

REPORT ON THE WORKSHOP ON CLIMATE CHANGE AND AGRICULTURE IN INDIA

Indian Statistical Institute, Bangalore Centre

Economic Analysis Unit

Project on Rural Energy

INTRODUCTION

The Economic Analysis Unit of the Indian Statistical Institute (ISI), Bangalore Centre, hosted a one-day workshop on climate change and agriculture in India. The workshop was held from 10 a.m. to 5:30 p.m. on March 28, 2016, at the campus of the Indian Statistical Institute, Bangalore Centre.

AGENDA

The focus of the workshop was on the following issues:

- To explore some aspects of the impact of climate variability and projected changes in the mean values of temperature and precipitation at the regional level for India.
- To discuss the issue of distinguishing between current climate variability and future changes in climate with respect to the mean and the variance of climate variables, especially in understanding the socioeconomic impact of climate change on Indian agriculture.
- To examine the importance of understanding the differentiated impact of climate variability across different socio-economic categories of producers, agro-climatic zones.
- To briefly review the new economy literature on climate change and agriculture.
- To understand the dimensions of energy inequality in rural India.

RESOURCE PERSONS

The workshop was conducted by a team led by T Jayaraman, Professor and Chairperson, Centre for Science, Technology and Society, School of Habitat Studies, Tata Institute of Social Sciences, Mumbai. Apart from Prof Jayaraman, the team comprised of the following speakers.

T Jayaraman Professor, Centre for Climate Change and Sustainability Studies, School of Habitat Studies, Tata Institute of Social Sciences, Mumbai

K. S. Kavikumar Professor, Madras School of Economics, Chennai

Kamal Murari Assistant Professor, Centre for Climate Change and Sustainability Studies, School of Habitat Studies, Tata Institute of Social Sciences, Mumbai

Tejal Kanitkar Assistant Professor, Centre for Climate Change and Sustainability Studies, School of Habitat Studies, Tata Institute of Social Sciences, Mumbai

WORKSHOP PARTICIPANTS

MPhil and PhD scholars and researchers from the following institutes and organization were in attendance at the workshop.

- Foundation for Agrarian Studies, Bangalore
- Indian Institute of Science, Bangalore
- Institute for Social and Economic Change, Bangalore
- National Institute of Advanced Studies, Bangalore
- National Law School of India University, Bangalore
- University of Agricultural Sciences, Bangalore
- University of Hyderabad, Hyderabad
- Indian Institute of Technology, Madras
- Indian Statistical Institute, Bangalore

In total, 56 participants attended the workshop.

INAUGURAL SESSION: OPENING REMARKS

Prof VK Ramachandran, Head of Economic Analysis Unit, ISI, Bangalore Centre began with a brief introduction of the speakers of the workshop. He remarked that Noam Chomsky, in one of his recent interviews has outlined two civilizational threats that the world faces today. The first is the threat of nuclear war and the second is climate change. He stressed that climate change and its effect on agriculture has immediate implications for country such as India where 70 per cent of the population still lives in rural areas. This is compounded by the fact that India is a country dogged by class, caste and gender barriers. He commented that Prof Jayaraman and his team from TISS conducting the workshop is distinguished for incorporating in their work on climate change, such institutional factors that mediate the question of climate change and agriculture in India,

Prof B. Rajeev, Head of ISI, Bangalore, began by giving a brief overview of ISI and its various academic departments. On the issue of climate change he remarked that it's a multi-national issue and a global commons problem which requires a multi-disciplinary focus which takes into account not only the magnitude and dimensions of the physical changes it will bring about but also the social side of the problem.

SESSION 1 CLIMATE CHANGE AND AGRICULTURE: OVERVIEW AND CRITICAL ISSUES

Speaker: T Jayaraman

Chair: Madhura Swaminathan

The opening remarks were followed by the 1st Session of the day conducted by Prof Jayaraman and chaired by Madhura Swaminathan, Professor at the Economic Analysis Unit, ISI.

Prof Jayaraman began by remarking that rather than provide an overview of the literature on climate change and agriculture, he would instead like to draw the attention of the participants to a few key issues and fault lines which require careful thinking within this vast array of literature from diverse sources such as climate policy think tanks, academicians, and NGOs. The key issues focussed on three themes. The first theme revolved around the current status of global warming accompanied by some remarks on climate change and agriculture. The second theme addressed the constant confusion in both academia and policy making between climate variability and climate change. The confusion between the two he stressed gives rise to discussion in a disorganized manner and leads to wrong policy emphasis. The third theme dealt with the economic impacts of climate change on agriculture and how they need to be discussed in context of the prevailing agrarian relations in India.

After introducing the three themes he elaborated on each one of them. He referred to the IPCC's Fifth Assessment Report on climate change which underlines that it is *extremely likely* that human influence has been the dominant cause of observed warming since 1950. He then proceeded to discuss the consequences of climate change including temperature rise, increase in precipitation, melting of glaciers and polar ice caps and extreme events. He emphasised that the climate change as a subject of study is in a state of scientific flux and the most challenging task then is to understand how to take decisions under conditions of uncertainty. The most important aspect of policy making under climate change then is the scientific, technological and socioeconomic uncertainty surrounding it. He further discussed how future global warming scenarios would look like.

He also made a brief point about the Paris agreement. He commented that while it is certainly true that a political agreement was reached in Paris but scientific aspect of the agreement leaves much to be desired since the sum total of promised emission reductions in Paris is insufficient to keep temperature below 2 degree Celsius. This, he said, could have serious consequences as it would increase the adaptation burden on countries like India.

On the issue of climate change and agriculture he stressed that models of crop production, considered together with global climate models, indicate that global warming will increase the exposure of major crops to temperature stress, leading ultimately to lower yields. Such decreases in yields vary significantly across the globe. He elaborated the effect it would have on different temperature and latitudinal zones around the world. Climate change in certain regions such as Russia, Canada and certain parts of United States will improve agriculture however these short term benefits will be accompanied by negative effects. The semi-tropical and tropical regions would suffer more because life in the tropics is already much closer to the optimal heat stress levels. That said, he emphasized that this should not lead to the conclusion that all forms of agrarian distress or all disruptions of production are due to climate change because these could have very serious policy implications. This is because it would shift focus from the problems faced by farmers which might be of socio-economic origin rather than just an outcome of climate change.

On the second theme he elaborated that traditionally the focus while studying impact of climate change on agriculture has been on mean values of climate variables as the

background to economic activity. However what climate change has brought into focus is the significance of climate variability. Climate variability can have as much impact as the mean value of change in climate variables. He also referred to recent research where the variable temperature understood in terms of critical temperature is treated as an independent variable.

Next, he emphasized the importance of understanding the notion of yield gaps in agriculture in order to make accurate conclusions about the impact of climate change and agriculture. Yield gaps are generated when the possible potential yield is not achieved in practice and this is a feature across countries. However its more serious for countries such as India where farmers lack access to agricultural inputs and yield gaps tend to be higher. Hence the discussion on impact on climate change and agriculture has to be accompanied by a discussion on yield gaps in order to understand the true extent of the impact of climate change on agriculture.

He then proceeded to discuss the impact of climate change on agriculture and concluded that agriculture in India is affected by climate variability but is not under immediate threat from climate change. But he cautioned that this should not lead to complacency, as development of Indian agriculture is a crucial task. He also stressed the importance of understanding monsoon cycles and modelling it more carefully in context of agriculture in India.

For the third theme of economic impact of climate change on agriculture, he highlighted that the crucial issue is the distributional impact of climate change on agricultural production between and within countries. This would require detailed analysis of agricultural production at the village level with focus on general instability of agricultural production, diverse crop incomes across classes, and different net incomes and assets across classes which leads to their varying ability to deal with climate shocks.

With this Prof Jayaraman concluded and the Chair invited questions and clarifications from the participants. Some of the questions asked and addressed were as follows: Does climate variability form a part of the legal definition of climate change as given in the UNFCCC? What are the methodological issues associated with assessment of climate change impact on agriculture? What role does technology like hybrid variety of seeds play in arresting the impact of climate change on agriculture? What has been the impact of climate change on agricultural production in colder latitudes such as Russia? Are there geographical regions where the global average rise in temperature has already crossed 1.5 degree Celsius? How much do we know about the distributional impact of climate change on various classes?

SESSION 2: REFLECTIONS ON THE NEW CLIMATE-ECONOMY LITERATURE

Speaker: KS Kavikumar

Chair: VK Ramachandran,

This was the second session of the day and was conducted by Prof Kavikumar and chaired by Prof Ramachandran, Head, Economic Analysis Unit, ISI, Bangalore. After giving a brief overview of the structure of his presentation Prof Kavikumar he went on to elaborate the cross sectional models and panel-data based models in studying climate change and also

highlighted the conceptual issues surrounding estimates based on both cross-sectional and panel data based models. He also discussed in brief how to overcome these conceptual issues. He then proceeded to discuss the new climate economy literature elaborating on the Agro-economic and Ricardian approach of studying the impact of climate change on agriculture and highlighted the strengths and weaknesses of each. The next part of the discussion focussed on climate change adaptation instruments in agriculture such as effectiveness of insurance as an adaptation strategy. He also discussed the role of eco-system services in reducing climate impacts by linking cost of adaptation with payments for ecosystem services. He also elaborated on the challenges of understanding migration as an adaptation strategy .

The Chair then invited questions and clarifications from the participants. Some of the questions which were asked and addressed were as follows: In the case of special autocorrelation how does one specify the weights matrix? Why is insurance not an effective adaptation strategy? There is a body of work which estimates crop prices in dollars upto 2050 on the basis of modelling, should one take such models seriously?

SESSION 3: DATA AND METHODS IN CLIMATE ANALYSIS

Speaker: Kamal Murari

Chair: Molly Chattopadhyay

This post-lunch session was conducted by Kamal Murari and chaired by Molly Chattopadhyay, who is an Associate Professor at ISI, Bangalore. The focus of his session was on understating the data available in the public and private domain to study climate change how can such data be identified, collected and coded. He began with a discussion on surface climate variables and discussed its two types -primary and secondary. He elaborated on measurement of surface variables and followed it with a discussion on identifying the agency which maintains such data and discussed the formats in which it is available. He explained with examples how to access and read the Indian Meteorological Department, automatic weather station data.

This was followed by a discussion on climate metadata. Climate metadata provides information such as how has the station data been collected? What is the type of weather station has collected the data? Has there been a change in location of weather station in the past? He emphasized the usefulness of metadata in doing research on climate change. This was followed by a discussion on station data and gridded data. He discussed which one should be used when and also their respective advantages and disadvantages.

He identified three categories of data and proceeded to discuss each in greater details The first category which was discussed was baseline data. It was accompanied by discussion on its sources and how and from where to obtain it. The third category discussed was re-analysis data which is data obtained from data assimilation project which aims to provide a consistent historical observational data spanning an extended period using a model based analysis scheme. Sources of re-analysis data were also discussed. Data from climate models formed the third category of data. These are outputs from GCM (General Circulation Model) and

RCM (Regional Climate Models) simulations. He discussed the sources of climate model data and also issues with GCM data.

The discussion then moved onto data processing and tools to process very large data sets. The topic which was discussed subsequently was downscaling of GCM data and the two methods of downscaling data- Statistical downscaling and dynamical downscaling. He also elaborated upon two types of biases in climate model data –systematic bias and random bias and explained different ways to correct it. In his conclusion he reiterated some of the points he had made earlier.

The Chair for the session then opened the floor for clarification and questions from the participants. Some of the questions asked by participants and addressed by the speaker were as follows: How is evapotranspiration measured for different crops? Can downscaling be done according to political boundaries? What is apparent temperature and why is it important to study it? How does one ensure time and spatial quality of data in large scale data?

SESSION 4: RURAL ENERGY: EQUITY AND ACCESS

Speaker: Tejal Kanitkar

Chair: KS Kavikumar

This session was conducted by Tejal Kanitkar and chaired by Prof KS Kavikumar. The speaker began by highlighting two important aspects of Climate change and rural energy. The first aspect discussed was energy access. It was highlighted that energy access especially in rural areas is an important issue especially in context of developing countries such as India because of large deficits in terms of energy services which can be accessed by the people. The government priority in such countries is on providing energy services to its population which can be in conflict with the mitigation effort it is required to undertake. The second aspect is the transition from using traditional sources of energy to modern sources of energy which would also imply increasing emissions. Modern and traditional sources of energy, was then, discussed in greater detail along with the differences in how they are extracted. Commercial and non-commercial sources of energy were discussed next and in particular difficulties faced in accounting the latter which leads to problems of underestimation. Following this, the contribution of various energy sources to total energy supply in India and data gaps in these figures were discussed.

The speaker then proceeded to elaborate on the three major areas of consumption of energy in rural areas. The three areas are: domestic, agriculture and rural enterprises. In domestic energy use it was highlighted that type of energy used varies according to various income classes. The use of LPG is limited to only higher income levels. For household by occupation and landholding size, agricultural labourer houses and those having smaller land holding have lower access to LPG. Various gaps in NSSO's data collection on energy use for domestic purposes in rural areas were also highlighted. Data on agricultural residue and dung cakes used as a source of energy are not collected by the NSSO leading to underestimation. It was also highlighted that no data is collected to estimate time spent in fuel collection, preparation and use. NSSO also reports only primary fuel used by households whereas multiple fuels are

actually used by households. Such data gaps, it was stressed, come in the way of a better understanding of energy deprivation in rural India.

Direct and Indirect use of energy in agriculture formed the next part of the discussion, along with a discussion on problems in estimating energy use in agriculture and data gaps. This was followed by a discussion on energy use for rural enterprises. It was highlighted that data for non-farm energy use in rural areas not covered in any survey. Moreover it is only the authorized electricity use that can be calculated; however there are dual use electricity connections prevalent in many places leading to possible underestimation. There are also no estimates of primary energy use in rural enterprises – e.g. coal use in brick kilns and jaggery production.

The speaker concluded by highlighting that rural energy access, availability and use is linked to climate change and forms a very important aspect of equity issue for India in international climate change negotiations. It was also stressed that estimates of rural energy use and demand for the future is based on poor data which should caution us to guard against underestimation. The third point highlighted in the conclusion was that energy use in agriculture is changing rapidly and it is the only sector in which the energy use per unit of GDP is increasing for reasons such as mechanization and groundwater irrigation.

After the speaker concluded the presentation, the Chair invited the participants to ask questions and seek clarifications. Some of the questions asked and addressed were as follows: Do we need to think about alternative solutions for transformation from traditional sources of energy to modern sources which can be less polluting than the western model of development? Could the NFHS (National Family Health Survey) database with data on clean fuel and unclean fuel help in quantifying the impact of traditional sources of energy on women's health? What is the role of wind energy in agriculture? Could you elaborate more on your sources of data? How do we account for the post-harvest energy use in agriculture? Does providing subsidized or free electricity to farmers lead to over-extraction of ground water?

SESSION 4: PARTICIPANTS SESSION

Chair: T Jayaraman

Prof Jayaraman, the chair of the session invited the participants to interact with the speakers of the workshop. He invited participants working on climate change related themes as a part of their PhD work or those working on climate change related projects to share with those assembled their topic of study and their research interests. He further requested the participants to comment, provide feedback or point out gaps in the proceedings of the day. He also invited clarifications from the participants on the sessions of the day.

A number of students came forward to discuss their work with the speakers of the session and some of them clarified a few questions they had as regards to their methodology of their respective study area such as how to construct a vulnerability index? Should local knowledge

be incorporated in adaptation policies? What are the funding channels available for adaptation action?

In response to the question from a researcher on how to construct a vulnerability index, Prof Jayaraman commented on the difficult nature of defining socio economic vulnerability and thereby constructing an index to capture it. Prof Jayaraman suggested to the students that instead of starting out with the question of how to construct a vulnerability index, it is more fruitful to first understand what aspect one is trying to understand and capture through such an index. Prof Kavikumar further explained this point made by Prof Jayaraman by giving the example of how Human Development Index (HDI) came to be defined.

To the question of incorporating local knowledge in climate change adaptation action, Prof Jayaraman noted that, the question of whether local knowledge should be incorporated or not would depend on the kind of project and the agreement amongst all stakeholders about the relevance of the local knowledge to the project in question. However he also cautioned that one has to bear in mind that climate change alone is not the problem, it is global warming in an unequal world which is the problem, and in an unequal and hierarchical society one cannot take stakeholder consensus for granted.

On availability of funding for adaptation, Prof Kavikumar remarked that there are several funding channels available for climate change action; however proving that action is additional is the key to receiving those funds.

Some of the other questions put to the speakers and addressed by them were: How can one capture the exposure to climate change at household level? How do you perceive the present government policy of promoting clean and modern energy such as solar pumps for irrigation? Several other participants sought clarifications from the speakers about certain aspects of their sessions.

Post this session, the workshop was concluded with a vote of thanks delivered by Kaushik Bora on behalf of the organizing team of the workshop.

Sreeja Jaiswal, Research fellow of Tata Institute of Social Sciences, Mumbai has served as rapporteur for the workshop.

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0930-0955 Registration and Tea

1000-1015 Introduction

V. K. Ramachandran

B. Rajeev

1015-1130

Chair **Madhura Swaminathan**

T Jayaraman Climate Change and Agriculture: Overview and Critical Issues

1130-1145

Tea break

1145-1300

Chair **V. K. Ramachandran**

K. S. Kavikumar Reflections on the New Climate-Economy Literature

1300-1345

Lunch

1345-1500

Chair **Molly Chattopadhyay**

Kamal Murari Data and Methods in Climate Analysis

1500-1510

Tea break

1510-1625

Chair **K S Kavikumar**

Tejal Kanitkar Rural Energy: Equity and Access

1625-1725

Chair **T Jayaraman**

Participants' session

1725-1730

Kaushik Bora Vote of thanks

1730

Tea and snacks

Speakers

T Jayaraman Professor, Centre for Climate Change and Sustainability Studies, School of Habitat Studies, Tata Institute of Social Sciences

K. S. Kavikumar Professor, Madras School of Economics

Kamal Murari Assistant Professor, Centre for Climate Change and Sustainability Studies, School of Habitat Studies, Tata Institute of Social Sciences

Tejal Kanitkar Assistant Professor, Centre for Climate Change and Sustainability Studies, School of Habitat Studies, Tata Institute of Social Sciences

B. Rajeev Head, Indian Statistical Institute, Bangalore Centre

V. K. Ramachandran Head, Economic Analysis