SUSTAINABLE ANIMAL PRODUCTION

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Summary

Sustainable animal production integrates environmental, economic and social aspects of agriculture. Cattle, poultry, swine and small ruminant productions are the main sectors globally. The objective of animal production could be for commodity such as food, clothing and energy or non-commodity such as agritourism, companionship and other benefits. A wide range type of livestock production systems exist. These include extensive production which has multiple objectives and focus on optimizing production and minimizing risk. On the other hand, intensive production systems keep higher density of animals for sole purpose of producing food. The challenge for further expansion of animal agriculture comes from competition for limiting resources such as arable land and water. Additionally, animal agriculture contributes to greenhouse gas emission in the form of carbon dioxide, methane and nitrous oxide. Nutrient loading, particularly phosphorus and nitrogen are also of particular concern in areas with dense

animal population.

Understanding the ecological, economic and social aspects of animal agriculture is critical to ensure access to safe and healthy food, and it is required for ecosystem services such as access to clean water and air, carbon sequestration, balanced nutrient cycling and preservation of biodiversity. This understanding is also important to society as it strives to maintain a viable rural community and plans for future needs, including successful adaptation to climate change.

1. Introduction

The World Commission on Environment and Development defines sustainability as "forms of progress that meet the needs of the present without compromising the ability of future generations to meet their needs." Sustainable animal production integrates three main goals - environmental health, economic profitability, and social and economic equity. The FAO reports that the livestock sector is socially and politically very significant. It accounts for 40% of the global agricultural gross domestic product. It employs 1.3 billion people and creates livelihoods for 1 billion people, many of whom represent the world's poor.

Globally, animal production, particularly livestock production is the largest user of agricultural land and accounts for almost 40 percent of the total value of agricultural production. In developed countries, this share is more than 50 percent. In developing countries, where livestock production accounts for one-third of the value of agricultural production, its share is rising rapidly as a result of growth in income and changes in lifestyle and dietary habits.

2. Scope and Scale – Species Distribution

Agricultural animals, also referred to as livestock, are the main sector in animal production. The main animal species include cattle (dairy, beef, buffalo), poultry (broilers, laying hens, turkeys), swine and small ruminants (goats, sheep). Table 1 shows the global distribution of livestock. Recent statistics show that about 25% of cattle and small ruminant population and about 30% of poultry and swine production are in developed countries. The number of ruminant animals produced per unit of agricultural area in developing countries is almost double that of undeveloped countries which has implications for nutrient utilization and environmental pollution. Non-livestock animal production includes keeping horses, dogs, cats and semi-domesticated animals such as bison, red deer and elk. Fish production (both from natural habitat and aquaculture) has shown significant growth globally, and according to FAO average fish supply per head has doubled from 8 kg in 1950 to over 15 kg in 1996. The average consumption of fish protein has risen from 2.7 g per head per day in 1960 to 4.0 g today, representing 16% of all animal protein.

	Cattle	Poultry	Swine	Small ruminant
Developed	326 830	4 518 867	285 215	400 136

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Developing	983 781	10 627 741	632 420	1 322 038
World	1 310 611	15 146 608	917 635	1 722 175

Table 1. Cattle, poultry, swine and small ruminant population in developed and developing countries (‘000 head). Source: FAO

3. The Purpose of Animal Production

3.1. Commodity

3.1.1. Food and Health

The world’s population is expected to increase by 50 percent between 2000 and 2050, with the developing countries supporting almost all of that growth. Analyses indicate that there is likely to be sufficient overall food production at the global level to meet expected increases in effective demand, although such analyses have not yet incorporated the recent surge in demand for biofuels. About 80% of the increase in land-based agricultural production is expected to be derived from increased input use and improved technology on existing agricultural land, while area expansion in parts of South America and sub-Saharan Africa is expected to account for the remaining 20%.

Global dietary patterns have changed significantly over the past four decades. Diets have shifted away from staples, such as cereals, roots and tubers and pulses, towards more livestock (meat and dairy) products, vegetable oils, and fruits and vegetables. Income growth, relative price changes and urbanization have altered dietary patterns in both developed and developing countries. When people have more money to spend, they normally add more variety and more expensive and high-value foods to their diets, although responses differ between developing and developed countries. Livestock products account for one-third of protein intake in humans and this is likely to continue to rise, especially in developing countries.

Animal products contain high-value protein which improves the nutrition of the vast majority of the world. Livestock products not only provide high-value protein but are also important sources of a wide range of essential micronutrients. These nutrients include minerals such as iron and zinc, and vitamins such as vitamin A. For the large majority of people in the world, particularly in developing countries, livestock products remain a desired food for nutritional value and taste. As a result global production of milk and meat are expected to double over the next five decades. However, excessive consumption of animal products can lead to excessive intakes of fat in some countries and social classes leading to health risks.

Recent advances in animal nutrition have added nutritional and health value to animal products; for example, the increased amount of conjugated linoleic acid (CLA) and omega-3 fatty acids in animal products. CLA is a group of polyunsaturated fatty acids of positional and geometrical isomers. The major health benefits accorded to CLA include decreased body fat deposition, modulation of blood lipids and prevention of

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breast cancer. Omega-3 fatty acids from fish oil in the form of EPA (eicosapentaenoic acid) and DHA (docosahexaenoic acid) have been shown to decrease cardiovascular disease related events in risk patients. Omega-3 fatty acid enriched eggs, and EPA and DHA rich milk and milk products are already available for consumption in most developed countries.

3.1.2. Clothing

A byproduct of animal production is its provision of clothing and household materials. Skins (hides) are made into leather and ultimately used to make coats, shoes, hats etc. It is estimated that about 10% of the value of the animal at the abattoir is in its skin, worth about $1.3 billion a year in the UK alone. Wool production is also a byproduct of the meat industry. Fine wool needed to make sweaters comes from Merino sheep, a breed that originated in Spain but now kept in Australia in vast numbers. Wool from other breeds is also used for coarse fabrics such as carpets. Genuine cashmere is one of the most expensive fibers. It comes from the underbelly of a special breed of Himalayan goat and it is obtained by combing each goat by hand during the molting season. One goat yields only about 100 g of cashmere per year and on average; it takes the yield of three goats to make one sweater. Eighty-five to ninety percent of the world's cashmere comes from China. Mohair is a product of the white Angora goat. It is a long fiber and coarser than cashmere. Very large herds of up to 20 000 Angora goats are kept in South Africa and Texas, purely for mohair production.

3.1.3. Energy/power

Until recently, a large proportion of livestock in developing countries were not raised for food, but for providing draught power and manure and as capital assets that were only disposed of in times of emergency. In developing countries, it is estimated that 52% of draught power comes from animals. Crop production in some developing countries, such as Ethiopia, almost totally depends on oxen power. In India, selling cattle dung for fuel to urban centers can supply up to 60% of the income of a poor village family.

3.2. Non-Commodity

3.2.1. Agritourism

Agritourism is a style of vacation which is normally spent on farms. This may include the chance to help with farming tasks during the visit. Agritourism is often practiced in wine growing regions in Italy and Spain. In North America, agritourism is wide-spread and includes any farm open to the public at least part of the year. Tourists can pick fruits and vegetables, ride horses, taste honey, learn about wine, shop in farm gift shops and farm stands for local and regional produce or hand-crafted gifts, and much more.

Agritourism is developing into a large part of the tourism industry and it is expected to be one of the largest sectors of tourism. Agritourism can be viewed much like eco-tourism in that it is small-scale, low-impact, and, in most cases, education-focused.

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3.2.2. Companionship and Other Benefits

Companionship is provided by pets such as dogs and cats. In developed countries, a significant amount of money is spent for their nutrition and health. Additionally, police forces, search and rescue companies, airport and security personnel as well as the hearing and visually impaired rely every day on working animals.

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Biographical Sketch

Ermias Kebreab has PhD (1998) and MSc (1991) degrees in ecological modeling from The University of Reading, Reading, United Kingdom.

He was a Research Associate at The University of Reading from 1998-2003 and Adjunct Professor from 2003-2007 at the University of Guelph, Canada. He was appointed to the Canada Research Chair position at the University of Manitoba, Canada in 2007. He is the author of more than 80 refereed articles and three books. His research interests are nutrition modeling and mitigation of environmental pollution including greenhouse gases from animal agriculture. He is working towards quantitative understanding of sustainable agricultural systems. His work has been recognized by the American Society of Animal Science Early Career Achievement Award in 2004 and Canadian Society of Animal Science Young Scientist Award in 2006.

Dr Kebreab is a member of American Society of Animal Science, American Dairy Science Association, American/Canadian Society of Agricultural and Biological Engineering and Western Director of Canadian Society of Animal Science.

Kimberly Ominski possesses a PhD (1994) in nutritional biochemistry from the University of Manitoba,

Canada.

Since joining the Department of Animal Science at University of Manitoba in 2001, she has established a systems-based multidisciplinary research program examining the environmental and economic sustainability of beef cattle production systems. Her research interests have focused on identification of strategies to reduce enteric methane emissions in cattle.

Karin Wittenberg has a doctorate in Ruminant Nutrition from the University of Manitoba, where she is now Associate Dean, Research in the Faculty of Agricultural and Food Sciences. An initiative led by Dr. Wittenberg has resulted in the recent establishment of the National Centre for Livestock and the Environment at the University of Manitoba.

Wittenberg's work reflects the continuing need to improve competitiveness and to address key issues facing animal agriculture. She was appointed to the Expert Panel on Future of Food Biotechnology in Canada, Royal Society of Canada (2000-01) to provide recommendation to the Government of Canada regarding the potential and risk of genetically modified plants and animals in our food production systems. She was appointed to the Agriculture and Agri-Food Table on Climate Change (1998-2000), the Agriculture and Agri-Food Canada Advisory Committee related to greenhouse gas mitigation (2002-2006), and Environment Canada's Technical Committee on GHG emissions from Livestock (2008-present). Wittenberg maintains a research program in the area of grassland management and environment, and has developed the research tools for some of the first greenhouse gas work generating information relevant to Canadian production systems.

Wittenberg has been recognized for her contributions by the Canadian Society of Animal Science Award for Excellence in Nutrition and Meat Science in 2004, the YMCA Woman of the Year in Science and Innovation in 2008 and the 2009 Education Award by Manitoba Pork Council.

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