2

METHODOLOGY

The basic equation (Eq. 1) followed in the study to estimate emission is:

$$E_p = \sum_R \sum_S \sum_F A_{R,S,F} \times EF_{R,S,F} \times (1 - \alpha_{R,S,F}) \times X_{p,R,S,F} \tag{1}$$

where, E_p is the annual emission of a pollutant (p) (Kt); R is the region/state; S is the sector; F is the type of fuel; A is the activity data (fuel consumption or other emission-related data); EF is the emission factor (Kt per unit of fuel use) of the pollutant (p); α is the removal efficiency (%) of pollutant (p) with the installed pollution control technology and X is the actual application rate of the control technology (Klimont et al., 2002).

The activity data (A) of 2016 for different sectors was mostly collected from the published dataset of different ministries of the Government of India. However, some data gaps have been filled through published peer-reviewed literature survey and with the help of the MARKAL model (Annexure V).

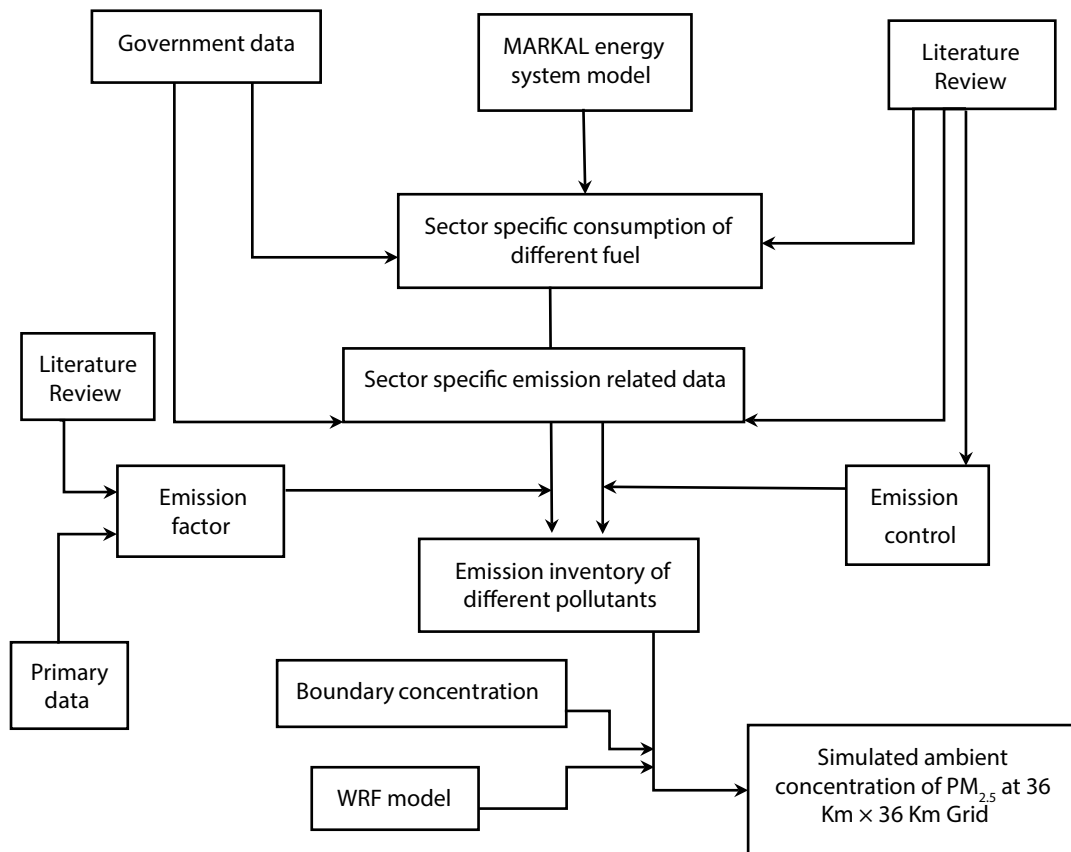The basic framework of the present study is summarized in Figure 1.

Figure 1 Framework of the study

2.1 Methodology to develop sector-specific emission inventory

Emission inventories of different pollutants, *viz.,* PM_{10}, $PM_{2.5}$, CO, SO_2, NO_x, non-methane volatile organic compounds (NMVOCs) and NH_3 were prepared during the period of the project, that is, 2016. Sectors involved in the emissions of different pollutants were broadly classified into two classes: A. Energy use sectors and B. Non-energy use sectors. The sub-classes under the former are: 1. Residential sector, 2. Power sector, 3. Industry sector, and 4. Transport sector. Sub-classes under the latter are: 1. Open burning of agricultural residues, 2. Refuse burning, 3. Crematoria, 4. Construction sector, and 5. Mining sector.

Sector-specific methodologies to develop emission inventory and detailed emission inventory of the respective sectors are provided in Chapters 3–13.

2.2 Methodology to simulate ambient concentration of $PM_{2.5}$

Atmospheric concentrations of PM are simulated by integrating the emission inventory and meteorological parameters using the WRF-CMAQ model in Chapter 14. India-scale emission inventory data developed here at a resolution of 36 km x 36 km was provided as input. To account for transport of pollutants from outside India, international boundary conditions have been adopted from global air quality products of the National Centre for Atmospheric Research (NCAR), USA. These global products are generated using the global chemical transport model MOZART. The contributions to the ambient air quality from neighbouring countries, such as Pakistan, Nepal, Bangladesh, etc., which fall within the Indian study domain were taken from ECLIPSE database (IIASA, 2014).