Climate Change and Human Health Studies

Global climate patterns are continuously changing, as the alteration of temperature typical weather patterns. That is connected to damaging weather events, like more frequent and more intense hurricanes, floods, downpours, heat and cold waves, and winter storms to a particular location or the planet as a whole. The timeline of climate change often depends on proxy evidence of some aspect of sedimentary and geochemical conditions of oceans and continents, and land surface characteristic of past climates. Undoubtedly, many of the causes of climate change are part of the Earth system and interactions and feedback between the atmosphere and other components within the Earth system. The school of EDM has dedicated R&D focus on the aspects of climate change studies, regarding its impacts on human health and wellbeing. The systematic study is in progress on the impacts of extreme heatwaves on human health. Using the Global Climate Model, WHO projected the morbidity and mortality about different climate dimensions and greenhouse gas emission scenarios, and estimated that the risk of health-related issues due to climate change might become more than double by the year 2030. Projections of future climate hint that increment in temperature extremes compared with mean ambient temperature values will be more in mid-latitudes compared with other regions of the world. Besides, the heatwave effect will be even more in urban areas due to urban heat island effect and a greater density of population in an urban locale, compared to the rural areas.

Artificial Neural Network-Based Prediction of Human Responses

Given the burgeoning impacts of climatic variability on human health, a longitudinal study is ongoing at the school of EDM, applying the paradigms of the artificial neural network (ANN) to trace the inter-dependencies between the climatic and human thermoregulatory adjustment. The ANN models examine the relationships between the climatic, behavioural, and intrinsic input factors and the human thermoregulatory outputs. Based on responses of human volunteers exposed to hot and humid climate outdoors, the ANN models were trained using the Levenberg-Marquardt (LM) algorithm combined with Bayesian regularization. The reasonably accurate prediction affirmed the suitability of ANN as a practical technique to elucidate heat-induced

human physiological challenges at future climate.

Human Skin Temperature Profile

The impacts of changing climate patterns have the first level indication on the thermographic profile of the human skin surface. The cumulative effects manifest on thermoregulation, and human ability to sustain the climate extremes. Under an ad-hoc project of the Department of S&T of Govt. of India, the school of EDM embarks on a longitudinal study in evaluating human skin temperature profile. The study spreads over several districts of West Bengal. This based on the recording of a large number of thermal images of human volunteers, which are captured by high resolution infrared thermal imaging camera. The analysis of images and the extraction of temperature information are highly technical and time-consuming. The school of EDM has developed an in-house computer routine, using the MATLAB's image processing toolbox that enables the extraction of the accumulative temperature information of a region of the human body. The probability distribution of the temperature data across body regions is critical for human heat-balance modelling.

Geoinformatics in Environmental Visualization

Geoinformatics *helps to address complex challenges of the earth system as well as the environmental issues through data* collection, analysis, storage, retrieval, representation and dissemination of information. This technology is widely used to generate land information with the help of remotely sensed satellite images. For example, the land use analysis is extended towards determining the land-use pattern, gathering data of deforestation, coastal change, urban expansion, mineral identification and other applications. The analysis of surface modelling like DEM (Digital Elevation Model), TIN (Triangular irregular networks), slope analysis is useful in regional planning. Network Analysis is also an emerging domain to identify optimum distance and locations for services. The Spatio-temporal analysis of climatic trend is widely used for environmental management. The students of the school of EDM acquire the knowledge of Geoinformatics, with a primary application on the climatic trends and future projections. The analysis covers meteorological data as discrete as well as continuous gridded structure (reanalysis data of climate modelling).

Urban heat island and thermal comfort

With the growing trend of urbanization, concern has been raised about the urban heat island (UHI) in the tropical cities, and its' effect on human health and wellbeing. Analysis of land surface temperature is a useful approach to studying UHI and assessing human vulnerability beyond the level of comfort. The pilot study of EDM in the metropolitan city of Kolkata and surrounding areas is a modest attempt in identifying UHI and assessing the thermal comfort level during the hot summer, based on the Predicted Mean Vote (PMV). The PMV value, assessing the thermal state of the respondents, was obtained from the online questionnaire survey. LANDSAT 8 was used to evolve the land surface temperature, and to recognize the locations with high-temperature value. On a limited scale, one encounters large variability in the human responses, and the approach makes a high promise towards more accuracy in the assessment of human thermal comfort over UHI.

Heat Wave and Mitigation Plan

Heatwave or extreme temperature is one of the primary concern in the tropical regions of India. The climate extremes beyond the human ability of adaptation, exacerbate mortality, morbidity as well as a gamut of health disorders. Identification of heat vulnerable population in the urban, as well as rural infrastructure, is a daunting challenge. Some states, like, Gujarat, Andhra Pradesh, Telangana, Odisha have attempted to developing heat mitigation plan and implementing the strategies at the grassroots level. Heat-related action plans have been proposed by different national and international agencies to mitigate the adverse effect of extreme heat.

The EDM student programme in the rural area of the Bankura district is a modest attempt towards the demonstration of such heat mitigation strategic plans. The analysis of different thermal indices indicates that the study region is under extreme danger during summer, declared as either heatwave or non-heat wave, and the people at outdoor occupational pursuits suffer from a high or moderate range of heat-related stress and disorders. The study emphasizes the necessity of a large scale cross-sectional study on the preparedness of the local community and adaptation procedure. The network and communication links between responsible authorities is a requisite for overall

planning towards mitigating heat effects.

Social Network Analysis

A detailed study on the Social Network Analysis (SNA) is ongoing in some districts to evolve and suggest a robust risk management plan. It is taken into consideration that social networks are the stable patterns of social relationships for the community. While the structure of the social networks changes rapidly when a disaster hits and keeps changing under different situations, the robustness of the structure determines the ability of a community to combat and recover from disaster events. Two aspects have been examined - (a) situational analysis of the existing social network in some districts of West Bengal, as regards imparting heat stress mitigation measures, and (b) the existing networks about the cyclone/flood-affected communities in the district South 24 Parganas.

Natural Disaster

A natural disaster is a calamity that seriously disrupts the functioning of a community, bringing in human, material and economic and environmental losses that exceed the community's ability to cope using its resources. The global scenario depicts that since 1960, occurrences of different types of natural disasters (tsunami, tropical cyclone, landslide, mass movements and floods) in Asia are manifold higher than in other continents. Bacterial and viral outbreaks are alarming new dimensions of disaster that bring owes to humanity. India encounters devastating natural disasters at regular frequencies. In the last half a century, the country faced several disasters of a colossal magnitude (geophysical - 28, meteorological - 190, hydrological - 222, climatological - 16, biological – 60). For instance, the majority of tropical cyclones have their genesis over the Bay of Bengal. The most flood-prone region is the Brahmaputra valleys, North Bihar and lower West Bengal. The students of EDM undergoes systematic study of different types and mechanism of natural as well as man-made disasters, its effect on human health, mortality and ecological systems. Based on the primary and secondary sources of data, the students undertake assignments in quantitatively evaluating the magnitude of the disaster, the early warning system and management.

COVID 19 Outbreak – Traumatic Stress Disorders

An online questionnaire survey explored the prevalence of traumatic stress disorders among a sample population in West Bengal, following outbreaks of COVID-19. The study sample was taken from some cities from March to July (complete lockdown period). The traumatic stress of the habitants was evaluated using the WHO PTSD PSL-C checklist that diagnoses symptoms like intuition, avoidance and arousal. The sample pilot survey on both male and female respondents indicated that over 1/4th of the total respondents having intuition sub-symptoms, i.e. unwanted memories and nightmares. Female respondents had higher arousal sub-symptoms. The avoidance sub-symptoms were found to be higher among the males, in comparison to the female respondents.

COVID 19 Pandemic — Household Resilience

The COVID-19 outbreak that emerged from Wuhan city of China's Hubei province, in a few months it has transformed into a global pandemic of unprecedented dimension in the recorded history of humanity. The epidemics of mortality and morbidity have brought down the entire world to a standstill. The Indian populace appears as one of the most affected countries, with counts of deaths and sufferings might continue for months to come. Even under extreme circumstances, the people show resilience to cope up with the challenges, concerning their health and economic disaster. That is, resilience is defined as the system's ability to return to its equilibrium after a temporary perturbation or disturbance. A student project involved an online questionnaire (Google form) survey of sample respondents from different districts of West Bengal. The situational analysis of disaster resilience of households to COVID-19 pandemic covered factors related to socioeconomic status, personal health, and health care facilities available, the supply of essential goods and services and, implementation of policy measures in the locality. The rapid transmission of the virus has taken the community by complete surprise, raising more confusions and misconceptions. The preliminary study yielded economic background, general awareness, health care and, family robustness are the identifiable dominant factors to explain the level of resilience of a particular household. Further study is ongoing on a larger sample across multiple villages and districts.

Community Participation in Disaster Management

Approaches towards disaster management refer to activities such as mitigation, preparedness, response and recovery that are planned and conducted before, during and after disasters. The

international strategy for disaster reduction calls for the engagement of several key parties, including vulnerable communities, local institutions and self-government, and other stakeholders. In the context of disaster management, a community places a significant role, since they are the people living in a common geographical area and exposed to similar kinds of hazards. In spite that a community may socially be diversified, however, the people are at the heart of decision making and implementation of an intervention to reduce vulnerability and enhance the capability to protect people from the menace of the hazards. The community whose survival and well-being are at stake understands the local affairs, opportunities and constraints better, and therefore, community participation is the core approach of disaster management. The school of EDM imparts grass-root training to students in the identification, analysis, treatment, monitoring, and evaluation of hazards. They undergo training on the core approaches of community participation in disaster management.

Bioclimate of Rural Housing

The state of West Bengal major ecosystems, covering mountains, hills, forests, the Gangetic plain, islands, coastal and marine, semi-arid zones. The primary characteristics of rural housing are (a) the low height structures and (b) the linear and scattered settlement patterns. These clusters are practically rural heat islands, due to (a) trapping of short wave and longwave radiation in and around the households, (b) anthropogenic heat released from the combustion of fuels, and (c) reduced evapotranspiration and convective heat removal due to stagnation of air, and (d) the poor indoor environmental quality in the small houses and cottages.

The bio-climatic analysis considers the sustainability of rural housing that is associated with (a) eco-friendliness that is, minimization of impact on the environment as well as non-renewable resources, (b) human friendliness that addresses human health, comfort and wellbeing, and (c) energy friendliness associated with minimum energy consumption and maximum energy efficiency. The sustainable design aims at maximizing the quality of the built environment and minimizing or eliminating negative impacts on the natural environment. The school of EDM undertakes a cross-sectional study on bioclimatic analysis about the household environment in Sundarbans regions and evaluating the household form and orientation, construction and materials, site and location, water use, energy efficiency, indoor air quality, and habitant feedback on health and comfort.

Indoor Environmental Quality (IEQ)

IEQ - Multispecialty Hospital

Indoor environmental quality (IEQ) in a built environment is determined by environmental aspects, covering the physical (lighting, acoustics, and thermal conditions), chemical (indoor air quality) and biological (microorganisms) origins. The student project focused on examining the IEQ and satisfaction level of occupants in different departments of a multi-speciality hospital. The questionnaire-based sample survey covered occupants (doctors and nurses, patients, other staff and visitors) in a city hospital. The pilot study recorded a significant difference in the satisfaction level of the occupants on thermal comfort, acoustic comfort and ergonomic comfort among the departments of the hospital. The doctors and nurses were the most affected group and suffered from IEQ associated health symptoms. The type of activity and time of exposing to the indoor environment were the crucial factors to determine the satisfaction level of the occupants. The male occupants had a more positive perception on satisfaction on parameters of IEQ as compared to females; in general, the younger occupants expressed more dissatisfaction.

IEQ - Urban Locale

The risk of poor environmental quality exists in slum prone areas, with harmful physical, chemical and biological effects on the slum occupants. The student project work set out to analyze indoor environmental conditions in the slum residential areas of the city and to recognize the stress factors among the people. The objective measurement and the questionnaire-based survey allowed gathering data from the slum prone areas. The traditional cooking techniques, the dumping of waste in nearby water bodies, poor sanitation and absence of effective waste management in the urban locale are the easily recognizable issues that pollute the IEQ. The findings revealed that the slums occupants are grossly unawareness about how environmental factors adversely influence the IEQ of the premises and their health status.

Household Water Distribution Pattern

Effective water distribution is an essential life support system in a cosmopolitan city, like Kolkata. Undoubtedly, this large city faces unending challenges to cope up with the vital baseline of water supply to every corner of the households and other economic activities. The survey was undertaken in three wards of north and five wards of south Kolkata, and sample residents were interviewed about the household water distribution pattern and the quality of drinking water. The survey used a subjective five-point scale based checklist that (a) examines the respondent's background (e.g. gender, family size, occupation), (b) water consumption pattern, drinking water quality, and water waste. The study also included secondary evaluation of the physical, chemical, and biological characteristics of water, as per the groundwater quality. Majority of the studied households complained of poor quality of potable water. Though most of the people aware of water management practices, these are rarely practised. The need of the hour is not only to make people aware of water management practices but also to ensure its application.

Sick Building Syndrome - Old and Heritage Buildings

Sick building syndrome (SBS) and building-related illnesses are the complex spectra of ill health symptoms. Primarily, mucous membrane irritation, asthma, neurotoxic effects, gastrointestinal disturbance, skin dryness, sensitivity to odours appear among occupants in offices, schools and hospitals. A building occupant manifests at least one symptom of SBS, the onset of two or more symptoms at least twice, and rapid resolution of symptoms following moving away from the building may be defined as having SBS. The pilot study explored the characteristics of SBS among the occupants of old and heritage residential buildings. The accumulated effects of a multitude of factors, such as the objective dimensions of IEQ, building characteristics, building dampness, and demographic and behavioural activities of occupants are the dominant indicators that attribute to SBS.

Environmental Impact Assessment (EIA)

The EIA is a process of evaluating the likely environmental impacts of a proposed project or development. Since 1994, the Ministry of Environment and Forests and Climate

change, Govt. of India, issued Notification and guidelines in making EIA statutory for environmental clearance of 29 specified activities, covering industries, mining, irrigation, power and transport. The EDM students acquire the skill to carry out EIA in a specific application in and around Kolkata city.

Some examples of EIA report prepared by the students on construction projects are (a) the metro railway project in Kolkata, (b) the environmental issues associated to the construction of Sursuna- Raipur road section, (c) the environmental impacts and mitigation measures of a proposed road bridge across the River Ganges from Howrah (Belur) to Baghbazar, and (d) a residential housing project of Category B1 in Newtown area, that required environmental clearance, where the built-up area was more than 150,000 sq.m.

Pilot EIA study was carried out in a food processing industry at Addirabad village near Sonarpur. It was attempted to explore the adverse impacts of such industries in terms of hazards originated from kinds of pollution generated. Tannery industry is a potential source of hazardous activities, having an adverse impact over the environment as well as on human health. It creates ecotoxicity due to water pollution and solid waste generations. A preparatory study project EIA focused at Tangra, Kolkata in evaluating pollution areas and aiming at optimum utilization of resources. Besides, the student EIA project covers electrical substation at Newtown- Rajarhat area, about possible environmental issues associated with the operation of the electricity delivery system in the locality.

Quantitative Environmental Risk Assessment

Many toxic chemicals that get released in the environment are suspected carcinogens, and other stressors of adverse effects, such as diseases, the formation of tumours, reproductive and other congenital disabilities. Even at the smallest exposure, these organic and inorganic compounds create a risk to the ecosystem and human health. Special mention is drawn to the serious health concerns associated with excessive human exposure of heavy metals through aqueous streams, air, soil, and food may become a health concern. The metals of most immediate concern are aluminium, chromium, manganese, arsenic, cadmium, lead, mercury, and nickel.

These repercussions mandated to the emergence of the field of environmental risk assessment. That is, the identification, evaluation, and estimation of the levels of risks, their comparison against benchmarks, and determination of an acceptable level of risk. The process involves (a) identification of hazards and risk factors (hazard identification), (b) analysis and evaluation of risk about the hazard (risk analysis and risk evaluation), and (c) determination of ways to eliminate the hazard or control the risk when hazards cannot be eliminated (risk control). The quantitative risk assessment encompasses both (a) the human risk (estimating the adverse health effects due to exposure to environmental contaminants), and (b) ecological risk (evaluating the probability of adverse ecological effects as a result of exposure to one or more environmental stressors).

As a part of the curricula, the students of EDM go through rigorous theoretical and task-based training on ecological and human risk assessment methodologies, identification of exposure and risk characterization in terms of life-time carcinogenic and non-carcinogenic risks, ICD 11 classification of environmental diseases and disorders, acceptable exposure limits, and mitigation measures against its adverse effects on human health. This advanced-level learning helps the students to classify environmental risks associating to pollution due to heavy metals, toxic organic chemicals, pesticide exposures and recognize disease and disorder categories.