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Greenhouse gas emissions from production chain of a cigarette manufacturing industry in Pakistan

Majid Hussain [a,c,*], Syed Mujtaba Hasnian Zaidi [b], Riffat Naseem Malik [a,**], Benktesh Dash Sharma [d]

[a] Environmental Biology and Ecotoxicology Laboratory, Department of Environmental Sciences, Quaid-i-Azam University, Islamabad 45320, Pakistan
[b] Leaf Agronomy Manager, Pakistan Tobacco Company, Akora Khattak Factory, P.O. & District Nowshera, Khyber Pakhtunkhwa, Pakistan
[c] Department of Forestry and Wildlife Management, University of Haripur, Hattar Road, Khyber Pakhtunkhwa, Haripur 22620, Pakistan
[d] University of California, Berkeley, California 94720, USA

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ABSTRACT

This study quantified greenhouse gas (GHG) emissions from the Pakistan Tobacco Company (PTC) production using a life cycle approach. The PTC production chain comprises of two phases: agricultural activities (Phase I) and industrial activities (Phase II). Data related to agricultural and industrial activities of PTC production chain were collected through questionnaire survey from tobacco growers and records from PTC manufacturing units. The results showed that total GHG emissions from PTC production chain were 44,965, 42,875, and 43,839 tCO_2e respectively in 2009, 2010, and 2011. Among the agricultural activities, firewood burning for tobacco curing accounted for about 3117, 3565, and 3264 tCO_2e, fertilizer application accounted for 754, 3251, and 4761 tCO_2e in 2009, 2010, and 2011, respectively. Among the industrial activities, fossil fuels consumption in stationary sources accounted for 15,582, 12,733, and 13,203 tCO_2e, fossil fuels used in mobile sources contributed to 2693, 3038, and 3260 tCO_2e, and purchased electricity consumed resulted in 15,177, 13,556, and 11,380 tCO_2e in 2009, 2010, and 2011, respectively. The GHG emissions related to the transportation of raw materials and processed tobacco amounted to 6800, 6301, and 7317 respectively in 2009, 2010, and 2011. GHG emissions from energy use in the industrial activities constituted the largest emissions (i.e., over 80%) of GHG emissions as PTC relies on fossil fuels and fossil fuel based electrical power in industrial processes. The total emissions of carbon footprint (CFP) from PTC production were 0.647 tCO_2e per million cigarettes produced in 2009, 0.675 tCO_2e per million cigarettes in 2010 and 0.59 tCO_2e per million cigarettes in 2011. Potential strategies for GHG emissions reductions for PTC production chain include energy efficiency, reducing reliance on fossil fuels in non-mobile sources, adoption of renewable fuels including solar energy, energy from crop residues, and promotion of organic fertilizers.

1. Introduction

The frightening impacts of global warming and climate change have diverted the researchers to assess the environmental impacts, especially of greenhouse gas (GHG) emissions from a variety of agro-industrial products across their full production chain (Lebel and Lorek, 2008). Carbon footprint (CFP) analysis is one of the widely adopted techniques for estimating GHG emissions during the entire life cycle or part of the product life cycle and quantified in terms of carbon dioxide equivalents (CO_2e) (Lynas, 2007). CFP is the sum of all the GHG emissions directly or indirectly caused by a product. It also gives ability to analyze the GHG emissions reduction options from industrial products by knowing emissions hot spots across the production chain (Wiedmann and Minx, 2007). World Health Organization (WHO) framework convention on tobacco control recognizes the need for

Abbreviations: BAT, British American Tobacco; CFP, Carbon footprints; CO_2e, Carbon dioxide equivalent; CSR, Corporate social responsibility; CNG, Natural compressed gas; DOC, Degradable organic content; EF, Emissions factor; GHG, Greenhouse gas; GWP, Global warming potential; GLT, Green leaf threshing; GWh, Giga watt hour; IPCC, Intergovernmental panel on climate change; JTI, Japan tobacco international; KP, Khyber Pakhtunkhwa; KWh, Kilo watt hour; LCA, Life cycle assessment; LPG, Liquefied petroleum gas; MCF, Methane correction factor; NGOs, Non-governmental organizations; N–P–K, Nitrogen–Phosphorous–Potassium; PTC, Pakistan Tobacco Company; TM and D, Trade marketing and distribution; tCO_2e, tonne carbon dioxide equivalents; UK DEFRA, United Kingdom department for the environment, food and rural affairs; WHO, World Health Organization; WBSCD, World Business Council for Sustainable Development

* Corresponding author at: Environmental Biology and Ecotoxicology Laboratory, Department of Environmental Sciences, Quaid-i-Azam University, Islamabad 45320, Pakistan. Fax: +92 51 90643017.
** Corresponding author.
E-mail addresses: majid_qau86@yahoo.com (M. Hussain), r_n_malik2000@yahoo.co.uk (R.N. Malik).

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"due regard to the protection of environment and health of persons in relation to the environment in respect of tobacco cultivation and manufacturing" (WHO, 2008). All stages of tobacco production and manufacturing i.e. from growing and curing of tobacco to cigarette manufacturing, distribution, smoking and final disposal contribute to global warming and are therefore considered the contributor to the single largest environmental hazard facing the globe (ASH, 2009).

Tobacco production and processing consume woody biomass that may result in off-site emissions of GHGs including CO_2, N_2O and CH_4 when burned to cure tobacco leaves in barns. The curing process is crucial to confer distinct taste and aroma characteristics to the tobacco (Junior, 2005). The process of extracting trees also causes CO_2 and non-CO_2 GHG emissions (Saud et al., 2013). Tobacco companies globally manufacture about 6.3 trillion cigarettes each year (The Tobacco Atlas, 2009). Annually about 200,000 ha of forested land is cleared for tobacco growing (Geist, 1999). It is important to note that deforestation mostly happens in the developing countries and attributes to 2–4% of all the deforestation globally (WHO, 2008). Similarly, large amount of fossil fuels is consumed for energy to run cigarette manufacturing and distribution processes resulting in GHG emissions. Cigarette smoke also contributes to anthropogenic GHG emissions due to the fact that cigarette smoke contains CO_2 and CH_4. Smoking emits 26,000 t of CO_2 and 52,000 t of CH_4 in the air each year globally (Florida State University Research Foundation, 2010).

Pakistan is a developing country where about 70% population depends on agriculture. Tobacco is one of the major cash crops in Pakistan (Rahman et al., 2011) where nearly 40% of all the government excise taxes and 10% of the total government income are earned through tobacco crop (Qamar et al., 2006). Tobacco crop is an extremely labor-intensive, about 80,000 peoples are involved in tobacco crop growing, 50,000 persons are engaged in the cigarette factories and a further one million peoples are indirectly working in the tobacco industry (Rahman et al., 2011). Pakistan Tobacco Company (PTC) is a member of British American Tobacco (BAT) group and the largest cigarette manufacturer in Pakistan. It is the first multinational corporation to start its business in Pakistan, 7th largest tobacco producer and 35th biggest company by tobacco yield in the world. The tobacco production of PTC has augmented from 23,800 t in 1967 to 66,000 t in 2007. The Virginia tobacco cultivation that began in Pakistan in 1948 with an average yield of 861 kg/ha now amounts to an average yield of 2400 kg/ha with estimated total production of tobacco exceeding one billion kg annually (PTC, 2012). Tobacco crop covers relatively small area among agricultural crops grown in Pakistan and accounted for about 56,400 ha or 0.27% of the total cultivated land during 2009–2011. Khyber Pakhtunkhwa (KP) province is the main hub of tobacco production and shares about 78.52% of the total tobacco production, followed by Punjab, Sindh and Baluchistan provinces respectively sharing 19.07%, 2.05%, and 0.36% of the total production. The province wise share of area under tobacco cultivation in KP, Punjab, Sindh and Baluchistan were respectively 63.74%, 32.31%, 3.38%, and 0.57% in 2007–2010 (PTC, 2012).

Leading tobacco companies intend to minimize GHG emissions from their production chain because they recognize that global warming could have the possible threat on their business and environment (example, BAT Group, 2006; Japan Tobacco, 2004)). However, to this date, only one study was carried out on CFP of tobacco industry by a Brazilian Tobacco Company "Souza Cruz" (a member of British American Tobacco) and reported that their GHG emissions were 202,810, and 203,443 tCO_2e for 2010 and 2011, respectively (Schuchter et al., 2011). While Pakistan showed eagerness to contribute to the global GHG emissions reduction efforts and is playing a vital role for tackling climate change (Khan et al., 2011), which is clearly mentioned in its climate change mitigation policy statement (Ali Hasnain, 2011), There has been limited research work on CFP of agri-products from Pakistan. To develop a comprehensive climate change mitigation policy

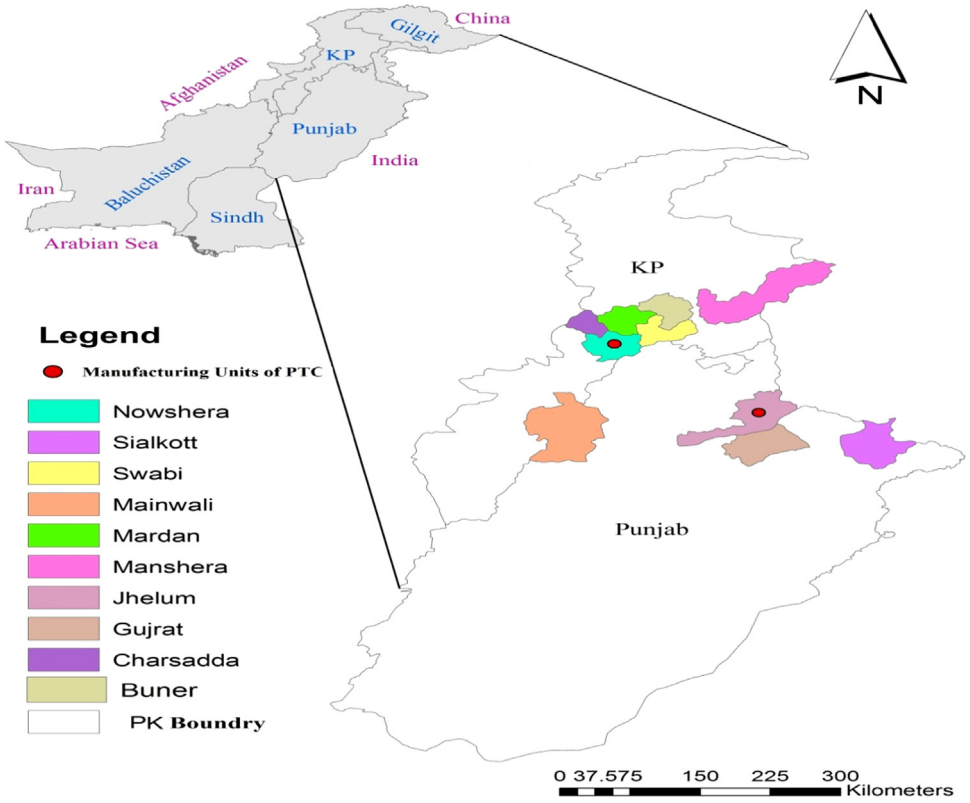

Fig. 1. Map of the Study area.