

BARRIERS AND OPPORTUNITIES IN ACHIEVING CLIMATE AND SUSTAINABLE DEVELOPMENT GOALS IN INDIA - A MULTILEVEL ANALYSIS: ISSUES AND CHALLENGES

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Abstract:

India; decision-making; climate change; climate action; climate policy Environmental Studies Climate action plans are essential for climate mitigation and adaptation as well as to achieve climate and development goals like the Paris Agreement and the Sustainable Development Goals (SDGs). However, the development and implementation of climate action plans at multiple levels involve decision-making processes. In this article, we examine the barriers and opportunities to decision-making in climate action plans for adaptation at three different governance levels in India: national, sub-national and local. Through a literature review and analysis of case studies, we find that lack of usable climate information; institutional weaknesses and capacity of actors are critical barriers to decision-making at all three levels in India. We recommend that providing usable and accessible climate information, creating evidence and knowledge on adaptation, strengthening the science-policy interface and institutional mechanisms, as well as building the capacities of actors can contribute to better decision-making and achieving targeted climate action plans and SDGs..?

Keywords: India; decision-making; climate change; climate action; climate policy

1. Introduction

Climate action plans are mitigation and adaptation strategies with specific targets, finances, time limits and outcomes. When effectively implemented, it has the potential to reduce economic losses and improve resilience to climate change. Further, it can contribute to green growth and help achieve Sustainable Development Goals (SDGs) (Nerini et al. 2019). SDG 13, which is about climate action, SDG 11, about sustainable cities and communities, and SDG 15, about life on land, all have strong climate linkages (UN, 2015).

While climate action is urgently required to keep global warming below the 1.5-degree threshold, developing and least-developed countries will have to focus on climate action for their sustainable development needs by reducing their climate risks, loss and damages while achieving multiple benefits, including eradicating poverty. The Intergovernmental Panel on Climate Change's (IPCC's) sixth assessment report on climate sciences has urged for immediate and higher climate actions. The IPCC's sixth assessment report acknowledges that the

prioritization of sustainable development and meeting the SDGs is consistent with efforts to adapt to climate change (Roy et al. 2018) and the United Nations Framework Convention on Climate Change (UNFCCC) Conference of Parties (CoP 26) has urged countries for taking climate actions. However, planning and implementing climate action at multiple levels, from the national to local, are required to achieve them and the SDGs. This involves decision-making by actors and institutions at various levels to successfully and effectively implement climate action plans. The critical barriers to decision-making on climate action are lack of climate information, limited knowledge, the low capacity of actors and institutions and institutional weaknesses, according to several scholarly articles (Kirchhoff et al. 2013; Bhave et al. 2016; Dewulf et al. 2020). However, there are limited case studies from the global south examining the barriers to decision-making on climate action plans and the opportunities to overcome such barriers. This information is critical for national and international climate policies, as well as for promoting climate resilient growth in developing and vulnerable nations of the global south.

In this article, we examine the barriers and opportunities to decision-making on climate adaptation action plans in India at three different governance levels: national, sub-national and local. India presents itself as a good case study to examine the barriers to decision-making at different levels. India is a developing country with high climate vulnerability owing to the population's exposure to various climate risks (Maiti et al. 2017; Yadav and Lal 2018). About one-third to half of the population of some regions in India is classified as multi dimensionally poor as per the Government of India's (GoI's) Multidimensional Poverty Index report in 2021 (Government of India (GoI) 2021). The IPCC's sixth assessment report (Intergovernmental Panel on Climate Change (IPCC) 2021) for India is multifaceted. The country has diverse climate-sensitive zones, such as its vast coastlines, the Himalayan region, as well as arid and semi-arid regions (Currie-Alder et al. (2020); Rao et al. 2019).

India has been running several national-level schemes and programmes targeted at natural resource management and community development since 1980. In 2004, India's climate action plans started with the release of its National Communication (NATCOM) report, which recognized its vulnerability to climate change and the need for climate adaptation. India has made significant progress since then in preparing and implementing climate action plans for which climate institutions were established at different levels (Dubash and Joseph 2016; Pillai and Dubash 2021). In 2007, at the 13th CoP, also known as the Bali Conference, developing countries agreed to develop Nationally Appropriate Mitigation Action (NAMA). Subsequently, India released its National Action Plan on Climate Change (NAPCC) in June 2008. The 16th CoP held at Cancun in 2010 established the National Adaptation Plan process to facilitate adequate adaptation planning in the least developed and developing countries. Thereafter, in 2009, India initiated the State Action Plan on Climate Change (SAPCC) to decentralize NAPCC objectives while addressing state-specific climate change issues for its federal states. Following the CoP 21 in Paris, India too submitted its Nationally Determined Contribution (NDC) with high targets for adaptation and mitigation. India also has grassroots governing bodies or the Gram Panchayat at the village level and urban local bodies (ULBs) like municipal corporations in towns and cities, which have allowed a few villages and towns (e.g. Mumbai Climate Action Plan, Chennai Resilience Plan) to come up with their own climate action plans.

Additionally, India has been an active member of the UNFCCC and a key player in climate negotiations for technology, finance, and international cooperation on climate actions (Dubash et al. 2018). India has also been focusing on implementing SDGs at the decentralized level of its

states, districts and villages (Government of India (GoI) 2019). Climate change is one of India's challenges in achieving its SDGs. Articulating decision-making processes for climate action plans in India can have valuable inputs for future climate change actions among many developing countries.

Although climate action plans include adaptation and mitigation, in this article we focus only on adaptation because nations in the global south, like India, are particularly vulnerable to climate change, and because climate adaptation is critical. Furthermore, global negotiations are at a stage of voluntary mitigation for these nations and mitigation actions are also dependent on several external factors like carbon markets and international climate finances. This paper discusses how climate adaptation actions can be leveraged to achieve SDGs 11 and 13.

2. Methods

We first reviewed the literature on international case studies and research articles to identify the critical barriers in climate decision-making. We used the Google Scholar search engine to identify the most relevant publications for which we used various combinations of keywords, such as "climate action plans", "decision making", and "barriers". We carried out a focused review to synthesize evidence from the top Google Scholar search results. Such an approach to literature review has been used in several social science research areas like climate change, which has voluminous literature (Fischer et al. 2021).

Numerous articles published on barriers to climate adaptation have been systematically reviewed earlier (e.g. Moser and Ekstrom 2010; Eisenack et al. 2014; Bhave et al. 2016). These reviews highlight that although there are several barriers to climate adaptation – such as finance and resources – governance, particularly institutional weaknesses and the ability of actors to make decisions, were identified as significant barriers. Several other works of literature have argued the importance of climate information in decision-making on climate adaptation actions, especially when preparing action plans for future climatic changes (Dessai et al. 2009; Kirchhoff et al. 2013; Bhave et al. 2016; Lemos and Klenk 2020). We then used these barriers – 'climate information', "institutional weaknesses" and "capacity of actors" – as keywords for a focused literature review on decision-making on climate action plans in India. We also included grey literature like published case studies on climate adaptation. Our main objective was to examine how these key barriers to critical decision-making differed across three levels: national, sub-national (federal state) and local (city and village). We present specific case studies to highlight each kind of barrier at the three different levels. Further, from the literature review and case studies, we identify the success factors and opportunities to overcome the barriers and improve the decision-making processes on climate adaptation actions in India.

The results of this analysis are arranged to present a brief literature on the barriers to decision-making in the global context, followed by the Indian context at the three levels (national, sub-national and local). In the discussion section, we identify some of the opportunities to overcome these barriers in decision-making at different levels and discuss how climate adaptation actions can be furthered to achieve SDGs.

3. Barriers to decision making at different levels

Climate information

Climate information is one of the top barriers to decision-making. It is not only on precipitation and temperature records and the possible future changes but also on climate risks. The climate risks are a combination of exposure and vulnerability (Wilby et al. 2009). Usable

climate information, including temperature and precipitation changes, the patterns of change and possible risks from such changes, is essential for decision makers to respond through climate action plans (Lemos et al. 2012). However, the existing climate information often comes with limitations, particularly the uncertainty in climate change projections and the gap between users and producers in what scientists understand and publish as helpful information and what users recognize as usable in their decision-making (Jones et al. 2017; Porter and Dessai 2017). For example, what would an increase in rainfall mean? Or the frequency of possible extremes in rainfall – what could be the possible impacts of such increase in rainfall and what type of climate actions are needed to adapt to such changes? What are the costs and benefits of such actions? Limitations on climate information also include impact assessments across different sectors and scales, vulnerability, as well as cost-benefit analyses (Diaz and Moore 2017). There is also paucity of information on possible extreme climate events (Bhave et al. 2016). Further, climate information for chalking out climate action plans is not readily available in accessible formats to many countries at different geographical scales and sectors, particularly in the global south (Blicharska et al. 2017). Countries in the global south cannot generate finer level climate information and rely on the global availability of historical climate data on rainfall and temperature as well as projected changes, which are available in open-source databases like Worldclim2 (worldclim.org) (Fick and Hijmans 2017). However, uncertainty and variability in rainfall at numerous timescales in global climate databases make it challenging to use this information to model future precipitation changes and to cater to national and sub-national needs. (Sun et al. 2018). There is a gap in available information on climate risks and methods to assess those (Adger et al. 2018).

India has been collecting information on temperature and precipitation since 1870 through the India Meteorological Department. This data has been increasingly used to understand climate changes in precipitation and temperature since 1990 (Thapliyal and Kulshrestha 1991). However, it was only in 2006 that India started to assess future climate impacts using global and regional climate models. The first one was developed using the global climate model, PRECIS (Providing Regional Climates for Impact Studies) (Kumar et al. 2006). This model provided the first of its kind high-resolution climate change scenario in India and predicted increased intensity of rainfall and temperature.

The PRECIS model projection was at a scale of 50 × 50 km and did not cater to sub-national planning levels in a country like India with high variations in climate zones. The Indian Network for Climate Change Adaptation (INCCA) published a report for Climate Change Assessment in 2010 based on PRECIS climate model. This report provided an assessment of the impact of climate change in the 2030s based on the PRECIS model on four critical sectors of the Indian economy– namely agriculture, water, natural ecosystems and biodiversity, and health– for four climate-sensitive regions, namely the Himalayan region, the Western Ghats, the coastal regions and the north-east region (GoI, 2010). This INCCA network-based programme brought together over 120 institutions and more than 220 scientists from across the country to undertake scientific assessments of different aspects of climate change. However, the information in the report was at a very basic scale and did not cater to geographical variations in climate impacts. At the national level, the PRECIS climate impacts information showed limited use in drafting detailed action plans under the NAPCC and in prioritizing regions for implementing different missions (Byravan and Chella Rajan 2012; Rattani 2018). At the state level, an analysis of 15 SAPCCs showed weaknesses in their action plans due to limited availability and access to

reliable climate information, including climate impacts and risk assessment at a state and local scale. This was partly due to the state government's is having borrowed heavily from the INCCA report, which presented broad regional climate impacts (Dhanapal and Panda 2014).

Since the publication of the climate change impacts assessment for India using the PRECIS model in 2006 (Kumar et al. 2006), there have been several advancements in climate information from national as well as international studies (Jin et al. 2018; Krishnan et al. 2020). The Coordinated Regional Climate Downscaling Experiment (CORDEX) South Asia framework that began in 2013 has been used to assess the qualitative aspects of future change in India (e.g. Sanjay et al. 2017). Results from the CORDEX are expected to provide better information to policymakers (Krishnan et al. 2020). However, the CORDEX experimental results are yet to reach local-level decision-making. They are essential to disseminate the experiment results in a usable format for decision-making at the local level.

There is also a lack of socio-economic and land use data that can be combined with climate information to assess climate risks. For example, to identify climate impacts and develop appropriate adaptation measures, there are several information gaps such as on the hydrology of river basins, meteorological data on rainfall patterns, socio-economic data on local communities and their land-use practices, including agriculture cropping patterns. These are essential data points when combined with projected climate impacts using regional or downscaled global climate models. Given India's different biophysical regions and social disparities, there is a gap in understanding how multiple natural and social stressors interact to cause vulnerability (Dubash et al. 2018). The lack of national level climate information, such as possible extreme climate events, loss and damages, and costs of adaptation, has hindered any effective planning for national-level budgets on climate actions (Garg et al. 2015). This has affected decision-making on allotting climate funds to different national missions and federal states.

At the local level, the lack of climate information has been particularly challenging for any decision making on climate action plans. For example, Indian cities have been experiencing severe floods in recent years due to extreme rainfall events, especially in the monsoons during June-September and October-December (Gupta 2020). However, climate change-related impacts of extreme rainfall events and climate risk assessments are available to only a few cities (Govindarajulu 2020). In rural India, the uncertainty of climate change projections is exceptionally high for precipitation, wherein changes in monsoon rainfall patterns are difficult to assess, carrying a significant implication for climate adaptation in the water and agriculture sectors (Singh and Achuta Rao 2019; Krishnan et al. 2020). In sum, the availability and access to climate information to aid decision-making at the sub-national level is limited in India (Singh et al. 2018).

4. Institutional barriers and capacity of actors

In addition to climate information, there are many institutional barriers, including institutional strengths and the capacity of actors in local governments to use climate information for developing climate action plans (Porter et al. 2015). Climate-related institutions at different administrative levels in a country typically include ministries, federal governments, nodal agencies and municipal administrations. Climate institutions and governance face significant barriers to cross-level communication and collaboration between national and sub-national levels. This is due to power imbalances across governance levels as well as between federal and decentralized systems of government (Regmi et al. 2016).

India's decision-making at the national level is centralized, and the NAPCC was appointed as the country's apex body for climate decision-making by the Prime Minister's Council on Climate Change (Dubash and Joseph 2016). The planning and implementation of the NAPCC are the responsibility of respective ministries. For example, the National Water Mission is under the Ministry of Water Resources, while the National Mission on Sustainable Habitat is under the Ministry of Urban Development. However, there are many barriers to decision-making at the ministry level. In the case of the National Water Mission, the institutional barriers include lengthy bureaucratic processes and systemic failures, which hinder effective inter-institutional networks from facilitating adaptation plans (Azhoni et al. 2017).

At the state level, institutions like the State Committee on Climate Change were made to prepare and implement SAPCC in 2010. Although the nodal ministry for climate change provided the guidelines for preparing the SAPCC in 2010, the tasks of collating climate information, assessing climate risks and designing action plans were that of the state government, which had limited capacities. The result was weak climate action plans (Dubash and Jogesh 2014). There are no strong climate institutions at the local level.

According to the 1992 constitutional amendment, there are supposed to be ULBs like municipal corporations in cities and towns and Gram Panchayats at the village level. These local administrative bodies are to function under elected representatives, aided by government officials. However, these local institutions do not work in many places in India. Furthermore, the ULBs are constrained by financial and institutional weaknesses to take climate action (Govindarajulu 2020). At the local level, there are several cases where institutions and actors have failed to recognize the climate risks and plan adaptation actions. Kochi city in India, for example, had scientific studies on extreme weather-related flood risks (Sowmya et al. 2015). However, no action plan was in place, and in 2018 the city was severely affected by urban floods (Govindarajulu 2020).

5. Measures for better decision-making

The critical barriers to decision-making on climate information, institutional mechanisms, and the capacity of actors have been overcome in India, and there has been successful preparation and implementation of climate adaptation action plans. There are few opportunities to overcome these barriers, however. This paper discusses some of the factors and potential opportunities to overcome these barriers by using past climate data, generating and disseminating usable climate information, vulnerability assessments, adaptive management, knowledge building and strengthening institutions, and the capacity of actors.

6. Generating and disseminating climate information

Climate information, including projected downscaled climate models, is unlikely to eliminate uncertainty. An evaluation of global climate models by the IPCC in its fifth assessment report concluded that although the models are improving, there is still high uncertainty in predicting precipitation changes (de Coninck et al. 2018; Hausfather et al. 2020). Global experiences show that while high-resolution impact assessments are better, understanding past climate variability and trends can help in robust decision-making (Nissan et al. 2019). This is particularly suitable for better decision making on climate action plans in India. The India Meteorological Department has had information on daily rainfall and temperature for over 120 years. When suitably corrected for biases and combined with regional climate model outputs, this data shows better results in mapping the effects of climate change in hydrological studies at the regional scale (Smitha et al. 2018).

In addition to climate information, precipitation and temperature changes and their impacts, vulnerability and risk assessments are essential. When combined with other relevant factors like vulnerability and event-oriented risks (Shepherd et al. 2018), this becomes useful in better decision making. The successful case of adaptation planning for urban floods in Surat city (Chu 2016) is an example of how past climate data combined with risk assessment can help plan for climate actions. Cities with more accessible and reliable climate information generated from scholarly research have shown remarkable improvements in their decision-making capabilities and response to climate risks. Information on climate risk assessment (Joerin et al. 2014) and the risks of urban flooding (Ramachandran et al. 2019) in Chennai helped the city to come up with a climate action plan in 2019, and more focus was given to urban flood mitigation works (CMC 2019).

Given the uncertainty and availability of climate information at the sub-national level, adaptive management could aid in better decision-making (Kundzewicz et al. 2017). In sectors like agriculture, water resources and rural development, adaptive control helps in better decision-making. Adaptive management relies on evidence and knowledge from earlier successes. Farmers have been changing their sowing and harvesting time, cultivating short duration crop varieties and adopting inter-cropping and agro forestry as climate adaptation measures, which are practices learned from the successes of other farmers without external intervention (Tripathi and Mishra 2017). A potential opportunity for strengthening decision-making based on adaptive management is thorough documentation of pilot projects under the NAPCC, SAPCC and the National Adaptation Fund. Best practices can be documented and mainstreamed into policies or scaled up through other programmes (Prasad and Sud 2019). Such pilot schemes could help states with adaptive management and improve their decision-making ability. The Central Research Institute on Dry land Agriculture has been documenting and promoting intelligent practices and technologies for climate-resilient agriculture under the National Mission on Sustainable Agriculture. The information on successful adaptation measures is verified and disseminated through institutions like Krishi Vigyan Kendra (Prasad et al. 2014). The National Mission on Strategic Knowledge on Climate Change under the Ministry of Science and Technology, GoI, is already attempting to generate and disseminate knowledge on climate change, network creation, institutional development, capacity building, international cooperation and knowledge exchange (Rattani 2018).

The Ministry of Earth Sciences, GoI, is the nodal ministry managing scientific institutions responsible for generating climate information, and such information can be disseminated through appropriate institutions. For example, the National Institute of Hydrology can share climate information generated by the Indian Institute for Tropical Meteorology on possible climate impacts and what it means for the water sector. Climate information should be made easily available at the local level. At the village level, institutions like the Krishi Vigyan Kendra have been instrumental in disseminating agro- meteorological advisories to farmers.

7. Strengthening research-policy interface

While generating climate information alone is not sufficient, a possible way of addressing the gap between climate information producers and decision-makers is by enhancing the research-policy interface (Prakash 2019; Lemos and Klenk 2020). In the case of India, there is a need for more feedback meetings between climate users, such as ministries, state departments and local bodies, and climate information producers like the Indian Institute of Tropical Meteorology and India Meteorological Department. Better usability is an iterative process that

emerges through interactions between knowledge producers and users (Dilling and Lemos 2011).

Climate institutions are essential for planning and implementing climate actions as well as for creating a research-policy interface. At the national level, the Prime Minister's Council of Climate Change, and at the state level, the State Centre for Climate Change, can facilitate the science-policy interface. In the coastal state of Odisha, which is frequently affected by floods and cyclones, a robust multilevel institutional arrangement was developed for disaster management and resilience building (Walch 2019), which gave a head start to the state in implementing its SAPCC. Odisha was the first state in India to implement SAPCC and access the Green Climate Fund. In contrast, many other states have yet to have institutional mechanisms in place to implement SAPCC (Dubash and Joseph 2016). Local bodies like municipal corporations and Gram Panchayats can also facilitate this by including scientists in the decision-making. For example, Chennai city constituted a Chennai flood management committee with government administrators, climate scientists, hydrologists and urban planners to collectively take decisions on flood mitigation and adaptation strategies. Similar actions have shown positive results in the past. In the case of Surat city, the Surat Climate Change Trust was formed as a collective decision-making body involving city administration officials, scientists and civil society members. A City Advisory Committee (CAC) was created to facilitate planning for socio-economic development and delineate the city's significant climate challenges. This was a structured, iterative process with distinct phases of stakeholder engagement, assessment and sector studies, collaborative city interventions, learning, synthesis, and documentation exercises (Chu 2016).

Capacity building of primary actors at the sub-national level is essential for the successful implementation of climate action plans (Hsu et al. 2017). In India, there are several cases where experience, extensive awareness, and capacity building have led to better decision-making. For example, the state of Odisha invested in better climate information for predicting cyclones, in institutional mechanisms such as the State Disaster Management Authority and in creating awareness among local communities to use cyclone shelters. This helped in reducing the impacts of the 2013 Phailin cyclone, saving thousands of lives (Das 2019). India has many scientific institutions that can take up capacity-building programmes for critical factors involved in decision-making on climate actions. The National Water Academy and the National Institute of Urban Affairs are already conducting capacity building programmes, for instance. Similarly, the Atal Mission for Rejuvenation and Urban Transformation (AMRUT), a national scheme to improve urban water supply, sanitation and green spaces is currently being implemented in over 500 cities, with particular focus on capacity building for ULB officials on integrated master plan development, water supply improvement and management, etc.

Table 1 provides an overview of climate change policies, decision-making institutions, and associated barriers and opportunities in India.

8. Climate actions for SDGs

Many countries do not have specific action plans for SDGs, especially SDG 11, and the climate actions themselves are the pathways to achieve these goals, which require appropriate decision-making. Decision-making on climate actions for achieving SDGs would require setting measurable targets. India's climate policy, as reflected in the NAPCC (2008) and NDC (2015), has been to reduce the impacts of climate change and avoid loss and damage through mitigation actions that have high co-benefits, such as alleviating poverty and energy access (Dubash and

Jogesh 2014; Government of India (GoI) 2015). In 2017, the GoI's policy advisory agency, the National Institution for Transformation of India (NITI Aayog), released a report on ongoing schemes to achieve SDGs, with a strong emphasis on climate and actions (GoI, 2019). In 2021, indicators for climate actions for SDG 13 were identified, which included disaster preparedness and resilience as critical factors (Government of India (GoI) 2021).

The NITI Aayog is the nodal agency for coordinating programmes for reaching the SDGs. Together with the Ministry of Statistics and Programme Implementation (MoSPI), NITI Aayog works with different line ministries to develop indicators that reflect the SDGs. There has already been an initial mapping exercise to identify specific nodal and other ministries for individual plans and targets, as well as that of recent central government initiatives (Government of India (GoI) 2019). The Ministry of Environment, Forest and Climate Change is the nodal ministry for SDG 13.

Climate change policies in India are anchored within a co-benefits framework, focusing on leveraging the synergies between development and climate outcomes (Dubash et al. 2013). These were first articulated in the NAPCC in 2008 and explicitly stated in India's 12th Five-Year Plan, introducing measures to promote economic development while yielding secondary climate benefits. NAPCC, released in 2008, aimed to create

Source: Authors' compilation from various sources.

a directional shift in India's development trajectory by integrating climate concerns with larger developmental ones (Byravan and Chella Rajan 2012; Dubash and Jogesh 2014) through sustainable development pathways that advance both economic and environmental objectives. Decentralized adaptive management strategies that engage with a political, policy and implementation continuum from the neighborhood, city and region to the national level have proved to be more effective in India and could be a way of achieving climate and SDG targets (Sami et al. 2017).

9. Way forward

As reflected in its policy documents like the NDC, India's climate policy shows high commitment to adaptation and human development. To achieve both climate goals and development outcomes, climate actions must be targeted at specific vulnerable communities, regions and sectors. India is also firmly committed to achieve its SDGs (Government of India (GoI) 2019). However, our research shows that the lack of usable climate information and its access at different levels along with the limited capacity of actors and institutions affect the decision-making processes on climate action plans. Although few success stories of good decision-making have led to better planning and implementation of climate action plans, there is an overall need to address the barriers to decision-making. This is particularly important for urban India, where the underlying risk of climate change calls into question the achievement of SDGs, especially SDGs 11 and 13 (Chirag et al. 2020; Govindarajulu 2020).

Sub-national level action plans, such as the SAPCC in India, are an essential way to achieve NDC and SDGs and promote climate-resilient development. To successfully implement such sub-national plans, India needs to invest in climate research and strengthen international cooperation to produce useful and accessible climate information. India also needs to generate climate information through integrated assessment models and damage functions, which have been useful in decision-making (Diaz and Moore 2017). Although India has advanced in generating better and more credible climate information, like the recent CORDEX and the Earth System Model developed by the Indian Institute of Tropical Meteorology, making this

information accessible and improving it through feedback from end-users are essential. The climate information needs to cater to situations on the ground and, therefore, should be deciphered and understood at the sub-national level. Information on vulnerabilities and cost benefits of climate actions must be improved in addition to predicted impacts for better decision-making through a powerful research-policy interface (Ojha et al. 2020).

Evidence shows that centralized decisions are essential for climate negotiations and technology transfer, while decentralized governance and accountable institutions are required to implement local action (Hsu et al. 2017; Prakash 2019). Robust institutional arrangements are necessary for upstream functions, such as strategy formulation and knowledge creation, as well as downstream functions of coordination and implementation of sub-national action plans in India (Dubash and Joseph 2016). While institutions such as the State Centre for Climate Change must be strengthened for decision-making processes, actors of these institutions must be trained and up skilled for using climate information. Here in lies the role of national missions to increase knowledge production, dissemination, and capacity building of state actors in climate decision-making. Overall, our paper also highlights the importance of prioritization of understanding barriers to improve the chances of achieving the UN SDGs. Using the example of India, we demonstrate the roles of national and sub-national action plans and decision-making institutions in addressing the barriers to decision-making and advancing climate compatible development.

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