March 2020. As of the beginning of October 2020, more than 35 million cases have been confirmed in the world and the number of deaths attributed to COVID-19 is now over 1 million. Besides this dramatic situation regarding human fatalities, the world has been on hold since March 2020. As a consequence, the majority of our economic and social activities have been deeply impacted.

This article will outline the consequences of this extraordinary crisis on animal breeding activities either during the lockdown period imposed by a large number of countries or in the longer term after the lockdown. In order to cover this topic properly in essential scopes that lead to genetic improvement, the impact of COVID-19 pandemic will be described first on research activities and then on routine activities.

Impact of COVID-19 on Animal Genetics Research
Research activities like conducting studies and experiments but also teaching, writing scientific articles, and discussing new topics adapted very fast and quite efficiently during the period of lockdown. Scientists are already accommodated to the extensive use of a virtual work environment either within international consortia or with remote teaching in different international universities. Therefore, the impact on daily activities was quite limited with almost no interruption in 2020.

However, there were some negative impacts which can be divided into two categories. The first one with an impact in 2020: as almost everyone except the essential activities, such as hospitals, food industry, and security, were on pause, collection of samples in the field and the work within the laboratories have been delayed for a few months. Consequently, many research projects planned in 2020 and for which sampling was an essential activity will be delayed. In Human genetics, together with the research on infectious diseases and the development of new vaccines, the host genetics studies have been boosted.

Will 2020 be a blank year in animal genetics research? Will the gap increase between human and animal genetics? Or will animal genetics research take benefit of all of these new discoveries in terms of biotechnology (turn-around time [TAT] for virus detection, TAT for virus surveillance, and new approaches taking into account the genetic specificities to understand the variation in the severity of COVID-19)?

The second category of impact is much more critical for animal breeding. As the demand for funds for human health has increased dramatically in all countries, this will definitely generate a research funds shortage for other species, such as livestock. Furthermore, in low- and middle-income countries, such as Africa, nongovernmental organizations focus their actions on infectious diseases and vaccine discovery instead of host genetics. Today, there is an urgent need to better understand the genetics of local breeds and local species in order to allow the local population to

Implications
• Since March 2020, like all other industries worldwide, the breeding world had to face the COVID-19 crisis.
• Breeding activities belong to essential economic activities being able to continue in some extend services and activities during locked down (for example AI).
• However, it is interesting to look at the changes that occurred during this time.
• Moreover, I invite you to discuss the long-term evolution between actors’ and also breeders’ needs and behaviors.

Key words: animal breeding, biotechnologies, COVID-19, phenotypes monitoring, research on genomics
overcome the challenges of food security, climate change, and biodiversity for the next decades.

Another consequence that is not visible at this time of the pandemic is the social impact on research teams. Research activities as many other essential economic activities are based on teamwork. One of the key factors of a successful scientific team is the capability to brainstorm together and to exchange different ideas, with different backgrounds and cultural approaches—all this needs social interactions. The first conclusion of remote working during the first half of 2020 coming from different organizations in finances and in web services shows higher productivity of the employees due to the lack of transportation to the office but also a decrease in creativity and a lack of innovative process or solution. Let’s see in the next years the number of new discoveries in the era of genetics all over the world. Will it be as prolific as previous years and will it be comparable to human genetics?

### Impact of COVID-19 on Animal Genetics Routine Work

Animal breeding is a very small and concentrated industry with a very well-organized sector and a clear distribution of the tasks: the recording organizations, the AI centers, the breeding companies, and, finally, the breeders/commercial farmers.

The COVID-19 pandemic impacted field activities deeply, at least in the first months: interruption of farm visits for nonessential activities, such as milk recording, type evaluation, bull dams, and bull sire’s recruitment. Except for some extreme situations, such as in North East of France during the peak of the crisis and the urgency to stop the propagation of the virus, AI daily service never stops in Europe. But how to adapt to the different actors of this industry? And what will be the changes?

#### 2020: less phenotypic data collected

Performance data collection in dairy farms is not automated everywhere. So the first direct consequence will be the lack of data collection during 2–3 mo depending on the regions impacting the workflow of milk samples in laboratories specialized in milk analysis; moreover, some of the traits have been collected without the same process of validation or precision (done by the farmer, e.g., for the quantity of milk) and some other traits will not be collected at all (weaning weight in beef cattle) or even postponed to a later age (type classification).

Will this periodic event have any impact on genetic evaluation? It will depend on the seasonality of animal farming in each country and the species. What percentage of the total amount of yearly records will these 3 mo represent?

#### More farms equipped with monitoring instrumentation

More than the effect on the evaluation of the herds in 2020, the most important impact for performance recording organizations is still not visible. As Jean Monnet said perfectly: “Human accept change only in necessity and they only see necessity in crisis.” We are facing a huge crisis. That is why we will change a lot and some evolution in our practices, habits, and methodologies will speed up dramatically.

Let us take the sector of traits measurements, such as milk recording. The future of farms will be to be well equipped to collect on daily basis and automatically records on performance traits, on health, on behavior. That will be done without any visits of operator. In the first half of 2020, we clearly see an increase in monitoring equipment sales all over Europe, the Middle East, and Africa.

Besides the traditional tools of breeding, did the COVID-19 crisis impact the implementation of genomics in animal breeding? Two factors may have impacted the number of animals genomically tested and when the test has been done. In regions where sample collection is made by third parties, we faced a momentary stop of the collection due to sanitary reasons advocating the farmers to receive no visits on his farm. Most of the time, the samples were stored on the farms and the samples will have been tested later. However, the impact on the breeding program for the sire selection should not be underestimated here. Holstein genetics is a very competitive market internationally. That’s why one-month delay may take away the chance of a bull to become a young genomic bull servicing AI few months later.

Another reason is the new priorities of some genomic laboratories. Even if human and nonhuman sample analysis does not follow the same network of labs, many laboratories dedicated to animal molecular testing, were switching to COVID-19 testing in order to answer the increased demand for PCR-based tests during the pandemic. The priorities were given to the human tests and the traditional animal genomic tests were postponed or delayed. In some regions where animal genomics was in its starting blocks, its implementation will be slowed down (Figure 1).

![Figure 1. In the cattle industry, the Montbeliarde breed is a good example of intensive and early use of genomics at a large scale dedicated to breeding and also herd management to secure herd replacement and farm performance.](image-url)
Conclusion

What can we expect in terms of the breeding landscape after this crisis? We will definitively face an acceleration of the ongoing breakthroughs or mutations within our breeding world. First, due to the financial burden faced by the different countries, subsidies for the animal world, either breeders association or research, will certainly decrease and sometimes even completely stop in order to fund other more important challenges regarding human health and social security. Consequently, the concentration of actors in the breeding world but also withdrawal from the state of certain activities will engage the different stakeholders to adapt quickly in terms of strategy according to the new level of resources. In that context, what will be the picture of the breeding world in 5 yr? How to conciliate the need of keeping biodiversity within species and critical size to run a breeding program with the new biotechnologies? In a few words, the new challenge could be: how to do differently with less?

Second, the use of new technologies, such as livestock monitoring, will be sped up for many reasons: need to manage larger herds with challenging economical deadlines with real-time data and production insight, keeping sanitary security (reduce farm visits) leading to more autonomy, increased traceability, especially beef industry, increased quality of the production, and lowered production costs together with reduced environmental footprint.

Finally, like the Chinese, the concept of crisis can be expressed in two words: once the risk generated is managed, let us work on the opportunities to accelerate the adaptation of the breeding world by integrating more technologies, either biotechnology or IT (big data), in order to deliver not only the right genetics but also the customized service to livestock farms.

About the Authors

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