An Assessment of the Carbon footprint of Milk Production under Small Scale Farming Conditions

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Abstract

The Carbon footprint (CFP) is "the total set of Green House Gas (GHG) - mainly CO_2, CH_4, N_2O - emissions caused directly and indirectly by an individual, organization, event or a product". The main objective of this study was to calculate the CFP values of raw milk at farm level under small scale farm conditions in Matara and Galle districts. The Tier-1 approach of the Life Cycle Assessment methodology under the Inter-governmental Panel of Climate Change (IPCC) guidelines was employed. Data were collected from 8 small scale dairy farms. It was found that the CFP values of the studied farms are in the range of 3.75 to 16.66 kg of CO_2 equivalent per kg of Fat and Protein Corrected Milk (FPCM). The mean CFP value was 8.5 CO_2 equivalents per kg of FPCM. Only three farms had lower CFP value compared to that of South Asian average. Main determinants of high level of GHG emission were enteric fermentation (50-70%), manure handling (10-20%) and feed (5-10%). Therefore, it can be concluded that CFP of milk production of small scale farms can be reduced by proper feed and waste management practices.

Key words: CFP, GHG, Life Cycle Assessment, Fat and Protein Corrected Milk

Introduction

Global warming which causes climatic change is one of the burning issues of the world. Increment of the global heat causes glacier retreats, sea level rising, extinction of valuable species, and ultimately the biodiversity face to a disaster. Among a number of several reasons for global warming, greenhouse gas (GHG) emission takes highest position. The GHGs are mainly CO_2, CH_4 and N_2O. The GHG emission occurs from several activities such as transportation, power stations, land use and biomass burning and also from agricultural by products.

Agricultural sector contributes considerable amount of GHG to the environment. Dairy farming has been practiced as a part of agriculture for thousands of years. The dairy sector plays a major role in GHG emission. Enteric fermentation of dairy cows releases a high amount of methane to the environment. A greater part of the GHG emissions of dairy products originates before farm gate (Gerber, 2010), and therefore the estimate of emissions from raw milk is crucial to reduce CFP of dairy products. Most of the emissions from raw milk production are biogenic CH_4 and N_2O originating from the biological processes in the rumen, manure and the soil.

The largest environmental burden for animal food products is created at the primary production stage. Raw milk is one of the primary products from dairy farms. Although there are several assessment for greenhouse gas emissions from dairy industry under global conditions, estimates of GHG emission under local conditions are lacking. Small and medium scale dairy are the main contributor to the national milk production. Therefore, information about the CFP of milk production under these conditions are of importance for the policy makers and scientist. Furthermore, a careful analysis of the different

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components of the CFP could be used as a tool to identify the strategies of reducing CFP. The objectives of this research are to (1) calculate carbon footprint of small scale milk production systems and (2) to make suggestions to reduce the carbon footprint of raw milk production.

Materials and Methods

The LCA approach was applied to analyze the CFP values, for several years. The reference unit that denotes the useful output of the production system is known as the functional unit, and it has a defined quantity and quality. The functional unit used in here is one kg of FPCM (fat and protein corrected milk). Followings are the five steps of the LCA approach.

1. Mapping the process: This is about identifying the goal of the project, the functional unit that will be the subject of the analysis, and all materials, activities and processes that contribute to the product's life cycle.

2. Setting scope and boundaries: The scope addresses the overall approach used to establish the system boundary which determines which unit processes are included in the LCA and reflects the goal of the study.

3. Collecting data- This phase involves data collection and modeling of the product system, as well as description and verification of data. This encompasses all data related to processes within the study boundaries. In this study secondary data, observations and available records were used. At Mapalana, Labuduwa Government farm and other six farms from Pinnaduwa village in Galle district were considered. Number of milking cows in the heard, average milk yield per cow per day, feed types and amounts, average body weight of milking cows, manure management system and energy used are the main aspects considered. Descriptions of selected farms are given in the Table 1.
4. Calculating- Tier-1 method was selected as it is a simplified approach that relies on default emission factors drawn from the literature.
5. Evaluating and reporting (Interpretation)

Methodology used by BIDF (2010) was used in this study.

Results and Discussion

Table-1 shows the details of selected farms. Number of milking cows per farm ranged between 1-9 and the milk production per farm ranged between 1.5 to 55 l/day.

The mean CFP was 8.5 CO_2 equivalents per kg of FPCM is comparable with that of that of Sub Saharan countries (7.5) but substantially higher than the averages of other regions; South Asia (4.6), North Africa (3.7) and Near East (3.7) where management conditions are thought to be poor. The CFP of the small scale dairy farms is much higher compared to that of developed regions such as North America (1), South and Central America (3.2), Europe (1) (FAO 2010). Above comparison shows that a serious attention has to be paid to reduce the CFP of small scale dairy production systems of the country.

Milk production varied with the feeding system, feed type and age, weights and also breed of the milking cows. It was found that most of the GHGs (72%) are released to the atmosphere from enteric fermentation followed by the manure management (24%). There is a variation of CFP value according to the production

Table 1. Farming condition and Calculated Carbon footprint values of small scale farms studied

Farm	Breeds	Feeding	Management system	No of milking cows	Yield (day)	CFP
1	Jersey, Sahiwal , Freshian crosses	Panicum maximum, Prima cattle feed, oral supplement	Intensive system MM-Daily spread	09	16.05	13.79
2	Jersy,Freshian crosses	CO3,Prima cattle feed	Intensive system MM-Daily spread	10	55	4.33
3	Jersy,Freshian crosses	Forages, Prima cattle feed	Intensive system MM-Daily spread	06	13.5	10.36
4	Sahiwal, Freshian crosses	Forages, Prima cattle feed, rice bran	Intensive system MM-Daily spread	03	8.5	8.23
5	Jersey	Forages, Prima cattle feed	Semi intensive system MM-Pasture/range	01	5	4.99
6	Jersy,Freshian crosses	Forages, Prima cattle feed	Semi intensive system MM-Pasture/range	01	1.5	16.66
7	Jersy,Freshian crosses,Apes	CO3, Prima cattle feed	Semi intensive system MM-Pasture/range	03	20	3.75
8	Jersy,Freshian crosses	Forages, Prima cattle feed	Semi intensive system-MM Pasture/range	02	8	6.25

systems, feeding systems and breeding types. CFP was highly influenced by the per head milk production (Fig 1). It was observed that the low milk yield is mainly due to the poor management practices. Other aspects which contribute to CFP were space provided for animals, ventilation of cattle sheds, feed and feeding systems and quality of the cattle sheds.

Conclusions

Based on the findings it can be concluded that the CFP of raw milk is comparatively higher in small scale farms. The largest contribution to the GHG emmission

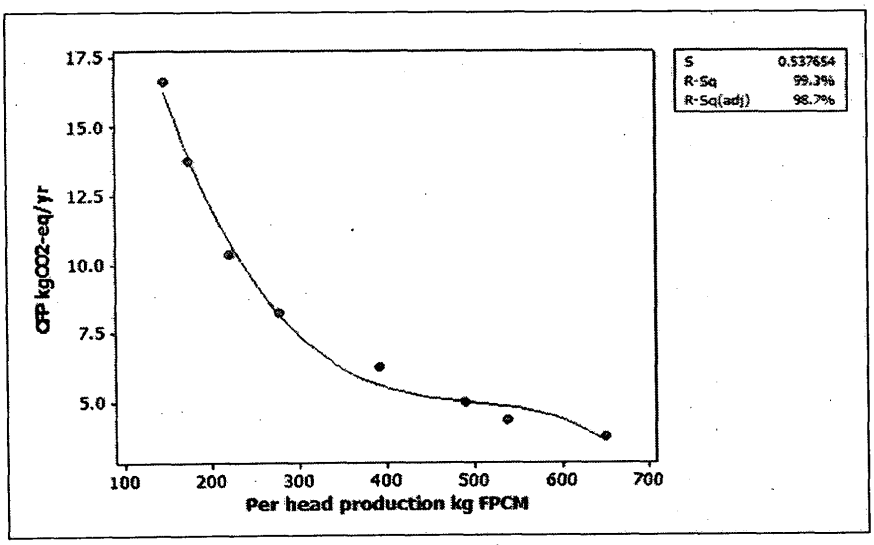

Figure 1. Effects of per head milk production on CFP of milk production

is due to enteric fermentation owing to poor quality feed and feed management. Proper feed and manaure management practices are important for the reduction of CFP of milk production under small farming conditions in Sri Lanka.

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