Perspectives of Animal Production and Farm Animal Research in Germany

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Introduction

In Germany, animal production represents more than 60% of the total value of agricultural output. As in other Western countries, the focus is no longer on volume (or mass production?), but increasingly on product quality and variety. According to recent estimates of the FAO, the world population will increase to 8.3 billion by 2030. With the predicted increase in affluence, the demand for high quality animal protein will increase significantly. In Asia, an increase by 40% is expected within the next decade.

In order to meet the growing demands, it will be mandatory to further increase the efficiency of production, while greenhouse gases from animal production have to be reduced in parallel. Under European conditions farm animals will also play an increasing role in maintaining the landscape, for leisure and sports as well as production for niche markets.

Animal breeders have to maintain genetic diversity as a reservoir for future adaptation of livestock populations to changing goals and production needs. Modern breeding methods applied since the second half of the 20th century, have changed populations of farm animals considerably. A small number of highly productive breeds have become dominant at the expense of local breeds and survival of some of these is now endangered. The distribution of high yielding and efficient breeding stock will become even more global in the future. More and more traits are being included in selection programs to develop farm animal populations for specific future needs.

Man's association with farm animals dates back to pre-historic times. The characteristics of today's farm animals are the result of centuries of deliberate selection. More recently, sequencing and annotating the genomes of farm animal species has contributed considerably to our understanding of the genetics of farm animals, including cattle, pigs, poultry, horses, dogs and honey bees. New genetic tools not only allow us to analyze genomic variation, but also to modify genotypes. Combined with advances in reproductive technologies, limitations of traditional breeding can now be overcome and new horizons will be opened.

The German Society of Animal Breeding (DGfZ) has developed the following guidelines for future animal breeding and farm animal research in Germany.

Application of molecular genetics in practical breeding:

The latest results from research on molecular genetics biotechnology should be combined with traditional methods of breeding and reproduction. Systematic analysis and detailed description of relevant traits using molecular genetics information is required to combine quantitative genetics with modern tools for genomic selection. This is the only way to assure continued genetic progress of farm animal populations. In cattle breeding genomic selection is already being practiced. Similar developments expected in other species will benefit from interdisciplinary research and development of new methods.

Preservation of genetic diversity and avoidance of inbreeding:

Accumulating knowledge from genome analysis will add novel possibilities to describe genetic diversity and to increase diversity in farm animal populations. Improved biotechno-logical tools and computer software as well as simplification of international exchange of genetic material (primordial germ cells, embryos, semen, somatic cells) can contribute to maintenance and increase of genetic diversity. The potential of these developments should be exploited in internationally competitive research and for developing novel strategies in domestic animal breeding and reproduction.

Molecular processes will become more important in applied breeding:

Animal farming is following the same path with regard to applied genomics as we have already seen with humans and laboratory animals. With suitable array techniques it is already possible to describe the expression of mRNA and/or proteins of organs or whole organ systems. On this basis it is possible to gain a better understanding of interactions between genes and gene clusters as well as processes within animals in response to given environmental conditions. Intensive inter-disciplinary and cooperative research will be required, and the farm animal industry should be open and receptive for the application of results.

Understanding epigenetic effects will contribute to improved reproduction:

Genomic information and the high degree of epigenetic plasticity offer new possibilities to reduce early embryonic mortality, to improve fertility and to shorten the generation interval by using prepuberal animals. Research with embryonic development of farm animals, predominantly cattle, is increasingly being used as model for human medicine, specifically for assisted reproductive technologies. Epigenetic research with farm animals is still in its infancy, but results from model populations suggest that epigenetics acts as bridge between genotype and environment and will thus become more important in explaining phenotypic observations in farm animal populations. The full exploitation of this potential will require innovative research.

Transgenic animals will become more important:

It is already possible today, to produce farm animals with specific genetic changes by combining molecular genetic tools with somatic cell nuclear transfer. Techniques which are being used in mice to achieve a tightly regulated expression of genetic elements are increasingly being adapted to farm animals. In addition to the use of transgenic animals for biomedical purposes, including gene pharming and xenotransplantation, research will address possible application for agricultural purposes related to efficiency, environmental impact and sustainability. Potential application of research results has to be validated, and potential risks and opportunities have to be communicated early with the public, which is known for a strong bias against genetically modified organisms.

Farm animals as model for human disease:

Transgenic animals are increasingly being used as model to study human diseases and disorders like mucoviscidosis, diabetes, different forms of cancer and diseases of the vasculatory system. This is not limited to basic research, but may also involve pre-clinical testing. Genetically modified farm animals will increasingly be used to test novel stem cell therapies. Research is needed to exploit these new areas of development and to train young scientists for these challenges.

To realize these promising perspectives will require innovative interdisciplinary research with international cooperation. To secure a sufficient supply of high quality animal protein for the growing world population will require continued interdisciplinary research and introduction of science-based innovations in practice. Highly qualified specialists need to be trained to respond to new challenges in animal breeding and reproduction, farm management, nutrition and disease control.

The rapid development of molecular genetic tools requires the protection of intellectual property and technical innovation, e.g. by patenting. However, progress in animal breeding should not be limited by patents. It is up to patent courts, politics and administrations to find practical solutions which protect new developments without hampering practical animal breeding and production.

In view of the global challenge to feeding the growing world population a return to traditional animal farming is no realistic option. Research and animal industry are called upon to continue the road of innovation with due responsibility.

Zusammenfassung:

Stellungnahme der Deutschen Gesellschaft für Züchtungskunde zur Zukunft der Tierzucht und Tierzuchtforschung in Deutschland

Dr. Ernst-Jürgen Lode, Präsident der Deutschen Gesellschaft für Züchtungskunde (DGfZ) und Prof. Dr. Heiner Niemann, Vorsitzender des Fachbeirats der DGfZ, haben Leitlinien für die künftige Tierzucht und Tierzuchtforschung zu folgenden Themen vorgestellt:

- Übertragung molekulargenetischer Erkenntnisse in die praktische Tierzucht
- Genetische Vielfalt zum Erhalt genetischer Ressourcen und zur Vermeidung von Inzucht
- Zunehmende Bedeutung molekularer Prozesse und Einfluss auf die züchterische Arbeit
- Bedeutung epigenetischer Erkenntnisse für eine Steigerung der Fruchtbarkeit und Erklärung von Umwelteinflüsse auf das Tier
- Künftige Bedeutung transgener Tiere
- Nutztiere als neues Modell für menschliche Erkrankungen

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