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CIAP

Consequences of Industrialized Animal Production Systems

Background

There has been a tremendous increase in meat consumption globally. To meet the growing demand, total meat production is projected to double by 2020. In response to this increase, industrialized animal production systems (IAPS) are proliferating, and consequently result in complex issues concerning the environmental sustainability of livestock production. Even though per capita consumption is leveling off in developed countries, per capita demand in many developing countries is rapidly climbing as a result of population and income growth. At present, one-half of all pork and poultry production is industrialized in the global markets, as is about three-fourths of the global egg supply. These industrialized systems are large, confined animal feeding operations that depend heavily on cereal grains and fishmeal processed from ocean stocks. Currently, one-third of all cereal grains harvested globally, and two-thirds of the grains harvested in the United States are now devoted to animal feed production.

Implications

The trends and structural changes in industrial systems have enormous consequences for society and the Earth system. Industrialized animal production systems have considerable impacts on the quality of the atmosphere, water and soil due to nutrient overloads; they impact terrestrial ecosystems directly and indirectly; in addition, disruption of marine fisheries occurs locally with pollution and runoff from production facilities and globally in terms of depletion of fish stocks where fishmeal has become a large commodity in the production of livestock feeds.

Growing intensities and increasing scales of production accompanied by geographic shifts and geographic concentration leads to vertical integration of production and longer food chains. This trend is becoming very evident on a global scale. Socially, many advanced technologies are not scale-neutral; smallholders cannot access these technologies, resulting in inequities in competition with businesses and livelihoods lost. In terms of public health, food safety has improved, but growing intensities have also given rise to new disease problems, such as Bovine Spongiform Encephalopathy (Mad Cow Disease) and Avian flu. Other serious residue problems, such as organic waste, heavy metals and antibiotics are also increasing threats to human health. The growing demand for concentrate feed, impacts land use and results in intensified cropping that affects local communities. The production of feed grains, in particular, adds additional stress on biodiversity through habitat loss and damage to ecosystem functioning (de Haan, et al 2003)

The resulting concentrated waste production from these systems and its effects on terrestrial and aquatic ecosystems is a serious matter; In addition, the massive global trade in grains for animal feed has greatly altered regional biogeochemical cycles. In some cases, IAPs may be a solution to resolving particular food supply issues. A greater understanding of the industry and inter-related problems is necessary to encourage more sustainable production systems that minimize impacts on society and environmental services.

What we need to do

Animal production is a complex endeavor involving or impacting, directly and indirectly, various segments of society. Many of the concerns relating to industrialized production are considered in isolation. In order to develop sustainable practices there must be an integrated view of the many interactions involved so that efforts to ameliorate one impact does not negatively impact another. Further, such an approach should reveal the full costs and benefits of these practices to society at large. We propose to examine the drivers of change in animal production systems; this includes the resulting trends in practices and their consequences. We will examine the various costs and benefits this industry presents to society and the environment, resulting in increased awareness of the issues, problems and associated solutions

Who is taking on this task?

In order to accomplish such a broad assessment, a team of natural and social scientists, government representatives and industry experts is being engaged. This geographically balanced team includes experts from both developed and developing countries. Under the auspices of the Scientific Committee on Problems of the Environment (SCOPE) this project is collaborating with LEAD (the Livestock, Environment and Development Initiative) an inter-institutional effort coordinated within the UN Food and Agriculture Organization (FAO). Other collaborators include the International Nitrogen Initiative (INI), which is co-led by the International Geosphere Biosphere Programme (IGBP), and SCOPE. SCOPE also recently completed a successful multi year program leading to the development of a global strategy for addressing invasive species (Global Invasive Species Programme - GISP) and administered the scenarios work of the Millennium Ecosystem Assessment.

The major issues that will be addressed in the assessment:

1. Atmosphere, water and soil

Animal wastes from industrialized facilities often exceed local assimilation capacity of surrounding landscapes resulting in pollution of air, soil and water affecting both humans and wildlife. Stored liquid manure produces over 13 million tons of the greenhouse gas methane per year (de Haan, et al 1997) and this figure is growing as more animal production systems are made operational, this coupled with other forms of pollution will increase unless improved practices become more widespread. This study will assess the consequences of the gases, liquids and solids generated from industrialized animal production systems and released to the atmosphere, water and soils, analyzing the impacts and benefits using an integrated approach and will identify more environmentally sustainable methods of production.

2. Interactions with coastal and marine systems

There are strong connections between terrestrial-based animal production systems and the effects on marine and coastal systems. These connections range from impacts created by effluents from facilities located in coastal plains to the heavy utilization of fishmeal in production animal feeds. About a third of the total marine wild fish catch is utilized for fishmeal, two-thirds of which goes to chickens, pigs and other animals (Naylor, et al., 2000). Waste spills from facilities located in coastal regions with high concentrations of animal production facilities have adversely affected estuarine fisheries (Burkholder, et al., 1997). Hurricane and flood prone areas are particularly vulnerable, such as the coastal plain of North Carolina where hundreds of concentrated animal facilities are located (Wing, et al., 2002). We will assess the inputs from animal production facilities to these ecosystems and analyze the impact of selective fish harvesting on marine ecosystems and species groups in collaboration with FAO and the University of British Columbia, marine fisheries department.

3. Global trade in livestock products and feed grain, resource use, subsidies and demand for food and feed grain

Industrialized animal production contributes to lower cost of production of meat, milk and eggs. In a global economy this can lead to increased international trade in these products and in the feed grains involved in their production. This in turn may potentially impact the global demand for feed grains, consequently affecting the supply of grain available for food grains directly consumed by humans and other resources used by various animal production systems. Though this is a necessary cycle in terms of food production, at various scales there are environmental consequences that are unaccounted for. For example, through trade of grain and meat, Japan is importing more "virtual" water than it withdraws from its natural sources (Oki and Kanae, 2004). The cost of this resource use is not necessarily included in the pricing of the products. Export nations, in turn, assume the burden of the environmental consequences of this resource use (cost of water, nutrient and energy for production) of the crop and meat production. This assessment will clarify the costs and benefits of increased production and consequent use of resources with an aim to increase awareness and inform policy makers and the industry.

4. Human health (Zoonoses, food safety, occupational health, nutritional quality, public health impacts)

Industrialized animal production systems have direct and indirect impacts on human physical and psychological health. This effort will identify and assess injury, respiratory disease, neurological impairment and other health issues among workers. The public health risks associated with communities proximal to operations are an issue in many communities. Other problems will be evaluated, such as the use of antibiotics, hormones and various chemical compounds in relation to livestock production systems. These components seriously impact human wellbeing and are utilized routinely in many production systems.

5. Animal health (disease control and prevention) and welfare (stress and well-being)

Industrialized animal production entails several factors that potentially impact the health and welfare of animals within and outside these systems. Greater concentrations of livestock increase animal stress, the risk of infection, and promote disease transmission among herds, flocks or schools (fish). There are ethical and public health concerns in many facets of production. Management techniques in animal health are key to preventing the spread of zoonotic disease. These health and welfare issues will be assessed within an integrated framework.

6. Economic and social systems (local to global scales)

Approximately 60 years of social service work, primarily in rural sociology and anthropology has resulted in a body of research on measurable social effects concerning the industrial focus of agriculture. This research includes assessing civic activity, involvement in community affairs, management of community services, local governance, poverty and other measures often

referred to as social capital (Thu and Durrenberger, 1998). The rapid development of vertical and industrialized production systems often precludes the possibilities of local social adjustment to the large changes engendered as is well documented for industrialized aquaculture production facilities. These issues are equally true for terrestrial animal facilities and the work of this assessment will engage various sectors and examine the complex relationships that exist with a focus on raising awareness and suggesting pathways for improving the current conditions.

7. Institutional dimensions (Industry influences, regulatory enforcement)

Exploration of the political economy of livestock production is the focus of this topic. How do the institutions perform? How do they fit the challenges and how do they interact on different scales? We will address this by analyzing the design and development of institutions that reduce the adverse affects of industrial animal production and enhance sustainability in food systems including the role of institutions for technological innovation. If improved policies and better technologies are adopted, small-scale producers can become more involved, with related benefits for environmental sustainability, consumer empowerment, and poverty alleviation (Delgado et al, 1999).

8. Scenarios

The objective of the scenarios focus is to develop plausible futures of animal production systems under different trajectories of local to global development. An approach we will explore is to model the methods utilizing global scenarios as developed by the Millennium Ecosystem Assessment (MA, 2004). These scenarios include ecological feedbacks and aspects of concern for human well-being. In order to accomplish this task, an integrated analysis needs to be made identifying the principle drivers of change of animal production systems and how they are inter-related, considering the social dimensions, economies, and production scales.

9. National case studies

Animal production systems have varied through time and among nations and cultures. There is currently a demand-driven revolution in livestock consumption and production that is taking place in many developing countries, impacting nutrition, health, the environment, national and international agricultural marketing and research systems (Delgado et al, 1999). How can we derive best practices from these experiences? How is globalization of trade affecting global practices in animal production? Representative case studies featuring a multi-scale approach to assessing practices and economies will illustrate specific responses to the demands and the role of industrialized systems in Brazil, China and other nations that are part of a growing trend in increased meat production.

How we will proceed

In order to address this large and complex issue we propose to hold an international meeting where specialists in all dimensions of this issue will come together and address the status of knowledge and practices of their specialty, and of the problems that they face in meeting the challenge of environmental sustainability and human well being. This general meeting is crucial in order to present the case for an integrated approach for future practices. For each of the topics noted above, specialists' meetings will follow where more detailed analyses and strategies for the future will be explored.

How we will integrate this knowledge

Following the special focus workshops there will be a synthesis meeting to facilitate bringing all of these components together. The output of the synthesis meeting will be an integrated model of how animal production systems are impacting local and global social and environmental systems. It will incorporate an analysis of best practices for mitigating adverse effects, and proposed new sustainable approaches that we need to develop to address the challenges that lie ahead in meeting the demands resulting from the huge shifts that are occurring in the consumption of animal protein in many parts of the world. Both scientific and popular publications will result from this effort, including a global strategy document. There will be focused public outreach to increase awareness of the issues, problems and associated solutions for the production industries, the general public and policymakers

Innovative concepts explored in the virtual workshop series:

Global Teleconnections are complex sets of human interactions driven largely by global trade that have environmental consequences in places widely separated in space. An example of such socially driven teleconnections is clearly shown by recent work on virtual water by Oki, Chapagain and Hoekstra, (2003). This concept refers to the water necessary to produce grain or meat that is subsequently shipped to some place distant from where it was originally produced, with the result that the receiving nation gets the benefit of the end product without incurring the water costs of producing the food. The Japanese import more virtual water than they withdraw for internal consumption. For this purpose, the majority of water comes from the United States and Australia, the latter a water-poor country. Globally, it has been calculated that 15-20% of the total global water use for agricultural production is virtual water trade—695 Gm³/yr in crops and 245 Gm³/yr for livestock and livestock products (Chapagain and Hoekstra, 2003).

In addition to investigating the complex issues surrounding the transfer of virtual water and nutrients in the global context of industrialized animal production systems, a national scales component was added to the assessment with

the intent to emphasize key implications of the industry at local scales. Preliminary calculations indicate very interesting trends for specific countries. These trends underscore the differing sources and sinks for nutrients and water, and highlight industrial determinants of change and potential impacts. These preliminary findings support the need for further analysis to identify hidden global teleconnections for both water and nitrogen.

Publications and Future Outputs

A series of scientific and popular publications will be produced as a result of the efforts of the working groups. Public outreach and engagement will serve various audiences that include the private sector, industry, government decision makers and the general public to increase awareness of the issues, problems and the associated solutions.

Outputs of the workshops policy forum paper will be prepared and in addition, a comprehensive technical review paper, will be completed in 2005, The paper will provide extensive qualitative and quantitative data and illustrate the issues surrounding virtual water and nutrient transfers on a global scale with the case studies providing a more localized and varied perspective. The group as a whole will combine to prepare a larger, more comprehensive technical review that will reflect a global overview, case studies analysis and policy implications. These two papers will illustrate the issues surrounding virtual water and nutrient transfers on a global scale with the case studies providing a more localized perspective highlighting the variations that exist based on various countries production and consumption aspects. Qualitative and quantitative data will be incorporated in the assessment process. The national case studies (Brazil, Netherlands, Japan, USA) will also be utilized to illustrate the main drivers, processes, and teleconnections.

The CIAP conceptual framework and program design meeting is in planning for 2006. Other meetings and activities are in planning for 2005 and 2006.

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