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Review on: Livestock Production and Global Climate Change

Ashenafi Assefa Adugna *
Jimma University college agriculture and veterinary medicine, Jimma, Ethiopia
PO box 307, Jimma, Ethiopia

Abstract
Livestock productions are changing rapidly in response to a variety of drivers as human population is expected to increase from around 6.5 billion today to 9.2 billion by 2050. This paper reviews on livestock production and global climate change. The effect of climate on animal production is categorized in to four ways: (a) the impact of changes in livestock feed availability and price; (b) impacts on livestock pastures and forage crop production and quality; (c) changes in the distribution of livestock diseases and pests; and (d) the direct effects of weather and extreme events on animal health, growth and reproduction. Livestock and livestock-related activities such as deforestation and increasingly fuel-intensive farming practices are responsible for over 18% of human-made greenhouse gas emissions, including: 9% of global carbon dioxide emissions, 35-40% of global methane emissions (chiefly due to enteric fermentation and manure), 64% of global nitrous oxide emissions (chiefly due to fertilizer use).
Keywords: impact, livestock production, climate change

1. Introduction

Livestock productions are changing rapidly in response to a variety of drivers as human population is expected to increase from around 6.5 billion today to 9.2 billion by 2050. Demand for livestock products is increasing specially in developing countries the rapid growth in demand for livestock and livestock products is driven by urbanization, population growth and income increases (Thornton P, 2007). According to Gowri and Danielle, 2008 scrutiny, livestock production incorporates rearing of animals, grain and fertilizer production for feed, waste storage and disposal, water and energy expenditures on farms and in transporting feed and finished animal products. The global average surface temperature increased by about 0.6 °C during the twentieth century (IPCC, 2001). Furthermore IPCC, 2007 states that the maximum observed global temperature increment since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations. This paper reviews the effect of livestock production on climate change and effect of climate change on livestock production.

2. Impact of climate change on livestock production

The effect of climate on animal production is categorized by (Silvia, no date) in to four ways: (a) the impact of changes in livestock feed availability and price; (b) impacts on livestock pastures and forage crop production and quality; (c) changes in the distribution of livestock diseases and pests; and (d) the direct effects of weather and extreme events on animal health, growth and reproduction.

Although indirect, effects on feed resources can have a significant impact on livestock productivity, the carrying capacity of rangelands, the buffering ability of ecosystems and their sustainability, prices of stovers and grains, trade in feeds, changes in feeding options, greenhouse gas emissions, and grazing management. The main pathways in which climate change can affect the availability of feed resources for livestock are as follows: Land use and systems changes: as temperature and rainfall becomes more variable the niches for different crops and grassland species change (Thornton et al., 2007). Changes in the primary productivity of crops, forages and rangelands: the effects are significantly different depending on location, production system and on crop and pasture species. Changes in species composition: as temperature and CO_2 levels change due to climate change, the optimal growth ranges for different species also change. It has also been suggested recently that the proportion of browse in rangelands will increase in the future as a result of increased growth and competition of browse species due to increased CO_2 levels (Morgan et al., 2007). Quality of plant material: it has been shown that increased temperatures increase lignification of plant tissues and therefore reduce the digestibility and the rates of degradation of plant species (Minson, 1990).

Livestock genetics and breeding and Livestock Health: the impacts of climate change on livestock in disease aspect have been on diseases that are vector-borne. Climate change is bound to have further impacts on heat-related mortality and morbidity and on the incidence of climate-sensitive infectious diseases (Patz et al., 2005).

The adverse effects of climate change are already evident in developing countries where population growth, lack of food security, and other socioeconomic factors exacerbate families' vulnerability to impacts (Bishaw et al., 2013). Similarly Seo S, et al., 2006 explained as American livestock appear not to be vulnerable to climate change because they live in protected environments (sheds, barns etc.) and have supplemental feed (e.g. hay and corn). In Africa, by contrast, the bulk of livestock have no protective structures and they graze off the land. Developing countries are generally considered most vulnerable to the effects of climate change than more developed countries, largely because of their often limited capacity to adapt (Thomas and Twyman, 2005).

3. Impact of agriculture on climate change

The agricultural sector is a driving force in the gas emissions and land use effects thought to cause climate change. Agriculture contributes to greenhouse gas increases through land use in four main ways: CO2 releases linked to deforestation , Methane releases from rice cultivation and enteric fermentation in cattle and Nitrous oxide releases from fertilizer application.

3.1 Impact of Livestock on climate change

Farm animals and animal production facilities cover one-third of the planet's land surface, using more than two-thirds of all available agricultural land including the land used to grow feed crops (Haan et al. 1997). Livestock and livestock-related activities such as deforestation and increasingly fuel-intensive farming practices are responsible for over 18% of human-made greenhouse gas emissions, including: 9% of global carbon dioxide emissions, 35-40% of global methane emissions (chiefly due to enteric fermentation and manure), 64% of global nitrous oxide emissions (chiefly due to fertilizer use) (Kedar,2008).

Worldwide, livestock production occupies 70% of all land used for agriculture, or 30% of the land surface of the Earth (Kedar, 2008). The production system of livestock have different level of impact on environmental pollution, for example raising cattle for beef organically on grass, in contrast to fattening confined cattle on concentrated feed, may emit 40% less GHGs and consume 85% less energy than conventionally produced beef (Alex Avery and Dennis Avery, Beef Production and Greenhouse Gas Emissions).

3.1.1 The Greenhouse gasses that are emitted from livestock production

Methane and N2O both extremely potent GHGs have greater global warming potentials (GWPs) than does CO2. By assigning CO2 a value of 1 GWP, the warming potentials of these other gases can be expressed on a CO2-equivalent basis (Steinfeld et al. 2006): CH4 has a GWP of 23, and N2O has a GWP of 296.

3.1.2 CO_2 emissions from livestock production

CO2 has the most significant impact on global temperature than all the natural and human-induced influences on climate over the past 250 years (Bierbaum et al. 2007). According to Steinfeld et al. 2006 study the animal agriculture sector accounts for approximately 9% of total CO2 emissions, which are primarily the result of fertilizer production for feed crops, on-farm energy expenditures, feed transport, animal product processing and transport. Energy uses in these industrial facilities differ substantially from those in smaller-scale, extensive, or pasture-based farms.

The amount of fossil fuels burned varies depending on the species and type of animal product. For example, processing 1 kg of beef requires 4.37 mega-joules (MJ), or 1.21 kilowatt-hours, and processing 1 dozen eggs requires > 6 MJ, or 1.66 kilowatt-hours (Steinfeld et al. 2006).That same 1 kg of beef may result in GHGs equivalent to 36.4 kg of CO2, with almost all the energy consumed attributed to the production and transport of feed (Ogino et al. 2007). Approximately 0.8 million metric tons of CO2 are emitted annually from the transportation of feed and animal products to the places where they will be consumed (Steinfeld et al. 2006). Farm animal production also results in releases of up to 28 million metric tons of CO2/year from cultivated soils (Steinfeld et al. 2006). Soils, like forests, act as carbon sinks and store more than twice the carbon found in vegetation or in the atmosphere (Steinfeld et al. 2006).

3.1.3 Nitrogen from fertilizer and feed production

According to Elizabeth Holland, (Bohan 2007), the changes to the nitrogen cycle are larger in magnitude and more profound than the changes to the carbon cycle but the nitrogen cycle is being neglected. Pollan, 2006 emphasize the same issue as Indeed, the overwhelming majority of all crops grown in the industrialized world are nitrogen-saturated, and overuse of nitrogen in crop production, nitrogen runoff into waterways, and the millions of tons of nitrogen found in farm animal manure threaten environmental integrity and public health.

4. Methane and nitrous oxide

The animal agriculture sector is also responsible for 35–40% of annual anthropogenic methane emissions (Steinfeld et al. 2006) that result from enteric fermentation in ruminants and from farm animal manure. Methane emissions are affected by a number of factors, including the animal's age, body weight, feed quality, digestive efficiency, and exercise (Steinfeld et al. 2006). Typically, the standard diet fed to beef cattle confined in feedlots contributes to manure with a "high methane producing capacity" (U.S. EPA 1998). In contrast, cattle rose on pasture, eating a more natural, low-energy diet composed of grasses and other forages, produce manure with about half of the potential to generate methane (U.S. EPA 1998).

With confined farm animals in the United States alone generating approximately 500 million tons of solid and liquid waste annually (U.S. EPA 2003). Storing and disposing of these immense quantities of manure can lead to significant anthropogenic emissions of methane and N2O (U.S. EPA, 2007). For example, as stated in Gowri and Danielle 2008 farm animal manure management accounts for 25% of agricultural methane emissions in the United States and 6% of agricultural N2O emissions.

Farm animal manure is the source of almost 18 million metric tons of annual methane emissions (Steinfeld et al. 2006). Between 1990 and 2005 in the United States, methane emissions from dairy cow and pig manure rose by 50% and 37%, respectively (U.S. EPA 2007a). The U.S. EPA, 2007 traces this increase to the trend toward housing dairy cows and pigs in larger facilities that typically use liquid manure management systems, which were first in use in the 1960s (Miner et al. 2000) but are now found in large dairy operations across the United States and in some developing countries, as well as in most industrial pig operations worldwide. Although 70% of anthropogenic emissions of N2O result from crop and animal agriculture combined, farm animal production, including growing feed crops, accounts for 65% of global N_2O emissions (Steinfeld et al. 2006).

5. Conclusion

Livestock production plays a key role in the food supply of human. Climate change is suppressing the increasing demand of livestock and livestock products globally. Particularly through changes in livestock feed availability and price, blow on livestock pastures and forage crop production and quality, changes in the distribution of livestock diseases and pests and the direct effects of weather and extreme events on animal health, growth and reproduction. Climate changes potentially affect livestock production and result in a decline in livestock products. Livestock production produces potent green house gases; C2O, CH4 and N2O that aggravate global warming through climate change. Methane from enteric bacterial fermentation and nitrous oxide from manure and application of fertilizer for feed cultivation.

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