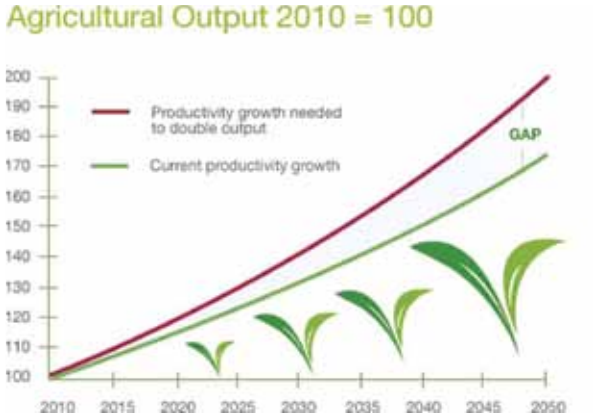
American Society of Animal Science
GRAND CHALLENGES 2012

Never before have producers of animal-based food products faced so many challenges and opportunities. Global demand for animal protein is increasing in response to both population growth and the improving financial status of people in many developing countries. Simultaneously, land and water available for livestock production is decreasing and climate variability is increasing. Costs of feedstuffs have also increased dramatically due, in part, to renewable energy policies that have resulted in competition between bioenergy companies and livestock producers for corn and other carbohydrate-rich grains. In addition, consumer sentiment and associated legislation often govern animal management practices without regard to cost and efficiency of production and cost of food to consumers.

Though research, innovation and education led to increased crop and livestock production during the twentieth century, experts predict that increases in efficiency of animal production will need to be greater during the next 40 years than ever before to meet the increased global demand for animal-based products by 2050. As ASAS enters its second century, our society must continue to be the world leader as the source of scientific information on animal well-being and the contributions of animals to human health. To deal with the many contributions of animals to society, ASAS recognizes the need to facilitate effective communication among academia, industry, government agencies, consumers and other stakeholders to reach consensus regarding science-based issues affecting animal production. The Grand Challenge documents were prepared to clearly articulate our priorities, to provide science-based information for shaping public policy, and to enhance future funding for research and education programs in animal science.



Source: 2010 Gap Report

In summary form, the grand challenges facing animal production in 2012 are:

- To optimize the health and productivity of animals in a manner that protects and enhances human health.
- To produce animal proteins in an economically, environmentally and socially acceptable manner that meets the demands of an increasing population.
- To ensure that animal scientists develop and disseminate strategies for mitigation and adaptation with increasing climate variability.
- To develop intervention and control strategies for foodborne contaminants along the entire animal production chain and enhance detection of pathogens to ensure a safe food supply and decrease foodborne illnesses.
- To optimize animal well-being in a socially acceptable and sustainable manner.

Animal Health

GRAND CHALLENGE:

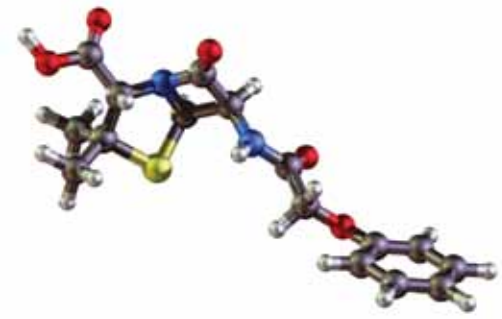
To optimize the health and productivity of animals in a manner that protects and enhances human health.

Healthy animals provide safe and wholesome products for human consumption. Although human and animal health are intimately linked, expenditures for animal health research are only 7 percent of those for human health research. Therefore, investment in animal health innovation for the world's 24 billion chickens, more than 1 billion cattle and sheep, 750 million pigs and goats, and more than 1 billion companion animals is very limited. It is essential to develop and maintain safe, effective and responsible animal health-management systems, including preventative vaccines, antimicrobial treatments, and production-technologies that promote efficient growth and ensure a healthy, safe and sustainable relationship between humans and farm animals.

Animal health research includes many areas related to the detection, control, prevention and treatment of diseases. Research is needed to understand the interaction of pathogens with their hosts, as well as the genetic basis for resistance to diseases. Studies are also needed to better define the therapeutic use of antibiotics to promote animal health and well-being in a sustainable manner that considers potential health effects on the human population, use of production enhancing technologies in livestock production, and of the role of specific feed ingredients to enhance nutrient utilization and animal growth.

KEY QUESTIONS:

1) How do we optimize animal health and productivity while ensuring human health?
2) What vaccines need to be developed to prevent, control and eventually eradicate animal diseases?
3) How do we maintain and ensure a balance between optimal animal health and productivity?
4) How can information from genetics, animal behavior, nutrition and physiology be integrated to optimize animal health and productivity?
5) What management methods or technological tools are needed to assess and ensure optimal animal health?
6) How do scientists communicate with the public and policy makers about zoonotic diseases in a manner that provides factual, science-based information without widespread hysteria?



EXPECTED OUTCOMES:

1) Understanding of the safe and effective use of products and technologies to promote animal health and productivity.
2) Management practices that ensure healthy, productive animals and safeguard both the farm animal and human populations.
3) Use of genetic markers to select individual animals for disease resistance, optimal health and productivity.
4) Vaccination and disease-prevention systems that control animal diseases.

Agricultural Animals and Climate Change

GRAND CHALLENGE:

To ensure that animal scientists develop and disseminate strategies for mitigation and adaptation to increasing climate variability.

Greenhouse gas emissions come from many sources. In animal agriculture, emissions arise from respiration in animals, enteric fermentation, manure handling and application, crop production, and transport of crops and livestock.

Just as animal agriculture affects climate change, climate change affects animal agriculture. As global temperatures increase, consequences for animal production include: increased heat stress in summer months; an extended growing season at northern latitudes; a northerly shift in cropping patterns; an increase in natural disasters, like hurricanes and flooding; and increased parasites and pathogens. There are also less apparent challenges, such as the potential for reduced protein concentrations in feed ingredients and decreased water availability.

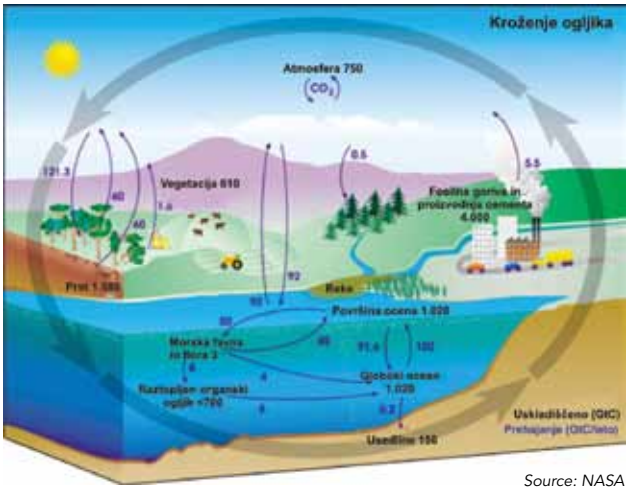
Complicating the challenges of animal agriculture and climate change is the prediction that the global human population will double by 2050. As a result, animal agriculture will have to produce more food with fewer resources in a changing environment.

KEY QUESTIONS:

1) How can we incorporate science into the global standards, methods and guidelines for quantifying the impact of animal production on climate change?
2) How can the production of animal proteins be included in a sustainable human food production system while reducing GHG production from those production systems?
3) How can genetics and selection of animals be matched with natural resources and feedstuff availability to optimize animal agriculture in a changing environmental climate?
4) How can interdisciplinary teams of scientists:
   a. Research, develop and implement potential mitigation and adaptation strategies to optimize animal production systems including: improved feed conversion; use of feeds that increase soil carbon sequestration vs. carbon emissions; use of animal manure instead of synthetic fertilizer; and use of animal manure as a source of renewable energy?
   b. Identify and evaluate strategies that allow farmers and ranchers to decrease animal GHG emissions and carbon and water footprints per unit of food output?
5) How can all components of the production system and other contributing sources be evaluated rather than focusing exclusively on endpoints associated with animal productivity?

EXPECTED OUTCOMES:

1) Informed decisions about mitigating the impacts of animals on climate change and adapting animals to a changing climate.
2) Improved animal management and feeding systems with efficient production in an economically and environmentally sustainable manner.
3) Animal production systems and appropriate infrastructure (e.g. laboratories, personnel, government policies) with long-term responsiveness to a changing climate.



Source: NASA

Food Safety

GRAND CHALLENGE:

To develop intervention and control strategies for foodborne contaminants along the entire animal production chain and enhance detection of pathogens to ensure a safe food supply and decrease foodborne illnesses.

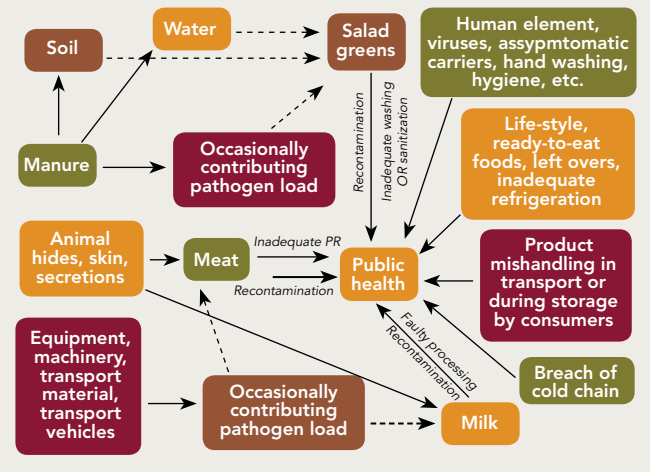
According to the Centers for Disease Control and Prevention, approximately 1 in 6 U.S. citizens (48 million people) get sick, 128,000 are hospitalized, and 3,000 die of foodborne illnesses each year. Although the U.S. animal-based food production system is amongst the safest in the world, meat and dairy foods production, processing, and distribution systems in the United States are diverse and vulnerable to the introduction of contaminants. Therefore, strategies to enhance food safety require a holistic approach from animals on the farm or ranch, through humane slaughter and processing, and ultimately to retailers and the consumer. Understanding factors that affect pathogen, toxin or chemical burden will help decrease contamination in the farm-to-fork continuum. Educational and research efforts will lead to development of risk management strategies. Research provides the means to ensure that animal and dairy products continue to be safe and secure for consumers, and that these products continue to meet regulatory requirements for domestic and international markets.

KEY QUESTIONS:

1) What technologies can be developed and used for the rapid detection and characterization of contaminated animal-based foods?
2) What additional or alternative pre- and post-harvest intervention and control strategies can eliminate foodborne contaminants throughout the food production chain?
3) What strategies and models can be used to identify effective management practices that improve food safety?
4) What microbial populations (pathogens and normal flora) are found in animals and humans, in their surrounding environments, and in animal products for human consumption?
5) What characterizes the behavior and fundamental biology of normal flora and foodborne pathogens? Can more effective technologies be developed to further differentiate pathogenic from non-pathogenic strains?
6) What is the most effective means of informing consumers about proper food handling to reduce the risk of foodborne illness in humans? How do we reach the groups most at risk (young, elderly, compromised immune systems)?

EXPECTED OUTCOMES:

1) Fundamental knowledge regarding microbial populations (pathogens and normal flora) in animal production systems from farm to fork.
2) More powerful and sensitive methods for the rapid detection and elimination of contaminants in animal-based foods.
3) Pre- and post-harvest strategies that use a holistic or systems-based approach to decrease foodborne contaminants throughout the food production chain.
4) Best management practices that improve the safety of all animal-based foods.
5) Educational materials for the public, especially at-risk populations or their care givers, on safe food preparation and handling.



Source: JAS, January 2012, Vol. 87, p. 422.

Global Food Security

GRAND CHALLENGE:

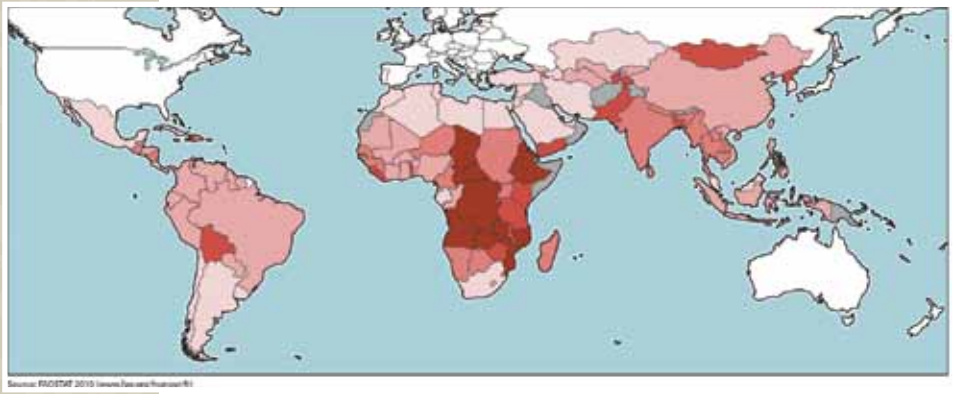
To produce animal proteins in an economically, environmentally and socially acceptable manner that meets the demands of an increasing population.

In 2012, despite decades of increased food production on a per-capita basis, nearly 1 out of 7 people in the world suffers from hunger or malnourishment or both. How will food security be achieved for a world population that is expected to grow from 7 billion today to 9 billion by 2050? In addition to population growth, a rise in disposable income in developing countries is expected to further increase demand for animal products.

Addressing the grand challenge of global food security will require integration of a wide range of technical, economic, financial and political issues. To achieve global food security, farmers and ranchers must produce more food with fewer inputs, including water, cereal grains, pharmaceuticals, and labor. Research and education programs are needed to develop and implement environmentally, socially and economically sustainable animal management systems that will support this increasing demand.

KEY QUESTIONS:

1) How can sustainable animal management systems be improved to maximize efficiency while simultaneously minimizing inputs and reducing negative environmental impacts?
2) How can the nutritional quality of animal-based foods be optimized to benefit human health and minimize obesity and malnutrition?
3) What alternatives exist to utilize plate waste in a more environmentally sustainable manner?
4) How can the production chain be made more efficient to minimize losses of meat, milk and eggs?
5) How can science inform local, state and national policies that ensure global food production and food security?



EXPECTED OUTCOMES:

1) A supply chain for meat, milk and eggs that minimizes waste and provides nutritious, safe, abundant and affordable animal protein for the growing global population.
2) Scientific advances that reduce the environmental impact of animal agriculture by identifying animals with increased feed efficiency, growth rate, fertility, and disease resistance.
3) Novel management practices or treatments that minimize early embryonic loss and optimize pregnancy rates in cattle, sheep and pigs.
4) Production systems that enhance lean muscle growth and milk production in an economically, environmentally and socially acceptable manner.
5) Improved nutrient content of meat, milk and eggs to minimize malnutrition and benefit human health and well-being.
6) Governmental policies and regulations at the local, state, and national level that promote sustainable animal production systems that are economically, environmentally and socially acceptable.

Animal Well-Being

GRAND CHALLENGE:

To optimize animal well-being in a socially acceptable and sustainable manner.

Farm animal welfare is an emotionally charged issue that is based on diverse values and ethics. Many U.S. consumers have increased interest in how agricultural animals are raised. Animal welfare extends beyond the farm to companion animals and exotic zoo animals. To ensure the public that the welfare and humane treatment of animals is a top priority, scientists, educators and animal producers must have a transparent, proactive role in establishing science-based, economically sustainable expectations for animal welfare.

KEY QUESTIONS:

1) What animal management practices optimize the well-being of animals, meet consumer demands, and ensure sustainable production of safe, affordable and abundant meat, milk and eggs?
2) How can information from genetics, animal behavior, nutrition, physiology and health be integrated to match individual animals with appropriate production systems?
3) What methods, management procedures or pharmaceutical tools are needed to assess and alleviate pain in animals?
4) Can improvements be made in transportation systems to promote animal well-being?
5) What are the best methods to mitigate animal pain before humane harvest or depopulation?

Source: Animal Frontiers, July 2012, Vol. 2, No. 3, p.25

EXPECTED OUTCOMES:

1) Management practices that meet consumer demand for safe and affordable meat, milk and eggs, while addressing concerns of animal welfare by the public and policy makers.
2) Use of genetic markers to select individual animals for behavioral and welfare traits that allow optimal performance in various production environments, when combined with custom diets, housing and animal health programs.
3) Effective pain mitigation strategies that are approved for use in food-producing animals, easy to administer, long-acting, have short withdrawal periods, reduce the risk of antibiotic resistance, are socially acceptable, and can be adopted rapidly by farmers and ranchers.
4) Animal transportation systems that promote animal health and well-being, are socially acceptable and are part of a sustainable food production system.
5) Safe, effective and socially acceptable methods of euthanasia for individual animals at harvest or when large populations of animals are exposed to infectious agents, thereby forcing depopulation.

Water Quantity and Quality in Agricultural Animal Production

GRAND CHALLENGE:

To optimize and ensure responsible and sustainable use of water.

Global demand for water is expected to increase significantly by 2025 and will be complicated by the impact of climate variability and altered patterns of rainfall throughout the world. The water footprint of products is the volume of freshwater used to generate the product, including all steps from production to consumption. About 8% of the available global supply of water is used for agricultural animals for the production of meat, dairy, and poultry products for human consumption. About 1% of this water is used to nourish animals, process and deliver animal products to consumers. About 98% of the water footprint of animal products is the water needed to produce feed (cereal grains, co-products from the ethanol industry, crop residues, pastures, etc.). The water footprint of animals is influenced by their feed conversion efficiency. Animals that are more efficient in converting feed to meat, milk, or eggs have a smaller water footprint. Animal feeds produced from crops that are irrigated have a higher water footprint than do crops or pastures grown under rain-fed conditions. Understanding how animals utilize water in different management systems is necessary to standardize methods to quantify this utilization and improve the sustainability of meat, dairy, and poultry products to meet the growing global demand for animal protein.

KEY QUESTIONS:

1) What are the factors that affect the water requirements of animals?
2) How can animal production systems be optimized to prevent microbiological contamination of water while providing effective manure handling, storage, and application to the environment?
3) Can international, standardized methods of calculating the water footprint of livestock be developed and implemented throughout the world with the ability to account for differences in animal production and management?
4) What animal production and processing systems, including the production of crops, are needed to minimize the water footprint of meat, dairy and poultry products?

EXPECTED OUTCOMES:

1) New knowledge of the quantity and quality of water to optimize production of meat, dairy, and poultry products.
2) Use of livestock manure to promote soil health while maintaining water quality and human health.
3) Standardized methods that integrate the effects of environment, animal genetics and physiology, management systems, and components in feed and water that lead to efficient use of water for meat, dairy, and poultry production throughout the world.
4) Management practices that optimize the use of water in the sustainable production meat, dairy, and poultry products.

Source: Animal Frontiers, April 2012, Vol. 2. No. 2

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