Data Article

Spatially explicit database on crop-livestock management, soil, climate, greenhouse gas emissions and mitigation potential for all of Bangladesh

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A R T I C L E   I N F O

A B S T R A C T

This data article provides spatially explicit data on greenhouse gas (GHG) emissions and mitigation potential at various administrative levels for the whole of Bangladesh. The results arising from analysis of this database are presented in research article "Quantifying opportunities for greenhouse gas emissions mitigation using big data from smallholder crop and livestock farmers across Bangladesh" [1]. We collected crop and livestock management data and associated soil and climatic data from variety of primary and secondary sources outlined below in our methodology. The datafiles on crops and livestock contain model outputs for three greenhouse gases (CO_2, CH_4 and N_2O) and their

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global warming potential, which are linked, to the information on crop/livestock management, soil and climatic conditions presented in the supplementary data of the associated manuscript. The datafiles on mitigation potential contain district-level annual GHG mitigation potential by 2030 and 2050 segregated by different crops/livestock types and mitigation options. This dataset is useful for Bangladesh's GHG accounting from the agricultural sector, and can be used to update its nationally determined contributions. Administrative level emissions and mitigation potential estimates segregated by crop-livestock types and mitigation options are useful to prioritize agricultural research and development interventions consistent with food security and environmental goals and to organize agricultural extension and support services to better inform farmers on food production and move towards GHG mitigation goals.

Specifications Table

Subject	Agriculture, Environmental Sciences
Specific subject area	Climate change, greenhouse gas emissions, mitigation
Type of data	Spreadsheet
How data were acquired	We collected crop and livestock management data and associated soil and climatic data from variety of primary and secondary sources outlined below in our description of data collection. The detailed description and source of these datasets can be found in the associated manuscript [1]
Data format	Crop and plot identifier Model output (spatial) District-wise mitigation potential segregated by crop/animal types and mitigation options (Analyzed)
Parameters for data collection	The crop model requires all management information from planting to harvesting including plot-specific soil and climatic information to estimate GHG emissions from production. To estimate livestock production related GHG emissions, the number of livestock within each district, segregated by animal type (e.g. ruminants, small ruminants, etc.), age, breed, sex, body weight and other management practices (e.g. stall-fed, grazing or mixed management) under particular agro-climatic conditions were considered.
Description of data collection	Crop management data taken from Bangladesh Integrated Household Survey (BIHS) [2]. Location specific analysis of cropping systems and irrigation map developed by Gumma et al. [3]. District-wise crop area: Yearbook of Agricultural Statistics 2015 [4]. Livestock data: Bangladesh Bureau of Statistics, 2010 [5], expert surveys, 2019 Soil data: database compiled for pedo-transfer function validation, 2017 [6] Climatic region and specific climate categories identification: Analysis of 30 years of climate data from the Bangladesh Meteorological Department and those reported by Maclean et al. [7] and Yan et al. [8]. Greenhouse gas emissions for baseline, business-as-usual and mitigation scenarios were estimated using CCAFS' Mitigation Options Tool (CCAFS-MOT) [9] for crops and using the approach developed by Herrero et al. [10]. Mitigation potential was determined as difference in emissions between business-as-usual scenario and mitigation scenario for respective years.
Data source location	Spatially explicit data on crop and livestock segregated by crop/livestock types and management practices together with associated soil and climatic information is available for the whole country (Bangladesh).
Data accessibility	https://data.mendeley.com/datasets/cnwdsb8hdn/1[11]

Value of the Data

- The dataset is useful for bottom-up and data-driven approaches to GHG accounting from agricultural activities in Bangladesh.
- The database is a valuable source of information for Bangladesh's national GHG inventory and to update the country's nationally determined contributions (NDC) and monitor progress against NDC targets.
- Spatially explicit data on GHG emissions segregated by each crops and livestock types together with their mitigation potential will be helpful for government of Bangladesh to better prioritize their mitigation work in ways consistent with food production goals.
- Bangladesh can make use of the data to demonstrate the mitigation potential of various technological and agricultural management options to better negotiate for the environmental services, for example the Green Climate Fund or other mitigation funds.
- Jurisdiction-wise emissions and mitigation potential by crops/livestock can help in the design of agricultural research and development interventions at administrative levels consistent with food production and environmental goals.
- The database will be useful to research for development communities in the area of agriculture, environment and natural resources management.

1. Data Description

The crop data files i.e. "Crop_Baseline_2014–15.csv", "Crop_BAU2030.csv", "Crop_BAU2050.csv", "Crop_MITI2030.csv" and "Crop_MITI2050.csv" contains location-specific information on greenhouse gases (CO_2, CH_4 and N_2O) emissions and global warming potential estimated using CCAFS-MOT [9] for base-year (2014–15 crop year), business-as-usual (BAU) scenario 2030, BAU 2050, mitigation scenario 2030 and mitigation scenario 2050, respectively. The corresponding location-specific information on crop management, soil and climatic conditions as well as management practices are given in supplementary data S1 (Input_data_crop) of associated manuscript [1]. Units of input and output variables are indicated in variable names and they are introduced briefly in "metadata.csv". No emission values in some cases (i.e. blank columns) are due to non-application of the associated production inputs/practices.

The livestock data file i.e. "Livestock.csv" contains input and output data related to livestock production. This data file contains information on livestock numbers at district level segregated by livestock type, breed, age, sex and management system. It also contains data on GHGs arising from enteric fermentation and manure management, and GHG mitigation potential from various mitigation options, as well as total annual mitigation potential by 2030 and 2050. All the variables in the datafile are explained in detail in "metadata.csv".

The data files on mitigation potential by options i.e. "Mitigation_options&potential_2030.csv" and "Mitigation_options&potential_2050.csv" contain district-level annual GHG mitigation potential and associated abatement costs for different mitigation options, by 2030 and 2050, respectively. Similarly, data files on mitigation potential by crop/livestock type i.e. "Mitigation_potential_by_crop&livestock_type_2030.csv" and "Mitigation_potential_by_crop&livestock_type_2030.csv" contain district-level annual GHG mitigation potential segregated by crop and livestock categories together with their 95% margin of error. These files also contains crop,

livestock and crop-livestock total annual mitigation potential by administrative district. All the variables in these datafiles are also explained in detail in "metadata.csv".

2. Experimental Design, Materials and Methods

Analytical framework starting from data sources to estimation of emissions for base-year, business-as-usual scenarios (2030 and 2050) as well as mitigation scenarios (2030 and 2050) and determination of mitigation potential for short-term (2030) and log-term (2050) is explained in detail in the related manuscript [1]. Briefly, we obtained crop management information from the "Bangladesh Integrated Household Survey" (BIHS) [2] and livestock related information from the Bangladesh Bureau of Statistics, 2010 [5]. We took plot-specific soil information from a database compiled for pedo-transfer function validation of Bangladesh soil, 2017 [6]. We determined rice water management by analyzing the rice irrigation maps developed by Gumma et al. [3]. Finally, we performed a telephonic survey of farmers and owners of farm tractors and irrigation pumps to gather information about crop residue management and fuel consumption per tillage or irrigation event. The proportion of these animals by breed, age, sex, body weight, feed consumption and livestock management system (i.e. stall feeding, grazing or mixed management system) were determined through expert opinion. The district-wise area under each of the eight crop types by season in 2014–15 were obtained from Yearbook of Agricultural Statistics 2015 [4]. Greenhouse gas emissions for baseline, business-as-usual and mitigation scenarios were estimated using CCAFS' Mitigation Options Tool (CCAFS-MOT) [9] for crops and using the approach developed by Herrero et al. [10] for livestock. Mitigation potential was determined as difference in emissions between business-as-usual scenario and mitigation scenario for respective years.

Ethics Statement

Data compiled in this database were gathered from various sources available publicly and these sources are properly acknowledged. See the "Specification Table" and the "Experimental Design, Material & Methods" section for details of data sources and source citations. Telephonic surveys were conducted with the proper consent of the respondents. Following statements i.e. "This study is conducted anonymously. You will only be identified through code numbers. Your identity will not be stored with other information we collect about you. Your responses will be assigned a code number, and the list connecting your name with this number will be kept in a locked room and will be destroyed once all the data has been collected and analysed. Any information we obtain from you during the research will be kept strictly confidential" were read before start of the telephonic interviews and respondents were informed that they are free to withdraw thier consent and discontinue participation in this study at any time.

CRediT Author Statement

Tek B. Sapkota: Conceptualization, Methodology, Supervision, Investigation, Formal analysis, Writing – reviewing & editing; **Fahmida Khanam:** Investigation, Data curation, Writing – reviewing & editing; **Gokul Prasad Mathivanan:** Investigation, Formal analysis, Writing – reviewing & editing; **Sylvia Vetter:** Investigation, Formal analysis, Writing – reviewing & editing; **Sk. Ghulam Hussain:** Investigation, Data curation, Writing – reviewing & editing; **Anne-Laure Pilat:** Writing – reviewing & editing, Investigation, Data curation; **Sumona Shahrin:** Investigation, Data curation; **Md. Khaled Hossain:** Investigation, Data curation, Data Analysis, Writing – reviewing & editing; **Nathu Ram Sarker:** Writing – reviewing & editing; **Timothy J. Krupnik:** Conceptualization, Methodology, Supervision, Writing – reviewing & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships which have or could be perceived to have influenced the work reported in this article.

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Supplementary Materials

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.dib.2021.107225.

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