CO_2 EMISSION FOR THE PRODUCTION OF BEEF IN SOUTH KOREA

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Abstract – Currently, meat consumption was confronted environmental burden, however animal product was very important to provide essential protein source. Already big agricultural countries tried to assess the environmental burden on animal production system and to reduce the environmental burden. Thus this study was conducted to provide base line data of environmental burden for beef production in South Korea. In this study, environmental burden was calculated to carbon dioxide emission, and methodology of the calculation was modified from PAS2050:2011 guideline of United Kingdom and carbon footprint calculation guideline of Korean Industry and Institute. As results of this result, 1kg of live cattle emitted 16.55kg CO_2-eq, 1kg of packaged beef was finally emitted 27.8659kg CO_2-eq. Also, 77.6661 g CO_2-eq was emitted at industrial storage, retail, and house storage.

Key Words – Beef production, Carbon dioxide emission, Environmental burden

- INTRODUCTION

Food and Agriculture Organization of the United Nation [2] reported about livestock on environ-mental burden and sustainable agriculture, and the report aroused many consumers' attention risk eating meat. They also reported that greenhouse gas emission of livestock sector was occupied to 18% on all of industry sectors, and livestock sector was bigger portion than industry (16%), transport (13.5%) and energy usage (13%). However the livestock sector feeds 30 percent of proteins consumption of global population, has very important nutritional role providing essential amino acid, also it solve gaining livelihood of around one billion poverty, and it has social significant to offer jobs for over the one billion [2, 5]. Currently, United State, Canada, Australia, New Zealand, and European countries already studied life cycle assessment for animal products and livestock area [1]. Moreover, in Japan that had similar condition of livestock farming with South Korea, several studies were conducted about meat production and consumption [4]. However, until now, there was any database of animal product, and only several agricultural products were assessed of their environmental burden in South Korea. Thus this study was carried out to provide base line data of environmental burden for the beef production in South Korea.

- MATERIALS AND METHODS

Methodological concept of this study was modified from PAS2050: 2011 (UK) and a guideline of Korea Environmental Industry and Technology Institute.

Goal definition and scope of this study: The purpose of this study was to calculate amount of greenhouse gas emission of beef associated with production, processing, distribution, and

imported beef transportation. System boundary of each stage was set up with considering characteristics of farm, processing plant, and distribution system that were used for case study (Fig. 1), and a steer farm and a slaughterhouse were sited on Jeonbuk province in South Korea. The purpose of functional unit on this study was provided basic database to animal production sector on carbon footprint in South Korea. This study was purposed to provide basic database on animal production system, there were various functional units in each stages.
Data collection: All of input source and waste on each stage was collected from 1st January to 31st December in 2010. Schematic diagrams of unit process for this study were reflected in data handling condition of field.

Calculation of carbon dioxide footprint: Carbon dioxide footprint emitted at farm, slaughterhouse, and distribution stages was calculated using database of Korea Environmental Industry and Technology Institute [3], LCAFood [7] and Ecoinvent [7] and from several previous studies [4, 6].

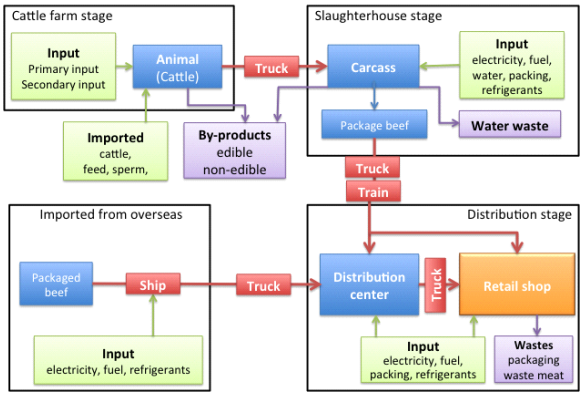

Figure 1. Schematic diagram of beef production in South Korea

- RESULTS AND DISCUSSION

At the farm stage (Table 1), 1kg of live cattle emitted 16.55kg CO_2-eq, in other words, total of 12,298kg CO_2-eq was emitted from 30months steer. However, this result was on limitation that did not include feed transportation. According to a study of Ogino et al. [4], feed transportation and processing was 41% of total CO_2-eq emission at beef production in Japan. In consider of the feed transportation part of farm stage, we could expect that finally 1kg of live cattle emitted approximately 28.5 CO_2-eq. Methane that ruminant generated by digestion was a major greenhouse gas, had 25 global warming potential (GWP_{100}). In this study, Hanwoo steer generated 144kg of methane for 24 months from 6month to 30month age; also amount of methane emission of Hanwoo steer in South Korea was higher than North America (53kg/head/year) and Oceania (60kg/head/year).

Table 1. Amount of Carbon dioxide equilibrated emission and methane at steer farm stage in South Korea

Functional unit	
..... Greenhouse gas emission.....	
1kg of live steer	16.551kg CO_2-eq
..... Methane emission	
A steer per day	0.1975kg CH_4
A steer for 24months	144.19kg CH_4

At slaughterhouse stage (table 2), 0.1074kg CO_2-eq was emitted from slaughtering for 1kg of hot carcass or edible byproducts, namely it means as that 17.5814kg CO_2-eq was emitted producing from 1kg of hot carcass. 1kg of trimmed beef and 1kg of packaged beef were emitted

27.4186 kg CO_2-eq and 27.8659kg CO_2-eq respectively.
Table 3 showed that CO_2 –eq emission due to energy input at distribution stage. In South Korea, chilled beef was stored for average 10 days at industrial storage, 26days at retail storage included display, and bought beef by consumer was consumed before average 3days. From the each steps, 0.7425g CO_2 –eq, 11.5836g CO_2 –eq, and 65.34g CO_2 –eq emissions were calculated respectively.

Table 2. Amount of Carbon dioxide equilibrated emission at slaughterhouse stage in South Korea

	Kg CO_2-eq	Functional unit
Slaughter process	0.1074	For 1 kg of hot carcass or edible byproducts
Carcass of cattle	17.5813	1kg of hot carcass
Trimmed beef	27.4186	1kg of chilled beef
Packaged beef	27.8659	1kg of packaged beef

Table 3. Amount of CO_2 equilibrated emission from energy usage at whole storage of beef after slaughter to consumption in South Korea

	At industrial storage	At retail	At house storage
Storage days	10days	26days	3days
g CO_2 -eq emission	0.7425	11.5836	65.34
Functional unit	1kg of chilled beef		

- CONCLUSION

South Korea had long fattening period with grain fed system on beef production that depended on imported grain. Thus environmental burden of beef production and/also consumption were higher than other big agricultural countries. This study could be base line data on greenhouse gas emission from beef production and consumption in South Korea. Additionally we suggest a possibility to reduce environmental burden of meat consumption at the after farm gate through tenderization technique.

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