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AN APPROACH TO MANAGEMENT OF DATA FOR INDIA'S NATIONAL ACTION PLAN ON CLIMATE CHANGE

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ARTICLE INFO	ABSTRACT
	The National Action Plan on Climate Change (NAPCC) enacted by Government of India had considered climate change as a global challenge and is committed to engage multilaterally as per the United Nations Framework Convention on Climate Change (UNFCCC). Numerous studies had pointed to Global climate change research using big data from Earth observations to enable the coordinated and sustainable development of humanity. NAPCC's missions will involve huge number of agencies and resources at both at the national level and exchanges at the global level. Here an approach using Climate Data Cloud and Data Science processes is presented for NAPCC to benefit from. Besides, geographic reference system based interventions had been suggested for spatial access to climate data and climate intelligence based decision support for development planning, allocations and disaster mitigation.

INTRODUCTION

With economy closely related to its natural resource base and climate sensitive sectors such as agriculture, forestry, water, land use etc there is always a major threat looming because of climate change. India has its National Action Plan on Climate Change (NAPCC) that charts out a development pathway that is ecologically sustainable. Presently, India's CO_2 emission at 1.02 metric tons per capita is well below the world average of 4.25 metric tons. This may be because India is at an early stage of development. NAPCC has to ensure sustainable production processes along with sustainable lifestyles for both present and future generations in line with the UN Framework Convention on Climate Change (UNCCC). Temperature data from four international science institutions *NASA's Goddard Institute for Space Studies, NOAA National Climatic Data Center, Met Office Hadley Centre/Climatic Research Unit and the Japanese Meteorological Agency* (Cook 2013) show rapid warming in the past few decades and that the last decade has been the warmest on record. Multiple studies in peer-reviewed scientific journals in the 1990s show climate-warming trends over the past century are due to human activities. And the consensus is getting stronger on Anthropogenic Global Warming (AGW) as provided in Fig1 below. India needs to substantially increase its per capita energy consumption

to provide well being to its people on one hand and on the other needs to be mindful on its AGW. The impacts of climate change would prove severe particularly for the huge population of India's poor to sustain their access to water, forest resources, energy, food, healthcare and disaster coping. As a way forward, NAPCC has its national missions to harness solar energy, wind energy, Green House Gases (GHG) mitigation, provide sustainable Habitats, management of municipal solid waste, health hazard and disaster preventions etc. There are multiple agencies involved to actuate NAPCC missions and mandates. The kind of data would be enormously huge in both its structured and its unstructured (big data) forms. Besides, there will be a need for decentralization in terms of priority-weighted planning, devolution of fund allocations and continuous monitoring and evaluation. NAPCC must then have an integrated and robust mechanism for climate data management for effective decision support using Climate Intelligence for right actions at the right time at the right cost at the right place and involving right participants. In this regard, a best-fit approach for management of climate data is recommended with the following objectives.

Management of Climate Data: Objectives

Promoting spatial climate data access for decision support

Priority based climate management, interventions planning and allocations

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- Disaster mitigation

MATERIALS AND METHODS

IT approaches like Data Cloud and Data Science processes for managing climate data is proposed for future investigative studies along with a geo-referencing mechanism as illustrated in Fig2, Fig3 and Fig.4.
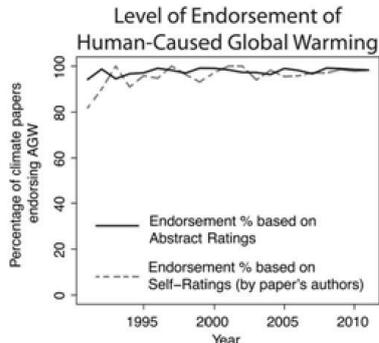
Source: J.Cook 2013 Research Paper on climate change available from www.theconversation.com

NAPCC Climate Data Cloud to serve as repository of data as in Table 1

Table 1. NAPCC Climate Data Cloud: Indicative List of Components

HUMAN ACTIVITIES	GREENHOUSE EFFECT	CLIMATE CHANGE	DISASTERS
Agriculture	Greenhouse gas emissions	Himalayan Glacier melting	Biodiversity losses
Industry	CO_2 per capita emissions	Precipitation changes	Floods / Cyclones
Housing	Carbon Cycle Disturbances	Clouds	Famine/ Diseases
Transport	Environment Assessments	Water temperature	Casualties
Land use changes	Air temperature rise	Abrupt changes	Economic losses

NAPCC Climate Cloud will eventually require Big Data management techniques. In this regard the model proposed (Fig.2) would involve processes under Data Science to provide decision support.
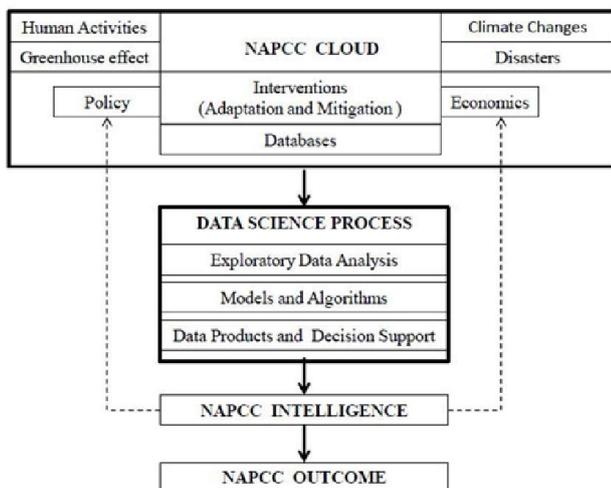

**Fig. 2. NAPCC Data Management: Conceptual Outline**
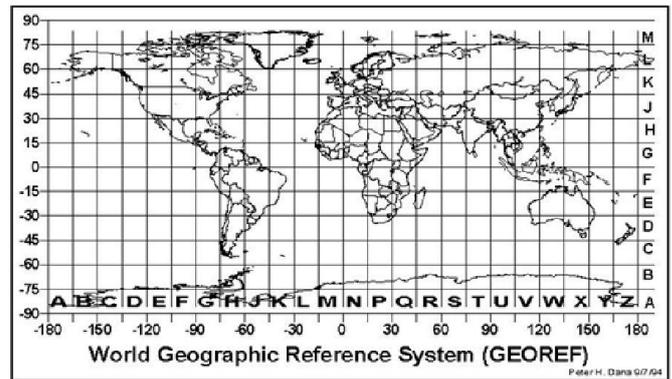
Fig. 3. World Geographic Referencing System (source: Google Images)
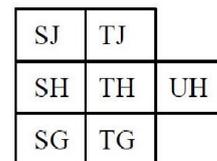
Fig. 4. NAPCC Geographic Referencing System: Indian Subcontinent

Exploratory Data Analysis (EDA) would provide early insights beyond formal modeling to suggest causes, statistical inferences and provide further basis to filtered data collection by NAPCC Cloud Databases (through surveys and experiments conducted for Human Activities, Greenhouse effect, Climate Change, Disasters and on interventions relating adaptation and mitigation).

Algorithms for machine based uncertainty modeling; predictive modeling etc. would help provide domain specific climate datasets/products for decision support. Further, multi-domain analytics of data products would lead to Climate Intelligence, which NAPCC can use to reengineer its policies/processes of planning and allocations.

Dashboard based NAPCC outcome indicators monitoring and spatial evaluation using a geographic referencing system outlined as in Fig.3 and Fig 4.

Indian Geographic Referencing System (based on World Geographic Reference System) is recommended for micro-grid spatial array based NAPCC management. Each such micro-grid's coverage area under 1° latitude and 1° longitude in the geographic references of SJ, SH, SG, TJ, TH, TG and UH. It would provide spatial access to data and intelligence for improved spatial cohesion and coupling along with best-fit solutions by data modeling and. analytics.

The methodology assumed here is expected to meet the objectives as in 1.1, 1.2 and 1.3.

DISCUSSION

NAPCC must involve capacity-participation of all Ministries along with Intergovernmental Panel on Climate Change (IPCC) and UNFCCC. It will have to innovate and actuate

interdisciplinary interventions with a global mandate to arrest climate change. The objectives (1.1, 1.2 and 1.3) provide a huge scope to employ IT approaches as suggested here would enable sustainable climate management interventions to mitigate the risks on health, food, livelihood, energy and environment securities. Besides, it will help in warehousing of research databases in areas of-- Oceans, Forests, Agriculture, Land use, Meteorology, Cryosphere, Socio-economics, Hydrological etc. India has its aspirations to reform and transform as a developed country with initiatives like 'Make in India', 'Digital India', 'Skills India', 'Smart Cities' etc.

The need therefore is for capacity-led convergent actions under NAPCC missions and policy framework. The climate data management approach suggested here would provide inputs for an integrated national knowledge network for informed actions at any spatial level thereby resulting in optimization of the financial and other resources. However, there are limitations with climate data. Heterogeneous provenance of massive data set pertaining real time climate changes at different geographies impairs any attempt to meet consistent standards of quality and consistency in management of climate data. Consequently, statistical models derived from this imbroglio will deviate from accuracy.

These are difficult to analyze comprehensively in any linear way (Kobielus 2014). Sometimes, it's so massive and inconsistent that no established data-scientific approach can do justice to interpretations. Global climate change is a complex data system, with large-scale and long-period spatio-temporal characteristics, which must be studied using a variety of theories and methods (Guo *et al*., 2014). The challenge is to use big data to make the case for climate change action, specifically **"**to bring forward data-driven evidence of the economic dimensions of climate change." (Borne 2014).

Earth observations big data has not only its own volume, variety, veracity and velocity but also unique advantages for global climate change research. Data science has the potential to handle climate data is still best a belief. Further, by using climate data digitization our future can benefit from the informed decisions of the present on climate change adaptation (Munang *et al*., 2013).

Anticipated Results

Super Computer with high speed networks for climate simulations and spatial studies possibly backed by a NAPCC satellite.

Cloud based data management and Data Science processes used for Climate Intelligence

Digitalization of climate data for understanding and assessing climate variability, predicting extreme climate events and designing adaptation and mitigation strategies.

Entrepreneurship development (medium, small and micro) with access to knowhow on Green, Clean and Lean mechanisms and resources.

Preventive measures based on informed climate-friendly adaptations for disaster mitigation.

Conclusion

Government of India must make its NAPCC interventions inclusive by design to arrest climate change. Where, every individual and institution should be empowered and encouraged to think globally and act locally. India must leverage cutting edge IT approaches to promote climate data access for decision support in decentralized planning, allocations and disaster mitigation. NAPCC data management approach with 'Cloud-Data Science' based decision-support along with geographic reference system would especially trigger the minds of data scientists, climate experts, IT experts, domain experts and policy makers to also develop Climate-management portable end-user systems that are operational, transitional and maintainable at any spatial coordinate under NAPCC.

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