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AGRICULTURAL LIFE CYCLE ASSESSMENT (LCA) AS A ROUTINE EXERCISE IN IRAN: OPPORTUNITIES AND CHALLENGES

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ABSTRACT

To direct sustainability in agricultural sector via Life Cycle Management (LCM), an easy access to high quality environmental, social and economical data is important. In this study, we explored the possibility of performing environmental life cycle assessment in Iranian dairy sector. Main life cycle stages were examined for availability and quality of needed data. At each stage, applicable databases are introduced. To spur life cycle studies, we need legislation to encourage all parties by incentives for more sustainable products. Next step may be to review & restructure already existed databases, articles and grey publications to extract suitable data for LCI stage. However, it is now possible to assess some impact categories in dairy industry.

INTRODUCTION

Agricultural productivity in world has increased 150-200% between 1960 and 2010 by only 12% expansion in the cultivated land area (FAO, 2011). However, industrialization, population growth and intensification of land use causing this increased agricultural yield over the past several decades has not already come without several costs (Gliessman, 2004).

Agriculture is an important economic sector in Iran and provides 23.0% of Iran's gross domestic product (GDP), of which 30% is attributed to livestock sector (FAO, 2005). Iranian livestock sector, in 2007 produced 2323 and 7596 thousand tones of Meat and Milk respectively and per capita consumption of Meat and Milk were 30.4 and 70.5 kg/year (FAO, 2009). Nearly 18.1 percent of Iran active labor forces are also in the agricultural sector, which illustrates the great impacts of sector on social and economical issues in the country.

Depletion of natural resources occurs because of the aggregate of human activities, in fact one agricultural product may not be a problem but a million becomes one. In Iran, soil is lost due to erosion approximately 19 times faster than it forms (Emadodin et al, 2012). This way, in a long run, natural world will not be able to support our increasing needs anymore and to keep higher or at least present level of productivity we need to apply sustainability measures.

Iran is ranked the fifth country in the irrigated farming area, however, in the 20th rank, according to the total arable land. In addition, Iran also listed between 7th to 18th countries with the most GHG emission in world according to different reports. Soil erosion is a major environmental threat to the sustainability and productive capacity of agriculture by reduction of soil fertility and loss of nutrients and thus, declines of crop yields in farmlands. Mean annual soil erosion rate in Iran is about 25 tons/ha/year, 4.3 times more than the mean annual soil erosion rate in the world (Rostamian et al, 2008) In a recent report by FAO, water scarcity and soil degradation are considered as major risks for Iranian agricultural production (FAO, 2011). Iran is situated in one of the most arid and semi arid regions of the world. The average annual precipitation is 252 mm (one-third of the world's average precipitation). Agriculture is responsible for 92% of yearly water withdrawal. Approximately 45 % of water is supplied through surface water and 55 % with groundwater. The average decrease in the groundwater table is 0.51 meter. Water average efficiency in agriculture is estimated to be approximately 35 % (Emadodin et al, 2012).

Life cycle management (LCM) is a powerful tool to assess sustainability in this sector and to make it operational, an easy access to high quality environmental, social and economical data through the overall life cycle of products is of great importance. To manage and efficiently steer the work in the different parts of the life cycle, different tools has to be applied such as environmental management systems, procedures for approval of chemicals, product safety, supplier evaluations, energy or water saving programs, etc (Riise and Palsson, 2011). Besides, we need mainly technical data and indicators for each product system for progress measurement, setting benchmarks and impact assessment. Because of data intensive nature of LCM, data management and availability is crucial to dissemination of method especially in developing countries. In this study, we explored the possibility of performing routine environmental life cycle assessment in Iranian dairy sector.

RESEARCH METHODS

The product system is comprised of three sub-systems of feed production, animal husbandry and dairy processing. For feed inventory, different national databases of crop & feed production developed by governmental organizations plus other reports and articles written by research institutes or Universities were reviewed. Moreover, seven animal husbandries providing raw milk were also studied by face-to-face questionnaire. Tehran Pegah company with a 600 tons of milk/day capacity was selected as a milk processing plant unit. Overally the gathered data are for 2011 and in Tehran Province. All these main life cycle stages were examined for availability and quality of essential data.

RESULTS

In general there are large amount of studies available in libraries of government and research institutes but most of them are neither in English language nor online. Studies on background inputs like pesticides and fertilizers are rare. In case of country's electricity mix production, yearly report of electricity production and fossil fuels burned in power plants are available (Tavanir, 2011), however, for fuels' life cycle we have to rely on International databases.

At feed cultivation stage, provincial agricultural input-output tables for each crop including fertilizers use, labor hour, machinery, water use, pesticides and transportation are at hand and are updated each 5 years by Ministry of Agriculture. These tables are historically used to estimate production costs of crops but there are possibilities to convert this vast amount of information to useful forms for application in Life Cycle Inventory. In addition, most of protein feeds consumed for livestock products like Soy cake are imported from countries like Brazil, India and USA (TCCIM, 2012). Thus, we must consider environmental burdens of this transportations.

For smaller animal husbandries, the main challenges are lack of documentation and clearly environmental consideration. Besides, they obtain needed feed from different sources and this makes life cycle study uncertain. However, they cooperate nicely. On the other hand, documentation and organization are the necessary parts in industrialized and bigger animal husbandries. Moreover, the source of feeds are usually known which helps in tracking regional environmental burdens. Moreover, constituents of the ration is completely planned which allows for clarity and order in data collection. Data collection and management is a routine work in the dairy processing plant, and being more industrialized and regulated by government and ISO standards, it is expected that dairy processing plants to comply with life cycle studies easily.

As a result of real concern over the issue of water consumption in agriculture, there are some databases for estimation of blue & green water needs of crops in different regions. In 1997, Farshi and coworkers (1997) published their water requirement database of main field crops in Iran, which included blue and Green water requirement of major crops per hectare. Modeling approach was applied together with extensive pilot studies. Model inputs were climate data, FAO equations in CROPWAT and pilot studies including crop yields and water consumption. Another example is Netwat, which is software database giving net blue water need of crops in each province based on previous studies.

DISCUSSION

As Wernet et al. (2011) suggested, it is better to first base our national Inventory on already existed databases like ecoinvent, and then try to revise and complete it with foreground data in time and it is acceptable as long as the sources of data are stated. However, without a major contribution from the government it seems impossible to do life cycle inventory studies on important background life cycle stages like fertilizers production and fossil fuel extraction & refinery.

Because of great reliance of country in dairy sector to import from other part of the world for example protein feeds and fertilizers, pesticides in feed production stage, medicine or Vitamin supplements in livestock’s ration and some food additives and stabilizers in dairy processing, it is necessary to note that, for producing a product considering environmental life cycle analysis, producers have to cooperate in global scale to form a network for collection and distribution of data.

In the case of water consumption in agriculture and animal husbandries, there should be sort of control over the consumption of water maybe by installing contour, because low or no price for water caused them to not account for water seriously. Over the last few years, by partly removing subsidies of water, electricity and fossil fuels, there is clear tendency in different sectors for innovation and efficiency in inputs consumption for cost reduction.

Although we should avoid putting too much pressure on producers and always bear in mind that to make a product sustainable means to keep it competent through the environmental, social and economical bottom lines from cradle to grave; in the whole life cycle (Hermann et al. 2011).

CONCLUSIONS

In conclusion, we need legislation to encourage all parties by incentives for more sustainable products. Moreover, probable financial benefits from applying life cycle thinking on overall long-term productivity must be stated clearly. Next step is to restructure already existed databases according to crop type, scope and time to extract suitable data for LCI part of agricultural products with unit process and appropriate functional units in mind. We concluded that, though with some improvements in data collection and management especially by government organizations, it is possible to study some environmental impact categories like global warming, eutrophication or acidification to support optimization in this sector.

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