



# Stakeholder Analysis:

Options Analysis for a Regional  
Climate Change Programme to  
Deliver More Effective Climate  
Services, Early Warning and  
Disaster Risk Reduction

**FINAL VERSION**

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August 2015

This report has been produced by Practical Action Consulting and the UK Met Office for Evidence on Demand with the assistance of the UK Department for International Development (DFID) contracted through the Climate, Environment, Infrastructure and Livelihoods Professional Evidence and Applied Knowledge Services (CEIL PEAKS) programme, jointly managed by DAI (which incorporates HTSPE Limited) and IMC Worldwide Limited.

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DOI:[http://dx.doi.org/10.12774/eod\\_cr.august2015.clementsretal](http://dx.doi.org/10.12774/eod_cr.august2015.clementsretal)

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## Executive summary

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The Department for International Development (DFID) is seeking to understand the state of climate information and services in South Asia and has commissioned a scoping study to identify possible intervention options aimed at strengthening the gathering, use and application of climate information across the region for better decision making, development planning and emergency responses.

The first phase of the scoping study entailed an analysis of major gaps and opportunities on the supply and demand sides, based on a literature review and initial stakeholder consultations. Broad intervention options for the regional programme were drawn up and prioritised including areas of activity, scope, timescales, opportunities, challenges and factors governing implementation. These are summarised in Table 1.

The views and perspectives expressed by stakeholders during the workshops and interviews carried out during the second phase of work substantially reflect the findings from the Evidence Review in terms of main gaps and priority intervention areas.

Numerous recent, on-going and planned initiatives focus on the supply side of climate services, with considerable investments being channelled into strengthening observation networks and building technical capacity amongst National Hydrological and Meteorological Services (NHMSs). Examples include Japan International Cooperation Agency (JICA) financed projects in Bangladesh (installation of S-Band Doppler radar systems in Dhaka and Rangpur), Burma (establishment of a cyclone detecting radar) and Pakistan (establishment of a specialised medium range weather forecast centre and installation of a weather surveillance radar), the South Asia Regional Hydromet Program and the planned Regional Weather and Climate Services Program, both financed by the World Bank. Notwithstanding, Afghanistan, Burma and Nepal stand out as countries in urgent need of substantial and sustained support to bring basic or very basic NHMS capacity up by one level, as recommended by the World Meteorological Organization (WMO 2011). As such, there is scope for DFID to invest in strengthening the physical asset base for weather observations in the region by partnering with regional development finance agencies (such as the World Bank, GFDRR and Asian Development Bank) as well as Regional and Global Climate Centres. A range of priorities were highlighted by the NHMSs during consultation workshops (see Annexes 5 to 10), including improving observational networks in Afghanistan and Burma through installing automatic meteorological monitoring stations and rain gauges, installing hydro-met stations in key river basins of Nepal, providing ocean-based data collection systems in Burma, and improving radar networks and technology for collecting upper air data in Pakistan.

There is significant room for DFID to make a unique and original contribution to strengthening climate services across South Asia by investing in a demand-led programme. While various successful initiatives exist, for example the *Scaling Up Climate Services for Farmers in Africa and South Asia* project led by the CGIAR Climate Change and Food Security Initiative (CCAFS 2013; Tall et al. 2014) and the provision of integrated agromet advisory services in India (Venkatasubramanian and Hansen 2012), there is a requirement for these ventures to be evaluated, replicated, tested and scaled-up across DFID's focus countries, with a particular focus on addressing so-called 'last mile' user needs (such as the information requirements of farmers, women and other vulnerable groups, and community-based Early Warning Systems) in the DRR and agriculture sectors, as well as in relation to water and health. This could include a programme of work to research, test and pilot co-



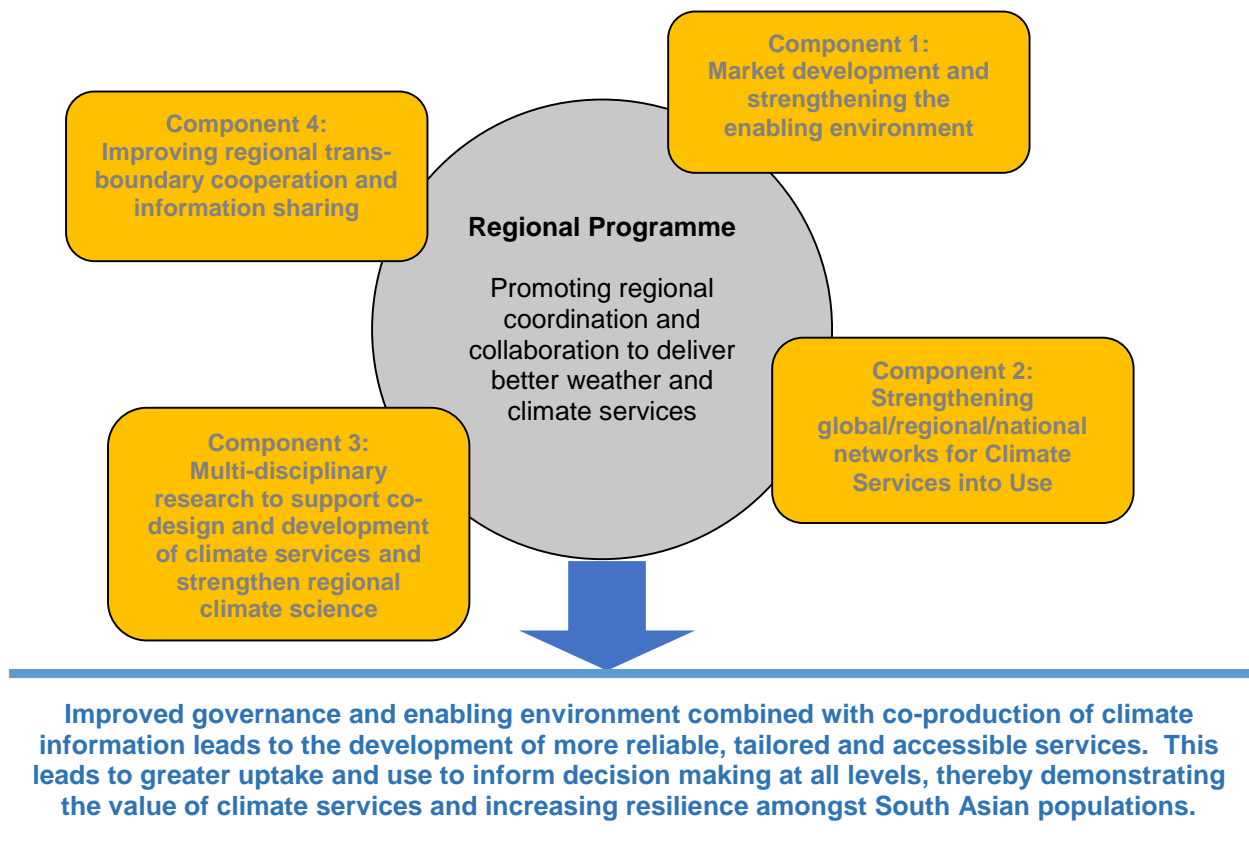
design, co-production and co-evaluation processes between producers, intermediaries and users of climate information, including developing networks for promoting the uptake and use of climate services, market development mechanisms (especially promoting pro-poor market development and stronger engagement from the private sector), last mile delivery and establishing mechanisms to promote regular interactions between users, intermediaries and producers.

Regional cooperation and information sharing remain critical issues within South Asia where improved data sharing and cross-border collaboration demonstrate the potential to make significant impacts on disaster preparedness and response. Various sub-regional initiatives are already providing useful lessons that could be scaled-up and/or transferred to other trans-boundary river basins. Examples include the South Asia Water Initiative (SAWI) in the Himalayan river systems, the Zurich Global Flood Resilience Alliance working in Nepal, India and Bangladesh, the South Asia Regional Hydromet Program, the Establishment of a Regional Flood Information System in the Hindu Kush Himalayan Region (HKH-HYCOS), and the South Asia Water Governance Programme (SAWGP), amongst others.

In scoping the programme outline, the intervention options developed are based on the findings of the Evidence Review and have been re-examined and refined by the consultancy team based on comments and feedback received during consultations, with a view to grouping together those options that best address on-going gaps. This exercise involved the mapping of needs and priorities against on-going and planned initiatives to identify clear gaps where DFID intervention could add most value. This process has resulted in the development of four potential programme components described on the following pages and shown in Figure 1 below, and described in more detail at Table 2. These four components represent potential ways of grouping the activities that the stakeholder analysis has suggested.



**Figure 1 Four potential programme components for Regional Climate Services**



Evidence from the scoping indicates that this “four component” approach, implemented in a coordinated way and at regional, multi-country, national and sub-national scales, will form a sound basis for developing effective weather and climate services in South Asia and achieving a step change enhancement in their use.

The Programme outcome, impact and theory of change are as below.

**Outcome:** Increased use of reliable, co-produced and accessible climate services based on better data, information, knowledge and tools informs regional, national, sub-national and community level policy, planning and decision-making in South Asia.

**Impact:** Increased use of climate information and mainstreaming into policies, plans and programmes in the agriculture and DRR sectors increases resilience to climate extremes and hazards in South Asia resulting in fewer lives lost and lower financial loss and damage.

**Theory of Change:** Improved governance and enabling environment combined with co-production of climate information leads to the development of more reliable, tailored and accessible services. This leads to greater uptake and use to inform decision making at all levels, thereby demonstrating the value of climate services and increasing resilience amongst South Asian populations.

These considerations will need to be explored with DFID during the finalisation of the programme outline and delivery options, to be developed for the next output of this scoping study.

**Table 1 Preliminary intervention options based on Evidence Review findings<sup>1</sup>**

Supply-side intervention options	Demand-side intervention options
Promote the development of a clear roadmap for climate services in South Asia tailored to the GFCS Framework and oriented to meet demand for information in the region	Increase and improve meaningful interactions among actors in complex information chains involving primary producers and intermediaries who process and add value add to this information, making it more relevant and useful for different sectors and types of users
Strengthen the capability of NMHSs to utilise available climate products from GPCs and RCCs for end-user interests	Strengthen inter-country communication systems and dissemination of climate information and services to priority users such as monsoon forum groups and the agriculture and health sectors
Promote the development of standard climate services toolkits together with accompanying training modules designed to support the generation and use of climate information and prediction products that meet user needs, especially women and vulnerable groups	Promote de-securitisation and declassification of trans-boundary water and climate data and information in South Asia to enhance public access to this information and increase regional collaboration
Support National Climate Outlook Forums and similar platforms to strengthen their presence and capacity and improve two-way communication between NMHSs and end users in priority sectors	Support capacity building amongst priority user groups to translate and interpret risk assessments into clear recommendations or plans of action
Support a more complete regional network for regional forecasting on various time scales (such as improving the capabilities and regional integration of the 'basic' or 'very basic' NHMS, enhancing the role of the more advanced Indian centres) and to provide better climate information for a range of applications including climate risk assessment	Establish regional networks between farmers' associations, DRR practitioners and water user groups to enhance the exchange and use of climate knowledge products and services
Raise the capability of least developed NMHSs (Burma, Afghanistan and Nepal) by at least one level, including the revival of silent stations, implementing new networks and exploring the use of non-traditional observations	Support the establishment of regional advisory teams comprising subject matter specialists in priority sectors and NMHSs to help improve the relevance of climate information and services to priority sector decision making needs
Support research to better understand RCM limitations when representing South Asia's complex topography at high resolution	Support collaboration and knowledge transfer between the different regional CORDEX so as to strengthen the capabilities of stakeholders in each country in providing efficient and useful climate services to the end user communities
Launch an interdisciplinary research programme to respond to major knowledge gaps and build global-regional-national partnerships, learning and exchange. Priority areas include climate observations and monitoring, reconstruction of high resolution data, seasonal forecasting, and downscaling regional information and scenarios	Support the integration of national climate information and ICT initiatives into everyday functioning of government, while at the same time investing in new and cost effective information and communication technologies
Promote research to explore potential of index based insurance facilities in South Asia. In particular, building capacity for estimating medium and long term hazard risks <sup>2</sup> and supporting development and testing of risk insurance products for low income sectors	Support scaling up of successful experiences where ICT tools have been used for more effective and efficient dissemination of climate information to end users

<sup>1</sup> Priority ranking: **First**, **second**, **third**

<sup>2</sup> WMO Definitions of Meteorological Forecasting Ranges (WMO 2015) describe medium range as beyond 72 hours and up to 240 hours and long range as monthly to seasonal outlooks



**Table 2 South Asia Regional Climate Services Programme Overview**

Component	Objective(s)	Activities	Outcomes	Indicators
Market development and strengthening the enabling environment	Create and build a more complete and sustainable market for high quality and relevant climate information and services	<ul style="list-style-type: none"> <li>i Develop Regional and National Climate Service Development Roadmaps</li> <li>ii Promote political leadership, policy direction and advocacy in the provision and use of climate information and services</li> <li>iii Hold forum events/conferences to stimulate debate and knowledge sharing and learning on climate services</li> <li>iv Establish national user groups linked to regional forums for interaction with climate information producers and intermediaries</li> <li>v Develop appropriate business models for providing climate services</li> <li>vi Develop standards and protocols for using climate information in risk assessments</li> <li>vii Facilitate interactions between 'last mile' users and credit providers to develop appropriate finance options for the uptake of climate services</li> </ul>	<ul style="list-style-type: none"> <li>➤ Growth of the climate services market stimulates demand for higher quality and more user-responsive products, resulting in new demand generated for research and innovation and increased opportunities for private sector engagement in the climate services market</li> <li>➤ Inclusion of planning for climate service development within national and regional development agendas aids sequencing of activities in a programmatic way, engagement of the private sector and coordination of donor support</li> <li>➤ Development, testing and promotion of standard tools, products and protocols, along with knowledge sharing protocols, leads to increased integration of climate information into development planning processes as well as driving further innovations</li> </ul>	<ul style="list-style-type: none"> <li>• At least three National Roadmaps for Climate Services and one Regional Roadmap developed with participation from all countries. All Roadmaps mainstream gender issues.</li> <li>• Decision makers have access to and are using standards and protocols for integrating climate information into risk assessments</li> <li>• Local organisations report accessing locally relevant climate services through new private-sector led business models</li> <li>• At least one regional forum interacts regularly with intermediaries and producers, with active participation from organisations representing women and vulnerable groups</li> <li>• Ministries from across the participating countries integrate climate services into development policy and planning, including the mainstreaming of gender approaches</li> <li>• Sector strategies, action plans and investment plans are climate-proofed<sup>3</sup></li> </ul>

<sup>3</sup> Climate proofing is understood as the integration of actions on climate change into all elements of sector planning and investment plans. See Section 4.1 for more details



Component	Objective(s)	Activities	Outcomes	Indicators
		viii Incentivise NMHSs to develop education and outreach programmes with a particular emphasis on science education for girls and women		
Strengthening global-regional-national networks for climate services into use	<p>Strengthen national-regional-global networks of climate observation, monitoring, research, modelling and service programmes</p> <p>Develop technical capacities to design and deliver co-developed weather and climate monitoring and prediction products</p>	<p>i. Strengthen Regional and National Climate Outlook Forums focussing on their role in coordination and dissemination of monitoring and prediction products</p> <p>ii. Establish pilot projects for the co-production and evaluation of climate information and services</p> <p>iii. Develop tools for transforming climate information into tailor-made products</p> <p>iv. Deliver training programmes aimed at public sector application of climate information, including handling uncertainties</p> <p>v. Provide training to intermediaries to improve the quality of communication around climate services</p> <p>vi. Investigate and raise awareness around the socio-economic benefits of climate services</p> <p>vii. Replicate and scale-up successful initiatives for delivering climate services to the last-mile</p>	<p>➤ Strengthened links and data sharing between national, regional and international climate organisations</p> <p>➤ Strengthened regional service dissemination through Regional and National Climate Forum activities</p> <p>➤ Integrated climate services hubs disseminate a range of co-developed services</p> <p>➤ Increased demand for climate services from the last mile resulting in increased funding and support for NMHSs, user and intermediary organisations</p> <p>➤ Improved access to tailored climate services, especially by last-mile user groups</p> <p>➤ Frameworks for improved last-mile delivery and social inclusiveness of climate services</p>	<ul style="list-style-type: none"> <li>• New and upgraded toolkits for transforming regional and global prediction information into climate and sectoral impact data</li> <li>• Increased numbers of trained personnel at NMHSs, Regional Climate Centres, user and intermediary organisations in participatory processes relating to climate service development and in the communication of climate information</li> <li>• Increase in the number of Regional and National Climate Outlook Forum meetings, and increased participation from organisations representing women and vulnerable groups</li> <li>• Increase in the number of co-produced early warnings and advisories for priority sectors</li> <li>• Increased involvement of women and vulnerable groups in co-production and evaluation processes</li> <li>• Improvements in agricultural productivity and/or resilience amongst farmers through the use of climate information</li> <li>• Improved timeliness of early warnings</li> </ul>



Component	Objective(s)	Activities	Outcomes	Indicators
				<ul style="list-style-type: none"> <li>Several tens of millions of rural households (including women and vulnerable groups) are able to access and use new and improved climate services</li> </ul>
Multi-disciplinary research to support co-design and development of climate services for the region and strengthen regional climate science leadership	Implement a multi-disciplinary regional climate services research programme that promotes climate resilience, building on existing regional partnerships and promoting learning and exchange between policy makers and applied scientists	<p>A. Research to promote implementation and use of existing “best data” and existing products and, where there are gaps, to co-design, develop and trial new services (75% of research programme). To include researching the obstacles and processes of climate service provision, as well as ways of improving information uptake</p> <p>B. Underpinning climate research (25% of research programme). Priority areas include climate observations and monitoring, reconstruction of high resolution data, seasonal forecasting, downscaling regional information, statistical down-scaling techniques, integrating data from in-situ and remotely sensed data sources and development of climate and socio-economic scenarios for longer term planning</p>	<ul style="list-style-type: none"> <li>➤ Translation and wider use of existing seasonal forecasting products and climate change information and identification of gaps and requirements for new services</li> <li>➤ New monitoring and prediction climate services and user-led delivery formats co-researched and trialled with users and intermediaries</li> <li>➤ Development of translational science (“last mile” research) around social and behavioural issues to bridge gaps between climate science and decision making</li> <li>➤ Improved understanding and modelling of the South Asian climate system</li> <li>➤ Comprehensive assessment of weather and climate model performance</li> </ul>	<ul style="list-style-type: none"> <li>The number of MSc and PhD graduates in climate service related subjects and number of job opportunities for these graduates, including the gender balance of these graduates/employment positions taken up</li> <li>Number of peer reviewed academic publications related to meteorology, environment or climate change</li> <li>The increase in the number of male and female scientists involved in international research programmes, conferences and co-production of academic papers at an international level</li> <li>The number of policy briefs developed as a direct result of the research programme</li> <li>The number of methods generated by the research programme put to regular use by relevant policy makers and other stakeholders connected directly to central and regional governmental bodies</li> <li>The number of government institutions with strengthened research capacities to deal with climate challenges related to priority sectors</li> </ul>



Component	Objective(s)	Activities	Outcomes	Indicators
Improving Regional Trans-boundary Cooperation and Information Sharing	Foster greater collaboration and political support for regional coordination and sustained improvements in trans-boundary climate data sharing	<ol style="list-style-type: none"> <li>Facilitate regional dialogues among the governments/ para-statal/ other institutions concerned at different levels, involving hydro-met data and information sharing towards DRR and early warning</li> <li>Set up regional knowledge platforms for peer-to-peer learning and sharing lessons and experiences</li> <li>Provide technical analysis to guide policy development at national level, on effective cross-border data sharing for EWS</li> <li>Establish training programmes between neighbouring countries to promote data sharing and joint work on modelling development of climate services for EWS</li> <li>Strengthen cross-regional links with the Association of Southeast Asian Nations through dialogue partnerships</li> <li>Fund joint research projects between two riparian states</li> <li>Fund pilot projects to improve communication across trans-boundary river basins and groundwater</li> </ol>	<ul style="list-style-type: none"> <li>➤ Deepened trans-boundary dialogues on enhanced regional trans-boundary cooperation on climate services</li> <li>➤ Enhanced knowledge base on climate services at the regional level</li> <li>➤ New incentives for increased sharing of climate data and relevant climate impact data held by non-meteorological agencies</li> <li>➤ Increased demand for climate services from government resulting in sustained funding and support for NMHSs, user and intermediary organisations</li> <li>➤ Evidence showing/quantifying the benefits of cross-border collaboration for DRR and EWS</li> <li>➤ Improved integration of national climate services and information exchange for trans-boundary units</li> <li>➤ Strengthening of links among national, regional and global climate organisations</li> </ul>	<ul style="list-style-type: none"> <li>• Policies and guidelines towards regional trans-boundary cooperation are in place and functional</li> <li>• NMHSs use and share improved data sets with each other, supporting design and production of new and improved climate services</li> <li>• At least one regional forum for knowledge sharing strengthened/promoted</li> <li>• Climate products are co-developed based on enhanced regional coordination and are being delivered on time</li> <li>• Several hundreds of thousands of households living in international river basins are able to use improved climate services through a range of intermediaries and communication channels</li> <li>• Local organisations report accessing effective climate services</li> <li>• Greater use of public domain (remotely sensed) data and tools</li> <li>• Greater interoperability of data, tools and platforms</li> <li>• Increased number of joint research projects and personnel exchanges</li> </ul>



# SECTION 1

## Introduction

The Department for International Development (DFID) is seeking to understand the state of climate information and services in South Asia and has commissioned a scoping study to identify possible intervention options aimed at strengthening the gathering, use and application of climate information across the region for better decision making and responses.

The first phase of the scoping study entailed an Evidence Review of current literature on the state of climate services in South Asia in order to identify demand-side needs, as well as current and future capacity to produce and deliver timely, accurate and relevant climate services. Supplementary evidence was gathered through telephone and email consultations with DFID regional and country teams and a diverse range of users, providers and intermediaries of climate information.

Based on an assessment of major gaps and opportunities on the supply and demand sides, broad intervention options for the regional programme were prioritised as shown in Table 2 below. These options were allocated an initial prioritisation by identifying the most significant and on-going obstacles to strengthening climate services in South Asia based on the views and evidence sourced through the literature review and initial stakeholder interviews. Further analysis of these options, including scope, timescales, opportunities, challenges and factors governing implementation, can be found in the tables presented in Annex 1.

**Table 1 Preliminary intervention options based on Evidence Review findings<sup>4</sup>**

Supply-side intervention options	Demand-side intervention options
Promote the development of a clear roadmap for climate services in South Asia tailored to the GFCS Framework and oriented to meet demand for information in the region	Increase and improve meaningful interactions among actors in complex information chains involving primary producers and intermediaries who process and add value add to this information, making it more relevant and useful for different sectors and types of users
Strengthen the capability of NMHSs to utilise available climate products from GPCs and RCCs for end-user interests	Strengthen inter-country communication systems and dissemination of climate information and services to priority users such as monsoon forum groups and the agriculture and health sectors
Promote the development of standard climate services toolkits together with accompanying training modules designed to support the generation and use of climate information and prediction products that meet user needs, especially women and vulnerable groups	Promote de-securitisation and declassification of trans-boundary water and climate data and information in South Asia to enhance public access to this information and increase regional collaboration
Support National Climate Outlook Forums and similar platforms to strengthen their presence and capacity and improve two-way	Support capacity building amongst priority user groups to translate and interpret risk assessments into clear recommendations or plans of action

<sup>4</sup> Priority ranking: **First**, **second**, **third**




Supply-side intervention options	Demand-side intervention options
communication between NMHSs and end users in priority sectors	
Support a more complete regional network for regional forecasting on various time scales (such as improving the capabilities and regional integration of the 'basic' or 'very basic' NMHS, enhancing the role of the more advanced Indian centres) and to provide better climate information for a range of applications including climate risk assessment	Establish regional networks between farmers' associations, DRR practitioners and water user groups to enhance the exchange and use of climate knowledge products and services
Raise the capability of least developed NMHSs (Burma, Afghanistan and Nepal) by at least one level, including the revival of silent stations, implementing new networks and exploring the use of non-traditional observations	Support the establishment of regional advisory teams comprising subject matter specialists in priority sectors and NMHSs to help improve the relevance of climate information and services to priority sector decision making needs
Support research to better understand RCM limitations when representing South Asia's complex topography at high resolution	Support collaboration and knowledge transfer between the different regional CORDEX so as to strengthen the capabilities of stakeholders in each country in providing efficient and useful climate services to the end user communities
Launch an interdisciplinary research programme to respond to major knowledge gaps and build global-regional-national partnerships, learning and exchange. Priority areas include climate observations and monitoring, reconstruction of high resolution data, seasonal forecasting, and downscaling regional information and scenarios	Support the integration of national climate information and ICT initiatives into everyday functioning of government, while at the same time investing in new and cost effective information and communication technologies
Promote research to explore potential of index based insurance facilities in South Asia. In particular, building capacity for estimating medium and long term hazard risks <sup>5</sup> and supporting development and testing of risk insurance products for low income sectors	Support scaling up of successful experiences where ICT tools have been used for more effective and efficient dissemination of climate information to end users

It should be noted that "highest priority" ranking should not be interpreted as "first to be funded" since lower priority tasks may be more easily achievable and could offer DFID the opportunity to add more value to the current landscape of climate services programmes in the region. As such, these intervention options have since been tested and explored with over 165 stakeholders through four in-country workshops in Bangladesh, Burma, India and Pakistan, as well as face-to-face discussions and telephone interviews. Workshops planned in Afghanistan and Nepal were replaced with telephone interviews due to the recent earthquake event in Nepal and security issues in Kabul. Findings from these consultations have fed into further refinement of potential intervention options, resulting in the formulation of the activities and outcomes described in Table 1.

Stakeholders were selected by national climate change and other sectoral experts within each of the focus countries to ensure broadly even representation from climate providers (NMHS and private sector), donors, national level government department/ministry officials (particularly from the agriculture, DRR and water sectors), academic, research and

<sup>5</sup> WMO Definitions of Meteorological Forecasting Ranges (WMO 2015) describe medium range as beyond 72 hours and up to 240 hours and long range as monthly to seasonal outlooks



resource/knowledge organisations and NGOs, civil society organisations and other ‘practice’ organisations, with special attention paid to those who work with vulnerable groups.

A full description of the stakeholder consultation methodology can be found in Annex 2. Annex 3 provides a list of interviewees. Workshop proceedings and attendees along with summaries of interviews held in Afghanistan and Nepal to replace the cancelled workshops are included in Annexes 5 to 9.

Building on the findings of the Evidence Review, this report begins by providing a detailed mapping of users and their requirements for climate information and services across priority sectors (section 2.1), a description of priorities cited by stakeholders and potential intervention options to meet these (section 2.2), as well as a country gap analysis (section 2.3) and an assessment of those regional actors DFID would be well-placed to partner with (section 3).

This information has been used to refine the intervention options shown in Table 2 above and to work up the overall outline and details of a regional climate services programme in South Asia; consisting of key objectives, outputs, outcomes, indicators and how these could link up to other initiatives in the region (section 4).



# SECTION 2

## Stakeholder Analysis

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Stakeholder consultations have been conducted through workshops, semi-structured interviews and bilateral discussions involving a wide range of actors in the climate services arena, including producers, intermediaries and users, as well as donors and independent experts. A supplementary review of literature (building on the Evidence Review) has also been conducted to capture a more complete range of evidence and views.

The following section provides an assessment of this information to show the range of intervention options available to DFID for the design of a regional programme for South Asia. The presentation of this information takes into account the different delivery options DFID may like to consider for the regional programme; ranging from demand-led testing and developing networks into use, to large-scale supply investments, to scaled-down provision of climate services (focusing on, say, a sub-region or single sector), and finally a DFID country office led programme.

As such, sections 2.1 and 2.2 focus on key users and their climate information needs, while section 2.3 describes county-level priorities with a greater focus on supply and intermediary-side issues. Finally, section 2.4 identifies emerging priorities and broad categories of action to show where DFID could add most value to the rapidly evolving landscape of climate services in the region. As a result of discussions with DFID during the implementation of this scoping study, the focus of intervention options has been turned towards the agriculture and DRR sectors, while also considering some activities within water and health.'

### 2.1 Users, their Information Requirements and Incentives

A key activity of the stakeholder analysis has involved the detailed mapping of intermediary and user group climate information needs, including key actions and decisions dependent on climate information, as well as incentives and drivers to using and applying climate information. These processes have also involved an assessment of whether these needs are currently being met and potential intervention options to meet them. Comprehensive information for the agriculture, DRR, water and health sectors is provided in Annex 13. This section focuses on providing an overview of user needs in particular within the agriculture and DRR sectors.



**Table 2 User Needs in the Agricultural Sector**

Users	Pastoralists, farmers, farmers clubs/ associations, cooperatives, fisher folk, fisherman forums	Department of Agriculture Agrometeorological field units Agricultural universities Farming institutes and training centres Emergency planners Extension services NGOs and civil society groups Media and telecommunications services	Ministries of Agriculture, Food Security and Rural Development Extension services Agricultural universities NGOs Seed distributors Fertilizer industry Risk Insurance companies	Financial institutions, donors and research institutes e.g. World Bank, ADB, DFID, UNDP, CGIAR CCAFS; IFAD; IFPRI mission in South Asia; SAARC; USAID Regional NGOs e.g. Practical Action South Asia, Christian Aid Media and telecommunications services
User level	Last mile	Sub-national	National	Regional
Information required	<p>Location specific data including:</p> <p>Real time weather information</p> <p>Temperature outlook (weekly, sub-seasonal and seasonal)</p> <p>Bi-weekly/weekly agro advisories on key crops, livestock and fisheries</p> <p>Potential impacts of short- to medium-term climate change on crops/ livestock/ fisheries/ management practices</p> <p>Sea conditions including wind speed and direction and significant weather patterns like rain, poor visibility and storms</p> <p>Likelihood, timing and potential impacts of severe weather events</p>	<p>Local-level data including:</p> <p>Seasonal climate predictions including seamless forecasts on rainfall, temperature, wind speed and cloud cover</p> <p>Early warning of extreme events such as hurricanes, floods, tropical cyclones, tornadoes, drought, heat and waves, winter storms, ice storms etc. and likely social &amp; economic impacts</p> <p>Anticipated wet and dry spells, temperature extremes, rainfall distribution</p> <p>Onset and withdrawal of monsoon rainfall</p> <p>Pest and disease forewarning</p>	<p>Monsoon status, departure of monsoon rainfall from normal conditions</p> <p>Seamless forecast information</p> <p>Coastal flood warnings</p> <p>Early warning of extreme events such as hurricanes, floods, tropical cyclones, tornadoes, drought, heat and waves, winter storms, ice storms etc. and likely social &amp; economic impacts</p> <p>Outlooks for staple crops, water supplies and public health impacts</p>	<p>Medium (seasonal) and long-term climate trends and forecasts</p> <p>Probability of occurrence of extreme weather events like flood, drought, extreme temperatures and cyclonic events</p> <p>Updates on monsoons</p> <p>Likely social &amp; economic impacts</p>



	Early warning of drought conditions to reduce moisture stress	Forewarning of occurrence of cyclone with wind speed, quantum of rainfall, time and location of land fall including tracking of cyclonic path		
Timescale	Daily, weeks, months and seasons and longer term	Weeks, months and seasons	Seasons, years and decades	Seasons, years and decades
Actions and decisions	<p>Selection of cultivars</p> <p>Review harvest prospects</p> <p>Choices regarding cropping patterns, irrigation practices, infrastructure construction, pest management, planting dates, transplanting of paddy etc.</p> <p>Livestock selection and management practices</p> <p>Decide timing of application of fertilizer, pesticide etc.</p> <p>Determine right harvest time and manage risks in harvest operations</p> <p>Purchase appropriate seeds</p> <p>Anticipated wet and dry spells, temperature extremes</p> <p>Estimating crop/livestock/fishery yields</p> <p>Longer term forecasts required to advise on perennial costs and</p>	<p>Sub-national policy and planning including risk management and budgeting</p> <p>Planning for the purchase of inputs</p> <p>Issuing timely warnings to relevant public and private sector players of potential emergencies</p> <p>Issuing timely warnings to communities about impending hazards</p> <p>Use of crop simulation models and pest and disease forewarning models</p> <p>Producing agro advisory bulletins/services, as well as information on crop and livestock choices, technologies, adaptive management practices</p> <p>Raising awareness amongst communities about the impacts of climate change, especially for women</p>	<p>National policy and development plans including risk management and investment planning</p> <p>Provision of climate information and services to national and sub-national stakeholders</p> <p>Planning for the purchase of inputs</p> <p>Planning risk insurance operations</p> <p>Weather based crop insurance product development</p> <p>Emergency / contingency planning and coordination with aid agencies</p> <p>Issuing timely warnings to relevant players about extreme events</p> <p>Vulnerability mapping and risk assessments</p> <p>Estimating agricultural productivity</p>	<p>Regional development plans and operational policy</p> <p>Strengthening public management systems</p> <p>Determining of short / medium / long term investment and financial support</p> <p>Developing climate services</p> <p>Improving free exchange of climate data</p> <p>Risk assessments</p> <p>Introduction of climate resilient crop varieties</p>



	<p>other investments such as soil erosion infrastructure</p> <p>(For some farmers) decisions on whether to work on their own farms or opt for manual labour</p>	<p>Production and communication of climate information and advisory services</p> <p>Risk and vulnerability mapping</p> <p>Estimating agricultural productivity</p> <p>Reservoir planning</p> <p>Groundwater management</p> <p>Selecting traits for crop breeding &amp; improvement</p>	<p>Strategic decisions about the balance of trade between exports and imports of crop, livestock and fisheries</p>	
Incentives and drivers	<p>Improve yields</p> <p>Improve access to food</p> <p>Reduce input costs (water/irrigation, fertilizer, pesticides, labour etc.)</p> <p>Increase income</p> <p>Better fodder conservation</p> <p>Reduced harvest and storage losses due to damages</p> <p>Improved groundwater, soil and water conservation</p>	<p>Increase productivity and profitability</p> <p>Increase input use efficiency</p> <p>Increase household income</p> <p>Increase household food security</p> <p>Avoid crop losses</p>	<p>Improve food security</p> <p>Increase agricultural productivity</p> <p>Build resilience amongst the last mile</p> <p>Empower farmers to manage uncertainties, inherent in climate forecasting</p> <p>Increase profitability of agribusinesses</p>	<p>Improve regional food security and rural livelihoods</p> <p>Reducing income risk</p> <p>Increase agricultural productivity</p> <p>Improve environmental health</p> <p>Enhanced adaptive capacity in agriculture, natural resource management and food systems</p>
Needs being met? <sup>6</sup>	<p>Existing data are not translated into formats that are useful and can be understood easily by users in the agricultural sector, particularly small-scale farmers</p>	<p>Few initiatives support sub-national users to understand and integrate climate information into key decisions and actions.</p>	<p>NHMSs demonstrate varying capacity to provide national and sub-national level data (see section 2.3).</p>	<p>Relatively few regional datasets exist for South Asia; even global downscaling partnership schemes such as CORDEX have limited data covering the region.</p>

<sup>6</sup> Illustrative examples



	<p>Users currently face difficulties in accessing real time data and/or climate services are not regularly updated with new information (Jha and Bisht, 2012).</p> <p>Crop-specific information limited or absent (Sivakumar et al. 2014).</p> <p>A variety of successful pilot initiatives from across the region. Examples include:</p> <p><i>CCAFS Scaling Up Climate Services for Farmers in Africa and South Asia</i> (last mile delivery, gender, 'hybrid' communications models, vulnerable groups) (Tall et al, 2014)</p> <p>The International Maize and Wheat Improvement Center (CIMMYT) assessing farmers' information needs in the Indo-Gangetic plains of India</p> <p><i>The Extended Range Forecast System for Climate Risk Management in Agriculture</i>, IRI and Government of India</p> <p>India and Bangladesh have made considerable progress in developing their agricultural advisory networks and extension systems in reaching the farmers through the Internet and mobile phones. For example, the</p>	<p><i>Flood Hazard Model in Index-based Flood Insurance (IBFI)</i> in South Asia will work with sub-national level users.</p>	<p>Private providers providing client-focused subscription services in India (e.g. Skymet, Express Weather)</p> <p><i>Flood Hazard Model in Index-based Flood Insurance (IBFI)</i> in South Asia (2015-2018). The project will involve national stakeholders like Natural Disaster Management Authorities, Ministries of Water Resources and Agriculture and private sector in particular insurance industry.</p> <p><i>Can Seasonal Climate Forecasts Improve Food Security in Indian Ocean Rim Countries?</i> AusAid-funded project in India and Sri Lanka to enhance food security by reducing agricultural production risks associated with climate variability and climate change.</p>	<p>IMD provides 1 and 4 months and seasonal forecasting for South Asia</p> <p>India IITM provides modelling for the prediction of the onset on monsoon season</p>
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	<p>IMD disseminates agromet advisory bulletins to 3+ million farmers through about 130 Agro Meteorological Field Units.</p> <p>IT-based system, eAgromet, being tested for rice and cotton crops in Telangana, India by IMD, IIIT and Agro Climate Research Centre.</p>			
Possible intervention options	<p>Replicate and scale-up successful pilots to communicate climate services to the 'last mile', including the use of 'hybrid' communication methods - traditional information sharing channels complemented by simple and affordable ICTs – to increase access to and use of climate information services by women and vulnerable groups (CCAFS 2013)</p> <p>Raise awareness around the impacts of short- and medium-term climate change on farm management decision making</p> <p>Invest in co-design, co-production and co-evaluation processes between producers, users and intermediaries of climate information to ensure that climate services are designed to meet the decision-making needs of last mile users. Ensure women and vulnerable groups are fully involved in these processes.</p>	<p>Support agricultural research and extension services to interpret and add value to agro-advisories for the local level</p> <p>Build capacity amongst media, NGOs and extension services to facilitate two-way communication between last mile users, intermediaries and providers</p> <p>Raise awareness around the impacts of climate change on local populations, livelihoods and planning</p> <p>Ensure the involvement of intermediaries that represent women and vulnerable groups in the design and delivery of climate services</p>	<p>Strengthen NHMSs to produce down-scaled forecasts</p> <p>Support greater engagement of private sector in provision of climate information and index-based insurance for the agricultural sector</p> <p>Support scaling-up of testing seasonal climate forecasts in farming systems across South Asia</p> <p>Run pilot projects for measuring and monetizing the value-added by climate services, building on the 2015 methodology developed by the WMO (see Section 3).</p> <p>Incentivise NMHSs to develop education and outreach programmes with a particular emphasis on science education for girls and women</p>	<p>Fund research to fill gaps in climate observations and monitoring, reconstruction of high resolution data, seasonal forecasting, downscaling regional information and development of climate and socio-economic scenarios for longer term planning.</p> <p>Promote integration of use of existing forecasting products into climate services for the agriculture sector.</p> <p>Collate impact relevant data and indices to support, for example, accurate seasonal forecasting of crop yields. Lack of availability or existence of such impact-relevant metrics may be a major obstacle to the development of climate services for the agriculture sector in the region.</p> <p>Build capacity to understand and communicate uncertainties</p>





	Deliver education programmes that support women farmers to connect to new sources of information (CCAFS 2013 and WMO 2015a).			in data and climate service products  Build gender awareness and promote mainstreaming of gender approaches into policy and programming for climate change and DRR strategies
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**Table 3 User Needs in the DRR Sector**

Users	Community-operated EWS (watchtowers, communications operators, local DRR leaders) Community radio Residents Farmers, pastoralists, fisher folk Health workers	Emergency planners/ Disaster Management Committees Disaster response and recovery agencies NGOs and civil society groups Basic service providers Army, police force Media and telecommunications services	National Disaster Management Authorities Hydropower agencies NGOs e.g. RedR India, Aga Khan Planning and Building Services, Focus Humanitarian Assistance; Islamic Relief; Red Cross Risk insurance companies Media and telecommunications services	Financial institutions, donors and research institutes, regional mechanisms e.g. World Bank, DFID, GFDRR, UNISDR; Community Based Disaster Risk Management Programme; Cyclone Preparedness Programme; Asian Disaster Preparedness Centre; SAARC SDRM; Asian Partnership on Disaster Reduction; RIMES NGOs, networks & humanitarian aid agencies e.g. International Red Cross and Red Crescent Movement; Duryog Nivaran; Practical Action South Asia, Christian Aid, Care, Concern, Red Cross, DIPECHO Media and telecommunications services
User level	Last mile	Sub-national	National	Regional
Information required	Sea and water level rise  Extreme weather event forecasts (cyclones, flooding, droughts, hail storms, tornadoes etc.)	Sea and water level rise  Extreme weather event forecasts (cyclones, flooding, droughts, hail storms, tornadoes etc.)	Sea and water level rise  Extreme weather event forecasts (cyclones, flooding, droughts etc.)	Climate Change forecasts  Hydro-meteorological hazards



	Near term climate forecasts  5 or 7 day forecasts	Near term climate forecasts  Seasonal forecasts of rainfall, temperature, cyclone indices	Prediction of wild fires (based on temperature extremes, wind speed and wind direction predictions)  Forecasts of extreme events such as hurricanes, floods, tropical cyclones, tornadoes, drought, heat and waves, winter storms, ice storms etc. and likely social & economic impacts	Landslide predictions (based on heavy rainfall event)
Timescale	Nowcasting, short-term	Nowcasting, Short-term, seasonal, long term (trends)	Short-term, seasonal, long term (trends)	Short-term, seasonal, long term (trends)
Actions and decisions	Developing household and community preparedness and evacuation plans, locating emergency shelters  Informing community members of risks  Purchase of emergency materials (e.g. lifejackets, lifeboats)  (Farmers) early harvest decisions; movement of livestock and assets	Making preparedness plans (evacuation plans)  Planning for safety (dikes, barriers, etc)  Purchase of emergency materials  Executing rescue operations  Delivering humanitarian aid  Warning relevant players of any potential emergency  Planning and executing emergency response operations  Informing communities of risks  Dissemination of real time warnings and hazard information  Post disaster reconstruction plans	Developing national DRR and DRM strategies, regulations, policies and programmes  Sectoral preparedness planning through strategic planning & scenario building  Coordinating emergency response and humanitarian aid  Government risk financing (trust funds, early warning systems, etc.)  Warning relevant national and sub-national players of any potential emergency  Training and awareness raising  Executing rescue operations  Risk insurance companies developing compensation plans and calculating insurance premiums  Disseminating early warning bulletins	Regional DRR policy and planning  Emergency response planning  Developing strategies and initiatives regarding trans-boundary natural hazard management  Determination of short / medium / long term (strategic) investment and financial support  International DRR policy negotiation  Building networks to strengthen DRR policy negotiation and regional capacity for preparedness and response  Coordinating humanitarian aid



			<p>Advisories on protection measures</p> <p>International DRR policy negotiation</p> <p>Public awareness campaigns and educational programmes</p>	
Incentives and drivers	Better protection of homes, cultivated land, stored food, livestock and human life (livelihood assets)	<p>Reduce fatalities, losses of livelihoods, assets and property</p> <p>Strengthening community-based EWS</p> <p>Improved prevention, preparedness, response and recovery of disasters</p> <p>Saving lives</p> <p>Reduced expenditure for management of contagious diseases</p> <p>Enhancement in emergency response capacity</p>	<p>Optimize infrastructure investment</p> <p>Reduce mortality rates</p> <p>Reduced public health expenditure</p> <p>Reducing asset and property loss</p> <p>Reducing infrastructure damage</p> <p>Quick recovery after disastrous events</p>	<p>Reduction in loss of lives, assets and property</p> <p>Reduce the number of deaths, illnesses and public health emergencies</p> <p>Better management of trans-boundary natural hazards</p>



Needs being met? <sup>7</sup>	<p>There is a need for significant improvement of real time flood forecasting systems including the establishment of automatic communication systems to allow the transmission of data in real time (Singh, 2012).</p> <p>Improvements in cyclone early warning systems in Bangladesh (IRIN 2007) and India (UNDP 2014) have saved hundreds of thousands of lives in recent times. For example, in Bangladesh there are around 43,000 Cyclone Preparedness Programme volunteers, stationed in the coastal districts, who are responsible for disseminating cyclone warnings among villagers via megaphones and by house-to-house contact. The number of cyclone shelters has also increased significantly (Paul, 2009).</p> <p>Global Flood Resilience Alliance (Practical Action, Wharton, IIASA, Zurich, Red Cross) focusing on translation and dissemination of weather and climate information to the last-mile</p>	<p>Global Flood Resilience Alliance</p> <p>In India the Central Water Commission (CWC) has a website that makes hydrological and hydro-meteorological information available to the public, including flood forecasts<sup>8</sup></p> <p>SAACR SDC South Asian Disaster Knowledge Network portal provides information about real-time, impending and historical disasters</p>	<p>Improvements in flood forecasting and warning have reduced the number of fatalities from these hazards in Bangladesh and India, despite the exposure to these hazards increasing (WMO 2013).</p> <p>In Nepal there is a web-based, real-time data acquisition based on 44 stations in major river catchments in Nepal (Gautam, 2011).</p> <p>The <i>Severe Weather Forecasting Development Project</i> uses a “Cascading Forecasting Process” (global to regional, to national) that provides forecasters of the NMHS with improved access, as well as effective utilization of existing and newly developed products and tools available through the advanced Global Data-Processing and Forecasting System (GDPFS) (World Bank 2014).</p> <p>Global Flood Resilience Alliance working with the Nepal DHM on forecasting and early warning</p> <p>SHEAR Nepal and Bangladesh: sub-seasonal to seasonal forecasting, landslides, floods and earthquakes</p>	<p>Lack of cohesive communication at times of flooding between China, India, Pakistan, Nepal, Bangladesh and Afghanistan results in delayed evacuation procedures (Haq and Nibanupudi, 2013).</p> <p>No communication related to flood forecasting and warning between Pakistan and Afghanistan (Khadka, 2013).</p> <p>Bangladesh receives relatively little hydrological data from Nepal which is located upstream (Khadka, 2013).</p> <p>Pakistan has a mechanism for receiving some limited hydrological data from India; however, these data are not deemed adequate enough to provide “meaningful” flood warnings (Khadka, 2013).</p> <p>The Severe Weather Forecasting Development Project is been rolled out in the Bay of Bengal</p> <p>Global Flood Resilience Alliance working on cross-border challenges in an integrated trans-boundary river basin approach including links to India and Bangladesh and is interested in</p>
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Illustrative examples

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See: <http://www.india-water.gov.in/ffs>



				<p>improving region-wide cooperation</p> <p>SAACR SDC South Asian Disaster Knowledge Network portal provides information about real-time, impending and historical disasters</p> <p>Build capacity to understand and communicate uncertainties in forecast data and early warning</p>
Possible intervention options	<p>Tailoring and targeted dissemination of climate and weather services to specific DRR last mile user groups. Ensure women and vulnerable groups are fully involved in these processes.</p> <p>Promote women's leadership in community-based DRR and early warning</p>	<p>Tailoring and targeted dissemination of climate and weather services to specific DRR local level decision makers, emergency planners and practitioners</p> <p>Build capacity of public sector agencies with responsibilities for DRR to understand, interpret and apply risk information</p> <p>Ensure the involvement of intermediaries that represent women and vulnerable groups in the design and delivery of climate services for DRR and early warning</p>	<p>Build capacity of public sector agencies with responsibilities for DRR to understand, interpret and apply risk information</p> <p>Upgrade NMHSs to produce early forecasts rather than relying on observational data. Bangladesh is one country in the region that has moved towards this model.</p> <p>Incentivise NMHSs to develop education and outreach programmes with a particular emphasis on science education for girls and women</p>	<p>Promote regional sharing and dissemination of data and information concerning early warning and weather/climate forecasts</p> <p>Support research priorities with respect to risk assessments and early warning systems for weather-related hazards. These have been recently identified (from highest to lowest priority) as droughts, landslides, floods and cyclones (Lumbroso et al., 2014).</p> <p>Promote the mainstreaming of gender issues across climate change and DRR policy, planning and implementation particularly amongst the SAARC SDMC and key regional NGOs</p>



## 2.2 User Identified Needs and Intervention Options

The barriers and needs most frequently cited by stakeholders consulted during this phase of work largely reflect the findings of the Evidence Review. These are summarised in Table 5 below and mapped against intervention options that could address these gaps. Views that appear consensual for almost the entire region are described here, while information specific to particular countries is provided in the country gap analysis that follows. Full proceedings from the workshops and interview notes are provided in Annexes 5 to 8.

**Table 4 User Identified Needs and Potential Intervention Options to Address These**

Need/Gap/Priority	Possible intervention options
<p><b>Low capacity to use existing climate information and services</b></p> <p>There is a wide range of historical and real time weather and climate information available from global, regional and national centres (see Evidence Review), however users reported being confused as to the choice of data sets that would best serve their purpose.</p> <p>Although an increasing body of evidence is emerging on the benefits of using climate information, (for example CCAFS work on climate services for farmers in Africa and South Asia, WHO Atlas of Health and Climate, WMO Valuing Weather and Climate: Economic Assessment of Meteorological and Hydrological Services, amongst others), there is generally low awareness of these potential gains amongst stakeholders in South Asia.</p>	<ul style="list-style-type: none"> <li>➤ Strengthen regional networks to raise awareness and training in the use of climate products and services should be a number one priority in the region</li> <li>➤ Lack of availability or existence of impact-relevant metrics may be a major obstacle to uptake and use of climate services in the region. Thus funding work to collate and disseminate information about the potential impacts different climate forecasts might bring on, say, agricultural crop yields, could go some way to supporting users to make strategic decisions based on this data – for example, from rural development strategies and export/import trade planning to choosing seed varieties and crop management technologies/practices.</li> <li>➤ Build understanding around the potential applications of existing climate information amongst national and sub-national users (see 2.1), who should be encouraged and supported to incorporate climate information into their planning, management and evaluation processes. Likewise, research is required to understand and communicate the implications of uncertainties of data and climate services, including early warning, for decision making processes</li> <li>➤ Set up schemes to second climate services experts to different (NAPA priority) government departments to support sectoral agencies to assess their specific needs for climate information and relate this back to information producers.</li> <li>➤ Establish training programmes to support national and sub-national planners to understand the impacts of short, medium and long-term climate change on programme design and investments and to mainstream this information across decision making.</li> </ul>



Need/Gap/Priority	Possible intervention options
	<ul style="list-style-type: none"> <li>➤ Apply existing tools and methodologies (e.g. WMO 2015) to provide practical examples of the socio-economic benefits of climate services, especially pilot schemes targeting last mile user groups and demonstrating direct impacts on DRR, agriculture and food security.</li> </ul>
<p><b>Climate information is not adequately transformed for decision-making purposes</b></p> <p>While various climate information, products and services exist, many are not currently transformed into different formats for practical application to decision making by users at national, sub-national and last-mile levels.</p>	<ul style="list-style-type: none"> <li>➤ Engage user communities in co-production processes, coordinated through sectoral advisory groups. To provide meaning and relevance, climate information should be linked to individuals, assets and livelihoods. The importance of keeping in view the age, gender and cultural diversity of users was also emphasised by stakeholders.</li> <li>➤ Undertake a systematic assessment of institutional capacities at the national and sub-national levels with a view to strengthening institutional arrangements and mechanisms for generating climate information and advisories adapted to user needs</li> <li>➤ Build capacity amongst sectoral departments, consultants and other service providers to convert generic climate information into usable and locally applicable information in differentiated formats for user (particularly last mile) accessible services, building on existing pilot initiatives from across the region</li> </ul>
<p><b>Important deficits in collection and processing of climate information</b></p> <ul style="list-style-type: none"> <li>i. National and local data are often missing completely or inadequate to generate meaningful climate information</li> <li>ii. Historical climate data is missing in many countries of the region. This is required for quantifying and characterising the frequency and intensity of hazard events especially in disaster prone areas, as well as climate modelling, developing scenarios, risk financing and insurance</li> <li>iii. Inter-annual, seasonal and decadal information is required for designing interventions, especially in drought and flood risk management</li> <li>iv. Farmers require an outlook of temperature and rainfall before the start of the spring and summer seasons</li> </ul>	<ul style="list-style-type: none"> <li>➤ Launch a research programme to fill current gaps around modelling capability</li> <li>➤ Invest in improving observational networks and the generation of data on impact metrics</li> <li>➤ Explore scope to digitise and rescue paper records held in the region. The Climate Data Management Systems (CDMS) initiative being developed through international efforts led by the WMO Commission for Climatology provides technological solutions for modern archiving and for quickly retrieving historical and near-real-time climate time series</li> <li>➤ Build human capacity within NHMSs (national and sub-national levels) to operate and maintain existing systems, as well as using more contemporary tools for processing and storing climate data</li> <li>➤ “Accurate and reliable” long-range forecasts meeting the expectations of various users may not be possible due to the chaotic behaviour of climate – this is inherent and will not be resolved via e.g. faster computers. This could indicate a need to educate prospective users regarding the limits and uncertainty of climate predictability.</li> </ul>



Need/Gap/Priority	Possible intervention options
<p>v. Currently, accurate and reliable long-range forecasts are not available</p> <p>vi. In Burma and Bangladesh, there are requirements for building comprehensive ocean-based observations</p> <p>vii. While there is rich data and information on flood risk management, it will be important to improve drought forecasting in any future initiative</p>	<p>➤ Promote the exploitation of existing satellite data sets for Monitoring and Verification, specifically (i) providing climate monitoring datasets for some Essential Climate Variables (ECVs) (but not yet rainfall) and (ii) providing input to climate models for their simulations. Remote-sensing would play a larger role in managing disasters. A satellite-based observation of recent climatology may help inform impact assessments and consequent management strategies, for example climatologies of snow cover, soil moisture, flooded areas, wild fire areas, deforestation, etc.</p>
<p><b>Little or no supply / demand interface</b></p> <p>Although there is a clear <i>need</i> for strengthening climate services in many South Asian countries, NHMSs and other stakeholders have indicated that <i>demand</i> for any particular kind of climate information and/or services is at present very weak. Thus, providers find it challenging to tune their services in accordance with the needs and priorities of different user groups. These perspectives corroborate with written evidence reviewed as part of this study, indicating that limited interaction between user groups and NHMSs currently inhibits the tailoring of climate services to different user groups' needs.<sup>9</sup></p>	<p>➤ Establish regional and national level forums to link up all actors along the chain for periodical exchanges and coordination between climate scientists, last mile users, sectoral departments, media, practitioners, private sector, policy makers etc., thereby enhancing the relevance and uptake of climate applications and products</p> <p>➤ Local level workshops held with communities will be helpful in articulating the practical needs of last mile users more clearly. Creating spaces for frequent feedback from the users to the providers and intermediaries of climate information is an important measure that is currently missing in most South Asian countries</p>
<p><b>Challenges to communicating climate services</b></p> <p>There are serious deficits in last mile access and connectivity for ensuring that climate services reach community level and especially vulnerable groups. Likewise, end to end aspects of early warning systems are not present and the chain of flow of climate information and warnings are poor in quality and timing. Likewise, lack of access to internet connectivity and poor telecommunications network coverage are considered major barriers for last mile users to access climate services. For example, weak radio signals are unable to reach fisher folk out at sea. Similarly, stakeholders reported that the number of transmission towers for mobile communications in the</p>	<p>➤ Evidence suggests that mobile telephone coverage is already being used effectively to disseminate climate information to different sectors.<sup>10</sup> There are a range of alternative methods being used to reach out to remote communities where telecommunications coverage is poor, including internet and village knowledge centres. Scale-up successful experience of 'last mile' information delivery, including exploring private sector engagement and technology innovations.</p> <p>➤ Verify claims about telecommunications coverage in coastal areas with on-the-ground assessment.</p>

<sup>9</sup> See, for example, the 2015 Kampala Declaration which arose out of the 2015 USAID-sponsored workshop *Improving Climate Services for Farmers in Africa and South Asia*.

<sup>10</sup> See for example, CCAFS work to harness ICTs, <https://gsmaintelligence.com/research/> which contains a number of reports showing current coverage and usage for various sections such as agriculture (see: [Agricultural value-added services \(Agri VAS\): market opportunity and emerging business models](#))



Need/Gap/Priority	Possible intervention options
<p>coastal areas are limited. While in India and Bangladesh, high percentages of the population have access to mobile telephones, in many other countries rural areas are completely disconnected from any kind of communication network.</p>	
<p><b>On-going research and knowledge gaps</b></p> <p>Stakeholders expressed demand for learning about experiences in the design, implementation and monitoring of climate services in the countries of the region and also in learning about index-based insurance.</p>	<ul style="list-style-type: none"> <li>➤ Evaluate, document and disseminate successful and not so successful experiences in climate services delivery, especially focussed on reaching the last mile, and index-based insurance</li> <li>➤ Set up forums and conferences for lesson learning and exchange with South East Asia where experiences in index-based insurance appear to be more advanced</li> <li>➤ Fill current gaps around modelling capability, in particular downscaling regional models to make them more relevant for sub-national locations</li> <li>➤ Fund research to understand, communicate and handle the implications of uncertainties of data and climate services, including early warning, for decision making processes</li> <li>➤ Test recently developed methodologies for calculating the added value of climate services (WMO 2015) and for evaluating climate services (building on work carried out by CCAFS/ICRAF and the CSP)<sup>11</sup> through action research involving communities and other key sub-national and national users (see Annex 13).</li> <li>➤ Research the potential for remote sensing data to support agricultural risk management</li> </ul>

<sup>11</sup> The Climate Services Partnership Working Group on Climate Service Evaluation has been carrying out some initial investigations into climate service assessment methodologies (see: <http://www.climate-services.org/content/climate-service-evaluation>). Likewise, the CGIAR Research Programme on Climate Change, Agriculture and Food Security (CCAFS) and the World Agroforestry Centre (ICRAF) are leading the research-based monitoring and evaluation component of the Global Framework for Climate Services (GFCS) Climate Services Adaptation Programme in Africa, to assess the value and usefulness of climate services being provided to farmers and pastoralists in Tanzania and Malawi.



Need/Gap/Priority	Possible intervention options
<p><b>Poor regional cooperation</b></p> <p>Bangladesh does not receive hydrology related information from upper riparian countries on any transboundary rivers. This impacts on Bangladesh's capacity to design and plan effective early warning systems.</p> <p>Some of the informal forums at the regional level like the South Asia Climate Outlook Forum (the SASCOF initiated and coordinated by WMO) are functioning well, with regular and periodical meetings. These meetings, held in different countries of the region in turn, are attended by renowned scientists based in regional met organisations in Japan and Korea. However, the current scope of SASCOF is narrow, essentially confined to monsoon forecasts/outlook.</p>	<ul style="list-style-type: none"> <li>➤ Provide support to Bangladesh to be integrated into the existing treaty between India and Nepal on river flow information sharing in Ganges river</li> <li>➤ Identify relevant learning from existing arrangements for information sharing among the riparian states of the Mekong River</li> <li>➤ Support the ASCOF to expand its scope to cover additional areas like storms, drought and floods as well as for integrating organisations representing a wider range of users</li> <li>➤ The monsoon forums coordinated by RIMES (presently confined to monsoon and floods) offer a good starting point for a regional programme aiming at enhancing transboundary coordination. In fact, the existing/proposed national forums (by whatever names they are known) could effectively feed into the regional forums.</li> <li>➤ Countries which are more advanced in terms of infrastructure and capacity could offer help to at least one neighbouring country (where the NMHSs are less developed) on a bilateral basis.</li> </ul>

## 2.3 Country-level Intervention Options

Country level gaps and needs were identified based on the Evidence Review and tested and explored during stakeholder consultations, in particular during the in-country workshops held in Bangladesh, Burma, India and Pakistan and through telephone interviews in Afghanistan and Nepal (Annexes 5 to 10). Subsequently, a list of priority intervention options (Table 6) has been developed via two complementary approaches: i) consideration of multi-lateral issues and programmes supported by other players (top-down); and ii) elicitation of country-level needs and priorities (bottom-up). This process has enabled the identification of common priorities from across the region that could be addressed by the regional programme, and these are described in section 2.4 'Emerging Priorities' that follows.

For the proposed programme to be truly regional in scope, DFID will be required to work with each country individually and all countries simultaneously. This will entail an approach that is at once responsive to the distinct needs found at national level and which works coherently to strengthen and develop key areas across national boundaries. This may be particularly relevant for intervention options that attempt to address cross-border issues, for example transboundary data sharing for improved EWS and DRR.

On the other hand, DFID may opt for an alternative delivery option such as a regional programme that supports the small-scale provision of climate services for one sub-region/ sector/ timescale or a research focused programme. To that end, understanding individual country needs and priorities will facilitate the identification of those countries that share similar challenges, for example Afghanistan, Burma and Nepal which



all have only very basic or basic NHMS capability (see table 6), and which could be grouped together for addressing a specific set of issues. An alternative could be for DFID to deliver the proposed programme through its country offices and, again, this country-level analysis provides the detail of information that could help orientate such an option.

**Table 5 Country-level Intervention Options**

Country and WMO NHMS Capability Rating <sup>12</sup>	Intervention Options
<b>Afghanistan</b> <b>Less than Basic</b>	<ul style="list-style-type: none"> <li>➤ The Afghanistan National Disaster Management Authority (ANDMA) and supporting Meteorological / Climate Services are still recovering from years of conflict and limited investment. Consequently they will take a number of years to recover and this will only be possible with external support. In the meantime there may be a strong case for deploying remote sensing capability to catalyse immediate service delivery by national agencies with support from regional centres / development agencies while the wider in country capability is developed</li> <li>➤ Install robust agro-meteorological stations to improve EWS, hazard mapping and surveys, assessments and projections of the impacts of deep wells on the water table and future water supplies</li> <li>➤ Support the ANDMA (with equipment, office and training) to identify the most vulnerable areas to flash floods and landslides</li> <li>➤ Support the Afghanistan Meteorological Services (AMS) and the Pakistan Meteorological Department (PMD) to establish a Flash Flood Warning Centre in Kabul, based on the experience of the Flash Flood Guidance System developed for Pakistan with the support of PMD &amp; HRC</li> <li>➤ Establish a centre to coordinate early warning and disasters in order to inform communities and government</li> <li>➤ Build the capacity of AMS staff with the support of PMD. Pakistan and Afghanistan's climates are similar and therefore Pakistani forecasters have good potential to provide training to AMS staff. AMS staff are interested in receiving training on weather forecasting based on global and regional models.</li> <li>➤ Build expertise for monitoring and analysing climatic trends and for using this information to plan and implement adaptation activities</li> <li>➤ Support the development sector to integrate DRR and climate information into planning and implementation</li> <li>➤ The Ministry of Finance should be supported to channel funding for improving climate services</li> <li>➤ Likewise, the National Environmental Protection Agency should be supported to play a stronger role in coordinating financial resources and technical capacity needs to be improved</li> <li>➤ Facilitate greater engagement by the private sector in climate services arena</li> <li>➤ Strengthen interface and communication between AMS and other departments and ministries, particularly the Department for Disaster Planning</li> <li>➤ Enhance regional cooperation through skill and information sharing arrangements.</li> </ul>

<sup>12</sup> As part of the preparations for the GFCS, WMO experts reviewed the level of capability of national meteorological services in 191 countries in 2011. Each country was assessed according to four categories from 'basic' to 'essential', 'full' and 'advanced' related to the services provided and information supplied to users.



Country and WMO NHMS Capability Rating <sup>12</sup>	Intervention Options
	<ul style="list-style-type: none"> <li>➤ Invest in and strengthen indigenous community weather forecasting mechanisms and link to spatial data to preserve the knowledge of remote communities in Afghanistan</li> <li>➤ Identify a mechanism to make climate or weather related information more demand driven and to support communities to take an interest</li> <li>➤ Prioritise community based awareness raising programmes on disaster management with greater focus on disaster prone and natural resource-rich areas</li> <li>➤ Work with the Ministry of Education to incorporate DRR and climate services in the curriculum for wider public awareness</li> <li>➤ Build local capacity for understanding climate information, especially amongst young Afghan professionals</li> <li>➤ Establish EWS with effective dissemination strategies using local TV channels, radio and other ICTs</li> </ul>
<b>Bangladesh</b> <b>Essential</b>	<ul style="list-style-type: none"> <li>➤ Enhance facilities and capacities for processing weather/climate information</li> <li>➤ Support substantial improvements in ocean based observatories</li> <li>➤ Build facilities and capacities to generate reliable data on river flow in transboundary rivers (e.g. Ganges)</li> <li>➤ Deliver training within the Bangladesh Meteorological Department (BMD) and in sectoral departments to handle more sophisticated observations, data and information</li> <li>➤ Support the establishment of a dedicated institutional mechanism within government (such as a Climate Services Unit) for analysis, processing and supply of locally relevant, sector specific climate information, as well as for coordinating initiatives with an understanding of the entire chain</li> <li>➤ Establish a forum where producers, intermediaries and users could periodically meet, interact and understand each other's needs better</li> <li>➤ Scale up successful experiences of disseminating climate information to the last mile using FM radio</li> </ul>
<b>Burma</b> <b>Basic</b>	<ul style="list-style-type: none"> <li>➤ Support the development of a National Climate Services Road Map to improve coordination, facilitate demand-side mapping and to develop a comprehensive institutional capacity development plan</li> <li>➤ Establish programmes to second climate services experts to priority sector departments (agriculture, DRR, water and forests)</li> <li>➤ Invest in infrastructure and human resources, in particular: <ul style="list-style-type: none"> <li>➤ Observation stations</li> <li>➤ Ocean-based observations</li> <li>➤ Skills and resources to carry out repair, maintenance and upgrading of the existing systems</li> <li>➤ Training on use of modern tools for data collection, processing, output</li> </ul> </li> <li>➤ Support the Department for Hydrology and Meteorology (DHM) to link up to regional and global forecasting systems and support greater participation of Burma in regional services like RIMES and SASOCEF</li> <li>➤ Several major planned projects for infrastructure are suffering from inertia, there is potential for DFID to help drive these forwards by seeking out partnerships with other donors (such as JICA)</li> </ul>
<b>India</b> <b>Advanced</b>	<ul style="list-style-type: none"> <li>➤ Provide training programmes for systematic translation of climate data into action-oriented options</li> <li>➤ Support development and dissemination of sub-district level climate information and advisories</li> </ul>



Country and WMO NHMS Capability Rating <sup>12</sup>	Intervention Options
	<ul style="list-style-type: none"> <li>➤ Promote the adoption of cross-boundary river basin approaches to climate data collection and sharing, especially in the Himalayan mountain areas</li> <li>➤ Build awareness and capacity of stakeholders at the community level of the relevance and application of climate services for enhancing rural livelihoods</li> <li>➤ Fund applied collaborative research aimed at enhancing downscaling capacities and impact assessment</li> <li>➤ Improve understanding around the increasing role of the private sector (currently providing climate information to the media, power and insurance sectors) in providing location-specific advisories</li> <li>➤ Promote the employment of crop weather models in all agro-climatic conditions for advising farmers on farm management</li> <li>➤ Enhance the capacity and role of local government units as intermediaries</li> <li>➤ Fund pilot schemes to identify appropriate communications channels</li> </ul>
<b>Nepal Basic</b>	<ul style="list-style-type: none"> <li>➤ Invest in infrastructure and skills for upper atmospheric measurements to improve modeling</li> <li>➤ Improve density of hydrological and meteorological stations and electronic data collection methods</li> <li>➤ Strengthen community-targeted EWS by supporting the coupling of meteorological observations and forecasts with a suitable hydrological model</li> <li>➤ Replace infrastructure for high altitude monitoring that was destroyed as a result of the recent earthquake</li> <li>➤ Pilot schemes to improve information flow to communities that are currently poorly served</li> <li>➤ Strengthen coordination between government sectors by creating institutional mechanisms, especially within and across the DRR, agriculture and water sectors</li> <li>➤ Provide capacity building for hydrologists and meteorologists at the Department of Hydrology and Meteorology (DHM)</li> <li>➤ Establish a Research and Development Unit within the DHM to facilitate the application of novel techniques and piloting of new technologies</li> <li>➤ Raise awareness amongst last mile users regarding the potential impacts of climate change</li> </ul>
<b>Pakistan Essential</b>	<ul style="list-style-type: none"> <li>➤ Strengthen observation networks for producing accurate weather forecasts at different scales, especially at the district level. The existing network requires upgrading with an arrangement for regular radio sounded upper air data</li> <li>➤ Upgrade the radar network with at least three more radars installed in vulnerable areas</li> <li>➤ Support the PMD to develop impact-based forecasts for last mile user groups in local languages</li> <li>➤ Fund pilots to employ ICTS for effective dissemination of climate information and services, especially to smallholder farmers in the semi-arid regions of Pakistan. Community based FM radio channels should be established in vulnerable districts.</li> <li>➤ A series of documentaries about the significance of climate services and explaining the socio-economic benefits should be prepared in national and local languages, and displayed in schools, colleges, universities and communities as part of an on-going campaign to raise awareness. Similarly, training seminars could be organised for key user groups on climate variability and climate change.</li> <li>➤ Establish advisory teams comprising agriculture specialists and PMD staff to interact with farmers on a regular basis to generate and distribute demand-driven services</li> <li>➤ Set up a national network of Farmers Associations to facilitate improved interactions between farmers and service providers</li> <li>➤ Develop and test appropriate mechanisms for feedback and sharing of success stories</li> </ul>



Country and WMO NHMS Capability Rating <sup>12</sup>	Intervention Options
	<ul style="list-style-type: none"> <li>➤ Enhance Public Private Partnerships (PPP) to improve delivery</li> <li>➤ Develop and test strategies for involving the media in the communication of climate services</li> <li>➤ Establish effective EWS at national, provincial and district levels</li> <li>➤ Ensure participation of women and female gender experts in policies, initiatives and decisions relating to climate change services<sup>13</sup></li> </ul>

<sup>13</sup> Note that in South Asia many gender experts are in fact men, thus the distinction has been made here to demonstrate the need for greater participation of women in particular



## 2.4 Emerging Priorities

The stakeholder analysis demonstrates clear gaps, needs and priorities in relation to both climate service provision and use, thereby validating and enriching the findings of the Evidence Review.

In order to provide an overview of emerging priorities, the intervention options described in preceding sections may be grouped into the activities/areas described below. These broad categories are worked up into a detailed programme outline and components in section 4.

**Capacity (service co-development and delivery):** centring on strengthening user-provider engagement; improving accessibility of information; simpler formats/language; strengthening intermediary activities and organisations; developing ‘last mile’ information delivery.

**Capacity (human):** centring on more and better trained personnel (in both users and provider communities); building capacity to interpret and apply climate information for different decision-making purposes; public awareness campaigns (around benefits of climate information).

**Capacity (technical):** centring on software tools for climate data storage, processing, analysis and prediction, especially short-term (seasonal and sub-seasonal) time scales, including quality control and archiving.

**Capacity (infrastructure):** centring on observation networks; satellite reception technology; IT hardware; internet connectivity; capacity to install, maintain and repair hardware.

**Research:** centring on new types of user-relevant co-produced information and other products (such as index-based insurance); making effective use of climate information services in specific decision contexts; improved prediction skill; more “seamless provision” over timescales (short in particular); improved delivery, communication and translation methods; improved knowledge, exchange and learning mechanisms.

**Governance:** centring on political support and secure funding; encouraging use of existing regional centres and networks; institutional strengthening and coordination; encouraging regional and trans-boundary cooperation; open data policies.



# SECTION 3

## Complementarity with Regional Donors

Interviews and workshops have highlighted several opportunities for DFID to build partnerships with other key actors financing and implementing climate services projects, programmes and initiatives in the region. Principal opportunities are summarised in the table below.

**Table 6 Principal opportunities for collaboration on climate services in South Asia**

Institution	Role and current priorities	Current/planned interventions	Opportunity for collaboration with DFID
Asian Development Bank	<p>ADB's support in the area of climate change focuses on supporting adaptation through strengthening national and municipal planning (ADB Long-term Strategic Framework 2008-2020).</p> <p>Priority social groups are women and marginalised people and priority sectors health, water, DRR, agriculture, urban development and the financial sector.</p>	<p><i>Pilot Project on Climate Resilience in Nepal and Bangladesh</i> as part of the \$1.2 billion Pilot Program for Climate Resilience (PPCR). Technical assistance will include strengthening capacities at the national level to integrate climate resilience into development planning. These are two distinct country programs under the PPCR. The PPCR in each pilot country is a collective effort usually involving more than one multilateral development bank. In the cases of Nepal and Bangladesh, partner implementing agencies are ADB, WB and IFC.</p> <p>The Strategic Programme for Climate Resilience (SPCR) is the investment plan that is developed in each PPCR pilot country, thus a SPCR exists for both Nepal and Bangladesh. The SPCR in turn describes a portfolio of grant- and loan-financed activities that in many cases complement more conventional infrastructure investments. ADB is involved in components relating to a. Mountain Ecosystems – climate resilience of watersheds and b. Mainstreaming of climate risk into development.</p>	<p>ADB would be interested in collaborating with DFID to implement a programme in South Asia, after identification of gaps and based on shared agenda and goals. This interest is essentially in getting involved in 'start to end' process and was expressed by Dr Vidhisha Samarasekara, Senior Climate Change Specialist.</p> <p>One area of particular interest indicated by Dr. Samarasekara is providing technical support to NHMSs for collecting climate hazard information and building capacity to use the information for modelling disaster risk.</p> <p>While the ADB acts as a multilateral implementing agency for the PPCR, the Climate Change Fund (CCF) is an internal fund managed by ADB and replenished periodically through retained earnings. To date the CCF has been used primarily to fund a range of technical assistance (grant-financed support) in the areas of mitigation, adaptation and REDD; although very little directly on climate services as such. The potential for channelling funds from second parties (e.g., DfID) through the CCF exists in principle but has not been utilized to date. The advantages to such an arrangement would</p>



Institution	Role and current priorities	Current/planned interventions	Opportunity for collaboration with DFID
		<p>Supporting the Bangladesh Meteorology Department (BMD) with a numerical climate and weather database project, as well as generation and dissemination of flood data, data on water levels and on water resources. ADB is of the view that there is need for automated climate services covering larger areas. ADB has mentored BMD through an automation process of digitised climate information and services.</p> <p>Active in the Indian States of Orissa and Bihar on flood risk management.</p> <p>Co-funder Climate Research and Information Services in South Asia (CRISSA).</p> <p>ADB is also a partner in the newly established Climate Services for Resilient Development (CSRD) initiative, organized by USAID (see below). Bangladesh has been identified as the CSRD pilot country in Asia, and ADB will co-ordinate the country program.</p> <p>Additional ADB work in South Asia in the area of climate services includes the Technical Assistance (TA) 7173: Strengthening Capacity for Managing Climate Change and the Environment; Component on Climate Data Digitization and Downscaling of Climate Change Projections for Nepal and the upcoming ADB TA 8572 on Action on Climate Change in South Asia, which will have climate services and climate data management components.</p> <p>ADB has good partnerships with various governments in the region and has established MoUs with numerous agencies working in climate</p>	include low overhead, high leverage and well established fiduciary standards.



Institution	Role and current priorities	Current/planned interventions	Opportunity for collaboration with DFID
CGIAR/CCAFS	<p>Under Phase 2 of the CCAFS programme, it is proposed that one of the 4-5 flagship programmes at the global level will be on climate information services and climate informed safety nets. Focus on early warning and agricultural sector.</p> <p>By 2022, one of the key outcomes is to reach 18 million farm households with enhanced capacity to deal with climate risks through accessing climate informed advisory services and safety nets.</p> <p>CCAFS research and engagement will continue targeting, design and coordination of investments and spur further investment through evidence.</p> <p>CCAFS is in the process of developing its Gender and Social Inclusion Strategy.</p>	<p>science such as the Hadley Centre, the Stockholm Environment Institute and UN agencies.</p> <p>Flagship work on climate services to focus on India, Nepal and Bangladesh.</p> <p>The International Research Institute on Climate and Society (IRI) will support the flagship programme on climate information with relevant climate science and facilitate connections with broader climate research, climate services and index insurance communities. The University of Reading will contribute to expertise in use of met data and communication approaches. The University of Florida will bring gender expertise to rural climate services research. Global partners will include WMO, GFCS, DFID and others.</p> <p>A surge of interest and synergies between CGIAR and several partner communities have opened the door for major advances in climate information and advisory services, weather related insurances and expanded use of early warning. For example, CCAFS has demonstrated major advances in rural climate services in agriculture sectors in Senegal, Tanzania and Malawi.</p> <p>A sourcebook for good practice in communicating climate information at scale to farmer groups, using intermediaries and boundary organizations as the "missing link" is currently being developed based on learning from an expert workshop held in Kenya in 2013.</p> <p>The CCAFS-South Asia project <i>Improving Index Insurance in Maharashtra</i> is working with industry and government to develop improved index insurance products that increase satisfaction of farmers and economic viability. Products adopted in</p>	<p>Strong implementation and research capacity. Many CCAFS experiences appear worthy of scaling-up and replication throughout the South Asia region, especially given the focus on gender issues, and that CCAFS targets vulnerable groups and seek to address 'last mile' issues with innovative ICTs.</p> <p>Specific research areas where synergies could be explored include:</p> <ol style="list-style-type: none"> <li>producing information about climate variability and its agricultural impacts, tailored to decision-maker needs</li> <li>supporting weather-related insurance for smallholder farming communities</li> <li>guidance and evidence to improve investment in climate services for agriculture</li> <li>scalable communication channels based on ICT and radio</li> <li>methods and curriculum to equip intermediary organizations to deliver services to rural communities</li> <li>methods to identify and meet gender-specific climate service needs</li> <li>institutional arrangements that foster sustainable co-production of services with relevant agencies and targeted rural communities</li> <li>sustainable public-private partnerships and business models</li> <li>communications and capacity-building approaches, including South-South learning</li> <li>synthesis of knowledge about impacts of climate services on agriculture and food security management</li> <li>improved methods for ex-ante evaluation of climate services investments</li> </ol>



Institution	Role and current priorities	Current/planned interventions	Opportunity for collaboration with DFID
		<p>Maharashtra, India, are expected to benefit 500,000 farmers in 2015</p> <p>An example of <i>institutional strengthening</i> is collaborative work with IRI on the ENACTS project to equip African NHMSs to reconstruct historic weather data, and make high-resolution products tailored to user needs available through web-based “maprooms”. CCAFS experience on <i>organizational development</i> includes developing national governance frameworks for climate services, in partnership with WMO under the GFCS.</p>	xii. analyses of alternative climate services investments at national to regional scales <sup>14</sup>
<b>Global Facility for Disaster Risk Reduction (GFDRR)</b>	<p>GFDRR Focus Countries: Bangladesh, Nepal, Pakistan, and Sri Lanka.</p> <p>GFDRR is working in South Asia to improve government and societal understanding of the vulnerabilities faced by growing urban populations and economies, and to support efforts to make disaster risk management a centerpiece of planning and development processes. GFDRR is also assisting with efforts to develop comprehensive risk financing strategies, such as setting aside reserves for post-disaster recovery and reconstruction work, and introducing financing models such as contingent credit and insurance mechanisms.</p>	<p>The Global Facility for Disaster Risk Reduction (GFDRR) is investing in the modernisation of weather, climate and water information systems globally with significant activity in South Asia. By 2014 GFDRR grants had contributed to a \$400 million investment from climate investment funds and the World Bank. Example projects include: <i>Support for Design and Implementation of Building Resilience to Climate Related Hazard</i> in Nepal (with PPCR); India’s <i>Cyclone Risk Mitigation Project</i> (with Gol) and the <i>Ayeyarwady Integrated River Basin Management Project and Information Systems Modernization Component</i>. Also in India, GFDRR supported an agricultural insurance scheme that has protected 29 million farmers from financial risks of natural hazards. In 2013, GFDRR and partners launched the Open Cities project in Bangladesh, Nepal and Sri Lanka, that uses open data technologies to map disaster risks and promote urban resilience to disasters. Finally, the Hydromet programme has supported modernization investments in Nepal.</p>	<p>Potential for working with GFDRR to extend the DRFI programme to South Asia to explore potential for risk insurance in DRR and agricultural sectors.</p> <p>There are opportunities for DFID to coordinate activities among global and regional climate information providers by collaborating with GFDRR.</p>

<sup>14</sup> Information gathered from CCAFS strategy documents provided to the consultancy team: CCAFS Gender & Flagship Summaries and Pre-proposal for the Integrative CRP on CCAFS.



Institution	Role and current priorities	Current/planned interventions	Opportunity for collaboration with DFID
		The Disaster Risk Financing and Insurance (DRFI) Program, a joint initiative of the World Bank Group's Finance and Markets Global Practice and the GFDRR, was established in 2010 and is supporting governments in South East Asia to strengthen financial resilience along four main priorities, including sovereign disaster risk financing and insurance; agricultural insurance; property catastrophe risk insurance; disaster-linked social protection.	
JICA	JICA's 2014 Cooperation for NMHSs Strategy aims to enhance the capacity for DRR and Climate Change Adaptation through modernisation of instruments and equipment and capacity building in operation and maintenance, and improvement of forecasting capacity in South Asia.	<p>Completed <i>Project for Development of Human Capacity on Operation of Weather Analysis and Forecasting In the People's Republic of Bangladesh</i>.</p> <p>On-going. <i>Establishment of End to End Early Warning System for Natural Disaster in Burma</i> and Development of Storm Forecasting Project with STSAT Satellite/ Storm Surge/ Forecasting Tools (in partnership with the Japan Meteorological Agency).</p> <p>Planned projects in Bangladesh (Establishment of S-Band Doppler Radar System), Burma (Cyclone Detecting Radar, automatic weather observing system) and Pakistan (Establishment of Specialized Medium Range Weather Forecast Center and Strengthening of Early Warning and Dissemination Network and Installation of Weather Surveillance Rader at Karachi).</p> <p>Co-funder SAWI programme</p>	<p>Participants at the Burma workshop indicated no major progress has been made on planned programmes there (see Annex 7).</p> <p>It could be of interest to DFID to discuss potential partnerships with JICA moving forwards, if interested in investing in hardware and technical operations and maintenance capacity.</p>
UNDP	One of the key focus areas of UNDP's 2014-2017 Strategic Plan is Climate and Disaster Resilience. No clear agenda on climate services.	<p>The UNDP developed multi-hazard risk assessments 4 states in Burma in 2011.</p> <p><i>Strengthening Climate Information and Early Warning Systems for Climate Resilient Development</i> in Pakistan, Nepal, Bangladesh, Bhutan and Burma. Supporting the development of EWS to help communities respond to both short-term/rapid onset</p>	<p>UNDP's strength and potential role in the proposed regional programme lies predominantly in technical service provision, in particular capacity building and institutional development.</p> <p>The ECCA established Communities of Practice and ran webinars. This distance learning model (amongst many other successful examples, SERVIR etc.) could be</p>



Institution	Role and current priorities	Current/planned interventions	Opportunity for collaboration with DFID
		<p>climatic hazards as well as long-term/slow onset hazards.</p> <p><i>Economics of Climate Change Adaptation (ECCA)</i> Asia. The capacity building programme is a part of UNDP's effort in helping countries to design and implement sustainable development pathways. The program helps countries to effectively manage risks by building institutional capacities, reduce financial risks and offer improved incentives for adaptation responses (Bangladesh and Nepal currently participating). ECCA is a cooperative effort between UNDP, USAID Adapt Asia-Pacific Project, and the ADB in association with the Global Water Partnership and Yale University.</p>	<p>adopted to provide training on the practical uses of climate information for practitioners and development planners in particular.</p> <p>There is also scope for a series of interactive talks co-funded between DFID and the UNDP along the lines of the Café Scientifique model of the British Council, which provide spaces for discussions around science and technology outside the traditional academic context. These meets aim to "facilitate learning and empower the public and scientists to consider eachothers' perspectives".<sup>15</sup></p>
USAID	USAID works across 24 Asian nations to ensure governments and communities can access and use climate information and services.	<p>USAID funds and partners in the Climate Services Partnership (CSP), Scaling Up Climate Services for Farmers in Africa and South Asia (CGIAR CCAFS) and SERVIR Himalaya initiatives, amongst others.</p> <p>USAID-led <i>Climate Services for Resilient Development</i> partnership. The partnership aims to develop new tools, services, and approaches that bridge technology and organizational gaps in order to strengthen climate resilience in populations around the world. USAID has committed \$10 million towards the partnership, with the total financial and in-kind contributions at \$34 million from: USAID (leveraging NOAA, NASA, and other U.S. agencies), UK Government (DFID and UK Met Office), IADB, ADB, Esri, Google, American Red Cross, and Skoll Global Threats Fund.</p> <p>Through the end of 2016, the partnership will deliver tailored and targeted services to three sub-regions in the Andean region of South America, Eastern</p>	<p>Potential for further partnerships, DFID to decide whether this would be sought at this time given recently launched <i>Climate Services for Resilient Development</i> partnership.</p> <p>A priority for collaboration should be carrying out economic analysis of climate services with USAID (and WMO, based on the 2015 <i>Valuing Weather and Climate</i> methodology) in order to demonstrate the value added by climate services.</p> <p>CSP represents potential partner for implementing regional research and programmes. Has not done too much focused on South Asia to date so could be interested in expanding operations in collaboration with the proposed regional programme. The CSP has developed several tools that could be tested in the region, such as economic analysis of climate services, and climate service evaluation methodologies.</p> <p>Support scaling-up of training, testing and use of the SERVIR system. Explore how SERVIR can support</p>

<sup>15</sup>

See: <http://www.cafescientifique.org/>



Institution	Role and current priorities	Current/planned interventions	Opportunity for collaboration with DFID
		<p>Africa, and South Asia - with Colombia, Ethiopia, and Bangladesh serving as pilot countries. Thereafter, the partnership aims to expand to a second phase of activity in three more sub-regions (the Sahel region of Africa, Southeast Asia, and the Caribbean) and build on lessons learned and replicable tools and services.</p> <p>USAID has also developed in partnership with the WMO a methodology for estimating the economic value of climate services to farmers and other users of climate data (see WMO below).</p>	<p>development planning through the provision of geospatial information and earth observation applications.</p> <p>Potential to apply success from other regions to meet current needs/gaps in South Asia, in particular relating to:</p> <ul style="list-style-type: none"> <li>• Training meteorologists and others to develop tools to help planners understand potential climate hazards; and</li> <li>• Coordinating meteorological and agriculture agencies to use climate information to support agricultural decision making</li> </ul>
<b>World Bank</b>	<p>The World Bank's South Asia Regional Integration Strategy (2014) identifies hydromet modernisation, disaster preparedness and climate resilience as high priority areas to support regional integration.</p> <p>Focus countries are Afghanistan, Bangladesh, Bhutan, India, Nepal, and Pakistan.</p> <p>Burma sits in WB East Asia region.</p>	<p><i>Regional Weather and Climate Services Program</i> in Nepal, Bangladesh and Bhutan are at planning stages and are expected to encompass improved meteorological information services, improved hydrological information services, strengthened forecasting and early warning systems, and improved dissemination of agro-meteorological information. These activities will be implemented as a series of projects over a five to eight year period. The programme in Nepal is up and running – The UK Met Office is supporting part of the project by working with the Finnish Meteorological Institute and the local met services to improve their capacity for EWS.</p> <p>The South Asia Regional Hydromet Program seeks to strengthen disaster preparedness and climate resilience through cross-border/regional dialogue, and the capacity of participating countries and institutions to respond to water related hazards and climate risks at the national and regional levels, by supporting improvements in monitoring, weather and flood forecasting, community based early warning systems and delivery of climate services.</p>	<p>Simon Bor, Advisor to the Executive Director, World Bank UK Office, has indicated that there are clearly opportunities going forward and the WB is keen to support regional coordination / integration.</p> <p>Generally, it takes longer for the WB to setup projects, given the need to develop, work with Governments in country, reiterate, sign off, and other procedural issues. In terms of supporting shorter studies e.g. quicker scoping studies or smaller pieces of research, then these can be setup and funding released fairly quickly</p> <p>For anything outside of the official Government “space”, i.e. work with other regional, national and sub-national actors (research institutes, NGOs etc.), DFID are potentially better placed to act.</p> <p>DFID may have more flexibility to influence areas such as governance, promoting trans-boundary / national coordination noting that WB works for the country (as the client) whereas DFID ultimately works for the UK.</p> <p>Poonam Pillai, Senior Environmental Specialist, was interviewed for this scoping and indicated she is keen to talk DFID direct about potential collaboration.</p>

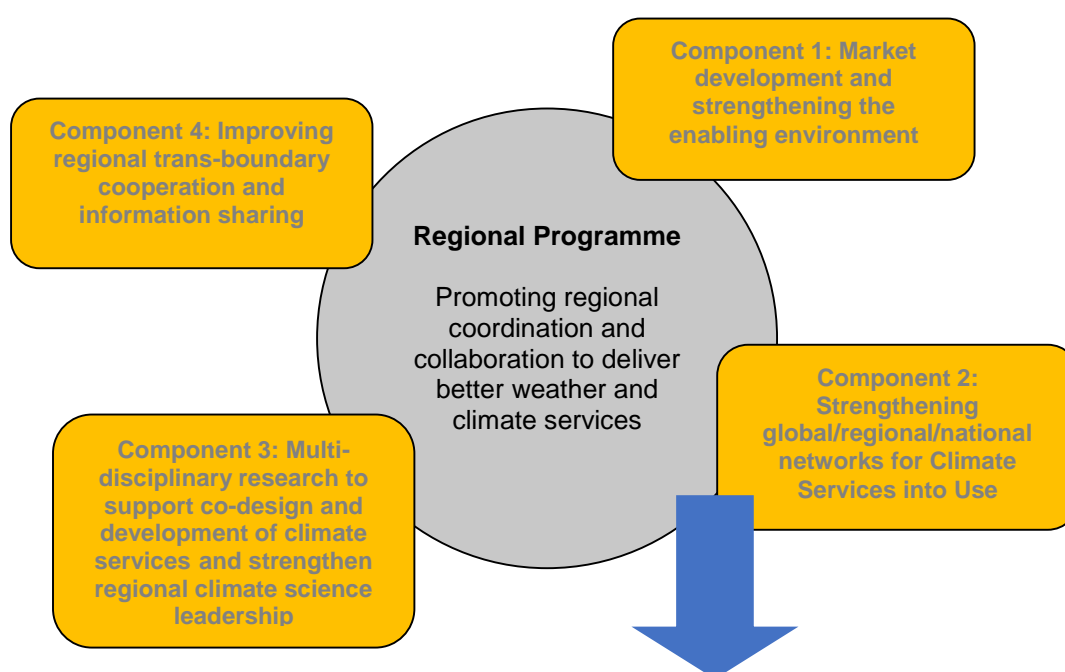


Institution	Role and current priorities	Current/planned interventions	Opportunity for collaboration with DFID
WMO	The WMO Regional Programme for Asia 2012-2015 has focused on: enhancing operation of the Regional Climate Outlook Forum; developing climate services to address the slow onset impacts of climate variability and climate change; establishing a regional-wide multi-hazard early warning system for DRR and implementing the Integrated Drought Management Programme, amongst others.	<p>In addition, there are numerous water supply and water management programmes being supported by the World Bank across Asia (see Evidence Review Annex 4 for more details).</p> <p>WMO-RIMES project <i>Reducing Risks of Tsunami, Storm Surges, Large Waves and Other Natural Hazards in Low Elevation Coastal Zones</i> in Burma. <i>The Severe Weather Forecasting Demonstration Project</i> (SWFDP) is successfully strengthening capacity in NMHSs in developing and least developed countries to deliver improved forecasts and warnings of severe weather to save lives, livelihoods and property. The project has improved the lead-time and reliability for alerts about high-impact events such as heavy precipitation, severe winds and high waves. Preparations are being made to implement the project in the Bay of Bengal (South Asia) region also.</p> <p>WMO <i>Valuing Weather and Climate: Economic Assessment of Meteorological and Hydrological Services</i>, written in collaboration between the WMO, the World Bank, and the CSP, with financial support from USAID.</p> <p>Funds Integrated Drought Management Programme</p>	<p>A priority for collaboration should be carrying out economic analysis of climate services with WMO (and USAID, based on the 2015 <i>Valuing Weather and Climate</i> methodology) in order to demonstrate the value added by climate services.</p> <p>In the future, depending upon the availability of resources, the SWFDP project will be expanded to cover more areas in different regions of the world. It is recommended that DFID explore potential for extending this work to other areas within South Asia.</p> <p>IDMP representatives attended the WMO co-sponsored 5th South Asian Climate Outlook Forum in Pune, India, in April to present the Assessment Report. Based on these discussions a clear way forward for the South Asian Drought Monitoring System (SA DMS) has been agreed with IWMI and additional co-funding secured. The system will be developed for the whole South Asian region, with a few countries in a first phase as a pilot to tailor the system to national needs. DFID could support complementary measures to this work, focused on overcoming the challenges identified in the Needs and Capacity Assessment, namely:</p> <ol style="list-style-type: none"> <li>1. Improving hydrological/meteorological measurement stations</li> <li>2. Improving access to satellite data. There is also scope for applying such data, particularly in the context of transboundary hazard forecasting</li> <li>3. Strengthening rainfall prediction capability</li> <li>4. Improving staff training</li> </ol>

# SECTION 4

## Programme Outline


In scoping the programme outline, the intervention options developed based on the findings of the Evidence Review (Annex 1) have been re-examined and refined based on comments and feedback received during consultations, with a view to grouping together those options that best address on-going gaps. This process has resulted in the development of four potential programme components described on the following pages and shown in Figure 1 below. These four components represent potential ways of grouping the activities that the stakeholder analysis has provided.



Improved governance and enabling environment combined with co-production of climate information leads to the development of more reliable, tailored and accessible services. This leads to greater uptake and use to inform decision making at all levels, thereby demonstrating the value of climate services and increasing resilience amongst South Asian populations

**Figure 1 Potential framework for the South Asia regional climate services programme**

These four components incorporate the majority of the emerging priority areas described in section 2.4. Those selected for inclusion are underlined as shown in Box 1 below. Activities that are not selected (i.e. not underlined) for DFID intervention have not been included in the four proposed components for the regional programme because the Evidence Review and subsequent consultations reveal that these are likely to be addressed by on-going and



planned initiatives.<sup>16</sup> Thus the areas underlined below represent areas where DFID interventions could *add most value* to the rapidly evolving landscape of climate services in South Asia.

**Box 1 Intervention areas that could be directly addressed by the regional programme**

***Capacity (service co-development and delivery):*** centring on strengthening user-provider engagement; improving accessibility of information; simpler formats/language; strengthening intermediary activities and organisations; developing ‘last mile’ information delivery.

***Capacity (human):*** centring on more and better trained personnel (in both users and provider communities); building capacity to interpret and apply climate information for different decision-making purposes; public awareness campaigns (around benefits of climate information).

***Capacity (technical):*** centring on software tools for climate data storage, processing, analysis and prediction, especially short-term (seasonal and sub-seasonal) time scales, including quality control and archiving.

***Capacity (infrastructure):*** centring on observation networks; satellite reception technology; IT hardware; internet connectivity; capacity to install, maintain and repair hardware.

***Research:*** centring on new types of user-relevant co-produced information and other products (such as index-based insurance); making effective use of climate information services in specific decision contexts; improved prediction skill; more “seamless provision” over timescales (short in particular); improved delivery, communication and translation methods; improved knowledge, exchange and learning mechanisms.

***Governance:*** centring on political support and secure funding, encouraging regional and trans-boundary cooperation; encouraging use of existing regional centres and networks; integration of climate services into development planning; open data policies


Evidence from the scoping indicates that this “four component” approach, implemented in a coordinated way and at regional, multi-country, national and sub-national scales will form a sound basis for developing effective weather and climate services in South Asia and achieving a step change enhancement in their use.

Programme outcome, impact and theory of change are as below.

**Outcome:** Increased use of reliable, co-produced and accessible weather and climate services based on better data, information, knowledge and tools informs regional, national, sub-national and community level policy, planning and decision-making in South Asia.

**Impact:** Increased use of weather and climate information and mainstreaming into development and sector policies, plans and programmes supports sustainable development in South Asia.

<sup>16</sup> See Annex 4: Intervention Mapping from the Evidence Review, plus section 3 of the current report and workshop proceedings in Annexes 5 to 9.



**Theory of Change:** Improved governance and enabling environment combined with co-production of climate information leads to the development of more reliable, tailored and accessible services. This leads to greater uptake and use to inform decision making at all levels, thereby demonstrating the value of climate services and increasing resilience amongst South Asian populations.

The four components articulated for the regional programme are proposed as follows.

## 4.1 Component 1: Market development and strengthening the enabling environment

### Overarching Objectives

This component is concerned with developing efforts to create and build a more complete and sustainable market for high quality and relevant climate information and services. An overarching objective should be to promote engagement of the private sector, which can play a pivotal role in successful creation and sustainability of the market (see Box 2).


Successful engagement under this component will require adopting a systems approach to support the development of regional and national infrastructures and mechanisms that foster the growth of a viable and inclusive climate services market. Numerous methodologies are available to guide a systems approach to market development and institutional change, however two approaches that seem particularly appropriate for fostering more inclusive markets aimed specifically at poverty reduction are Making Markets Work for the Poor (M4P) and Participatory Market System Development (PMSD) (see Box 3 below).

The diverse range of ‘market’ actors to be targeted by activities under this component include the NHMSs, the ‘last mile’ end-users, intermediaries working as conduits between the providers and the end-users, such as NGOs, agricultural research institutes and extension services, the private sector and insurance companies.

### Box 2 Capitalising on private sector engagement for climate service markets

The difficulties associated with conducting risk assessments for complex and seemingly distant trends have driven many businesses away from investing in such endeavours. While governments and non-profits in the region are busy tackling climate change with the help of funding from abroad, the business sector is currently lagging behind. There is considerable potential for businesses to team up with government and civil society to promote resilience and adaptation among the most vulnerable segments of the population – and make a profit while doing so. In order for the private sector to flourish in such activities, it must draw support from national governments, which is currently often lacking. In many countries across the region, there are no specific policies that support private sector engagement in this area.

Notwithstanding, a business market is slowly emerging in the field of provision of customised high value-added weather and climate services to a range of private and public users. However this market is currently small due to the fact that climate intelligence amongst businesses is still low and general awareness of climate change impacts is only now beginning to influence business’ decisions. While the primary responsibility of providing weather and climate services for the public and private sector lies with the




NMHSs, there is a demand for customised and tailored products in various sectors of national economy, which cannot always be fulfilled by the official agencies.

In India, for example, the private sector is filling the gaps left by the IMD (see Box 5 below) in terms of meeting on-going demand for customised and localised weather forecasts. Skymet, for instance, sources publicly available data and uses this to generate region-specific information. Skymet has developed 3 day precipitation information at village-level granularity, 24/48 hour weather forecasts in 15 minute increments, medium term (15 day) daily precipitation forecasts, seasonal and monsoon forecasts. Key sectors include power companies, media conglomerates, farmer information services, agricultural input producers and logistics operators. Expressweather has joined with Jadavpur University in West Bengal to develop their own forecasting model using data sourced from their own weather stations. Likewise, the Weather Mart and BKC Weather Sys. Private Limited are also selling weather forecast information to stakeholders in different sectors. Indications are that major global private forecasters like Foreca and Accuweather are also now looking towards India as a potential market for their services (see [http://www.business-standard.com/article/economy-policy/private-weather-forecasters-fill-the-gap-left-by-imd-112092103018\\_1.html](http://www.business-standard.com/article/economy-policy/private-weather-forecasters-fill-the-gap-left-by-imd-112092103018_1.html)). Weather Risk Management Services provide weather forecasting operations for various end users and have a strong presence in the field of weather-based farm insurance. They also have a large and expanding business in the manufacture of automatic weather stations which are being supplied to the domestic and international markets, thereby expanding their international footprint. The company has also recently been awarded a large weather-based insurance project in Bangladesh, funded by the ADB. All the companies mentioned here represent potential candidates for participating in the activities described under this component.

As well as being an active player in the field of operational weather services, the private sector in general is important as a key driver of job creation and economic growth. Second, it is expected that climate change will expand existing markets and create new ones for adaptation-relevant products and services, such as drought resistant crops and weather index based crop insurance. Against this backdrop, the private sector should be regarded as a “supplier of innovative goods and services”, using its capacity to make a unique contribution to adaptation, such as investing in innovative technology, resilient infrastructure and improved information systems.

Evidence indicates that demand for climate services is particularly weak and under-developed in the current climate services market in South Asia. In order to bring demand up to pace with supply, two key users groups in particular could be targeted with activities under this component: development planners (regional, national and sub-national) and communities themselves, the so-called ‘last mile’. Consultations have revealed that despite increasing literature on the gains of climate services, often these user groups are unaware of the benefits of climate information for decision making purposes. Thus raising awareness and stimulating demand will require demonstrating effective use and application (‘benefits’) of climate services on development objectives and livelihoods. Likewise, there is a need to explore finance options to promote uptake of these new climate services amongst last mile communities.



The activities that form part of this component should be carried out within the ambit of prevailing systems of international cooperation and under the umbrella of regional arrangements such as SAARC, WMO etc.

**Box 3 Suggested Roadmap for the development of an inclusive climate services market in South Asia, based on the European Research and Innovation Roadmap for Climate Services (EC, 2015)**

- Assess the climate services market in the South Asian region (partly completed for this scoping study). Adopting a pro-poor approach - such as Making Markets Work for the Poor (M4P) or Participatory Market System Development (PMSD) – would provide the benefit of bringing strategic players together to gain an understanding of the whole system, to jointly assess blockages and opportunities and to implement collaborative strategies and actions that will improve how the system

**Making Markets Work for Smallholders and Rural Producers in Bangladesh  
(2007 to date, funded by the EC)**

**Objective:** To increase income and employment opportunities from production in trade in farm and non-farm activities for marginalised rural communities in Bangladesh

- During the market mapping workshops, market actors identified that access to appropriate credit services at different points of the value chain was critical to transform the market system
- Information on interested actors and their credit needs was sent to 4 banks
- Learning sessions provided financial institutions with a better understanding of appropriate credit packages, facilities and repayment options, amongst others
- Local providers introduced improved credit packages that are less risky to the most marginalised smallholders

**Successes:** 200% increase in business transactions, 300% increase in local veterinarians' incomes, higher quality milk, among others

Source: <http://www.pmsdroadmap.org/examples.html>

functions. The PMSD approach, for example, empowers marginalised actors and facilitates the development of market systems that can be extremely powerful at tackling poverty (see insert);

- Map service providers, intermediaries and users and undertake a detailed assessment of user needs for climate services. Partly carried out for this scoping study, this initial mapping would benefit from further development as part of on-going efforts to understand the evolving needs of different user groups, especially within the water and health sectors where less is currently known;
- Assess the extent to which existing climate services are able to meet user demands via pilot studies (covered under component 2);
- Continuous assessment of bottlenecks and barriers for the uptake of climate services and pilot innovations to overcome them (covered under component 2);
- Identify public and private domains of climate services markets and identify the services which should be paid for and those available on free access as public goods;




- Establish methodologies to convert system generated climate products into tailored services (covered under component 2);
- Develop appropriate business models for the provision of climate services;
- Develop research and pilot projects to demonstrate the impact and added-value of climate services as standalone services and/or integrated into broader decision-support systems, for both end users and national and sub-national development planners, using existing methodologies (e.g. WMO, CSP, see section 3) (covered under components 2 and 3);
- Demonstrate the credibility of climate services by developing standards for vulnerability and risk assessments. Quality control and certification can promote relationships of trust between supply and demand; which are crucial for a healthy and sustainable market;
- Improvements in modelling and prediction capacity (priority improvements identified under component 3);
- Develop tools that can be used by users and intermediaries to transform and apply climate information to different decision-making scenarios (covered under component 2);
- Promote collaborations between providers and intermediaries. Providers should ensure the availability of a broad range of public, free and open access data (or subscription-based in the case of private sector providers), products, models, indices and other climate information; intermediaries should use products for providing customized, locally relevant and high value-added services and products to users, thereby contributing to healthy market dynamics.

## Possible Activities

- I. Facilitate the development of Regional and National Climate Service Roadmaps that draw coherent links to existing policy and cooperation frameworks such as the South Asian Association for Regional Cooperation (SAARC) Disaster Management Center (SDMC) Roadmaps and the Bhutan Climate Summit Framework of Cooperation. These Roadmaps could be based around the GFCS Framework or the European Research and Innovation Road Map for Climate Services, which could be considered more demand-focused than the former (see Box 3).<sup>17</sup> A participatory approach to this activity (such as the PMSD described in Box 3 above) would provide the benefit of bringing strategic players together to gain an understanding of the whole system, to jointly assess blockages and opportunities and to implement collaborative strategies and actions that will improve how the system functions. Special attention should be paid to the mainstreaming of gender issues within these plans, including the development of monitoring and evaluation indicators. These Roadmaps could be used as the basis for providing assistance to NMHSs and other data providers to develop 5 year plans, which should help identify and coordinate potential donor investments in a structured way, rather than reactively. The private sector could represent a strategic ally in this activity since it tends to be demand-focused and may be prepared to take higher risks with regards to investing in innovations (see Box 2).

<sup>17</sup> The European road map attempts to organise research activities and to stimulate the climate services market.

[http://www.kowi.de/Portaldata/2/Resources/horizon2020/coop/A\\_European\\_research\\_and\\_innovation\\_Roadmap\\_for\\_Climate\\_Services.pdf](http://www.kowi.de/Portaldata/2/Resources/horizon2020/coop/A_European_research_and_innovation_Roadmap_for_Climate_Services.pdf)

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- II. Deeper involvement of political leadership in every member country is of paramount importance. In Africa [AMCOMET](#) has been established to raise awareness on weather issues at Ministerial level. AMCOMET was constituted in 2010 by the Nairobi Ministerial Declaration from the First Conference of Ministers Responsible for Meteorology in Africa, as a high level mechanism for the development of meteorology and its applications in Africa. According to its website, “*AMCOMET aims to provide political leadership, policy direction and advocacy in the provision of weather, water and climate information and services that meet societal and sector specific needs, including agriculture, health, water resource management and disaster risk reduction to name a few*”. A key feature of the programme underlines the need to integrate weather and climate services into development policies at regional and national levels. In the context of South Asia, there is no such programme, although there are arrangements for regional cooperation under the aegis of SAARC in the form of SAARC Disaster Management Centre (SDMC) located in New Delhi, India and SAARC Meteorological Research Centre (SMRC) in Dhaka, Bangladesh. These centres could be supported to pro-actively raise awareness at Ministerial level.
  - III. The Asian Pacific Adaptation Network (APAN) – funded by the UNEP - organises the Asia Pacific Climate Change Adaptation Forums which are among the biggest climate adaptation events in the region attracting over 500 participants from all levels of government, the private sector and the donor community. Climate services have not been explicitly addressed to date and as such the forum provides an opportunity for DFID to stimulate debate and cross-regional (Asia-wide) knowledge sharing and learning around climate services, thereby strengthening the enabling environment required to move from policy (which many countries already have in place) to planning to implementation. Other donors could be interested in co-sponsoring such as USAID which sponsored an event on adaptation financing in 2014. Coordination could be promoted with the South Asian node of the APAN, the Climate Action Network South Asia (CANSA) whose members include organisations from Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka. These networks could also be invited to participate in the user groups described in component 3. Mini-training workshops could also be run as side events to the APAN forums, including sessions on climate services and gender.
  - IV. Establish user groups (national, sub-national) building on successful experiences of RIMES (monsoon groups) and link these up to regional forums, such as the SASCOF, whose scope could be broadened to cover additional areas like storms, drought and floods, as well as for integrating a wider range of organisations representing users. The membership of these regional forums could be expanded include other players such as academic and research institutes, the private sector (as information providers) and National Parks, irrigation and water boards as well as NMHSs. Special attention should be paid to ensuring the involvement of organisations representing women and vulnerable groups. These national and regional groups could be encouraged to participate in coordination mechanisms with producers and intermediaries, covered under component 3 below, and are potential partners in the research projects described for component 4. In Nepal, RIMES is developing the National Dissemination Protocol to Communities and Users to generate advisories and bulletins for EWS, DRR and water sectors. They also provide monthly hydrographs which are used for hydropower and water resource management.
  - V. Organise a series of interactive talks co-funded between DFID and the UNDP along the lines of the Café Scientifique model of the British Council, which provide spaces for discussions around science and technology outside the traditional academic



context. These meets aim to “facilitate learning and empower the public and scientists to consider each other’s perspectives”.<sup>18</sup>

- VI. Create mechanisms where ‘last mile’ users and local credit providers can interact to explore finance options to promote uptake of the new climate services developed under component 2 (see example in the insert in Box 3 above). Special attention should be paid to ensuring the participation of women and vulnerable groups.
- VII. Incentivise NMHSs to develop education and outreach programmes with a particular emphasis on science education for girls and women.
- VIII. Develop appropriate business models for providing climate services. This would require market studies on private sector providers and linkages to user communities as well as actions to identify public and private domains of climate services markets and identify the services which should be paid for (linked to Activity VI above) and those available on free access as public goods. This could include holding business forums to link up local telecommunications companies (climate information communicators) to commercial sponsors, such as input providers.
- IX. Develop standards and protocols for using climate information to undertake vulnerability and risk assessments in order to demonstrate credibility and quality assurance of climate services and to reinforce relationships of trust between supply and demand, which is crucial for a vibrant market. This could draw on work already undertaken by the Climate Services Partnership Working Group on Climate Service Ethics (CSP 2014) and involve a series of pilot studies. These standards and protocols should incorporate gender considerations, such as the need to incorporate the views of women and vulnerable groups into risk assessments and the elaboration of gender-specific M&E indicators.

### **Geographic Focus**

India and Bangladesh offer one option since they are the two countries in the region where the climate services market is most substantially developed. Working within these countries to develop more inclusive systems would provide replicable models for future developments in other countries of the region. Alternatively, pilots could be initiated across all focus countries of the region.

### **Timescale Focus**

Two to five years.

### **Sector Focus**

The two sectors which should be prioritised under this component given they demonstrate the maximum potential for creating a successful and sustainable climate services market are (i) Agriculture and food security and (ii) DRR. In addition, building the market to serve the needs of the health sector could add significant value since it appears very little has been done to date.

### **Proposed Key Outcomes**

- Growth of the climate services market will stimulate demand for higher quality and more user-responsive products, thereby generating new demand for research and innovation and creating new opportunities for private sector engagement. Creating feedback loops between climate service providers and the research community will

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<sup>18</sup> See: <http://www.cafescientifique.org/>



help to ensure that product development and delivery models are both ‘demand-driven’ and ‘science-informed’.

- Inclusion of planning for climate service development within national and regional development agendas will aid sequencing of activities in a programmatic way, engagement of the private sector and coordination of donor support with special attention paid to gender issues.
- Development, testing and promotion of standard tools, products and protocols, along with knowledge sharing protocols, will lead to increased integration of climate information into development planning decision making processes as well as driving further innovations (EC, 2015).

### Proposed Indicators

- Participatory market mapping of climate services at national and regional level leading to the development of at least three National Roadmaps and one Regional Roadmap for Inclusive Climate Services.
- Several tens of millions of rural households (including women and vulnerable groups) access and use new and improved climate services targeted climate information, seasonal forecasts and early warning on weather extremes.<sup>19</sup>
- At least in three countries of the region, decision makers have access to and are using new standards and protocols for integrating climate information into risk assessments.
- Local organisations report accessing locally relevant climate services through new private-sector led business models.
- At least one regional forum interacting regularly with intermediaries and producers, with active participation from organisations representing women and vulnerable groups.
- Ministries from across the participating countries integrate climate services into development policy and planning with mainstreamed gender approaches.
- Sector strategies, action plans and investment plans are being climate-proofed.<sup>20</sup>


### Linking with other Programmes

The M4P and PMSD are approaches to poverty reduction that various donors – amongst them DFID and the Swiss Agency for Development and Cooperation (SDC) – have been actively promoting over recent years. Projects and programmes adopting these approaches have typically focussed on productive sectors (agriculture, livestock etc.) and on improving the provision of basic services. More recently, efforts are being made adapt and apply these methodologies within the climate change and DRR sectors.

Examples include work being carried out by Practical Action under the *Global Flood Resilience Alliance*. In Nepal and Bangladesh, Practical Action is leading some action-research to bring together its disaster risk reduction work with its market system development expertise to research and test how the identification, assessment, promotion and protection of key supply and value chains can enhance flood risk reduction,

<sup>19</sup> This figure is based on the potential of ICTs, and in particular mobile telephones, to facilitate the delivery of climate information and services to a vast number of rural populations.

<sup>20</sup> Various methodologies could be used to develop this indicator, such as the GIZ *Climate Proofing for Development* tool available here: <http://climateplanning.org/tools/climate-proofing-development> or the Asian Development Bank 2012 Report *Guidelines for Climate Proofing Investment in Agriculture, Rural Development, and Food Security* which suggests the following six activities are carried out for making decisions around climate proofing: i) Project risk screening and scoping ii) Impact assessment iii) Vulnerability assessment iv) Adaptation assessment v) Implementation arrangements and vi) Monitoring and evaluation



preparedness and response. This area of work will build on Practical Action's Emergency Market Mapping and Analysis (EMMA) and PMSD approaches.<sup>21</sup>

Another example is *Katalyst*, a jointly funded programme of the SDC, DFID, the Canadian International Development Agency, and the Netherlands, and implemented by the Government of Bangladesh and GIZ International Services. Katalyst uses a pro-poor market approach to link rural entrepreneurs, including farmers, with ICT based information channels and services. Activities have included:

- Creating strategic linkages between telecommunications companies and input providers;
- Providing training to 'agri-helpline' call centre staff;
- Linking community radio and TV channels to commercial sponsors;
- Developing agricultural journalism courses; and
- Establishing Television Rating Points: feedback loops for rural views top rate information services<sup>22</sup>

### Potential Partners

SDC, CIDA, and GIZ are currently adopting market and value chain approaches within the region and may be interested in piloting work in the climate services sector.

## 4.2 Component 2: Strengthening global-regional-national networks for climate services into use

### Overarching Objectives

This component aims to strengthen the national-regional-global networks of climate observation, monitoring, research, modelling and service programmes to enable better management of climate related risks by filling gaps in seamless provision, improving accessibility and geographical inclusiveness of data sharing, and formulating clearly defined service agreements for data products and support (technical manuals, training).

The provision of climate services at local levels in South Asia will benefit from enhancing coordination, availability and use of monitoring and prediction data generated by national, regional and international organizations – this has been demonstrated to date by the Severe Weather Forecast Demonstration Project (SWFDP), which employs a “cascading forecast” methodology in which regional centres in Africa synthesize and add value to predictions from global centres and disseminate consolidated products on to NMHSs to facilitate early warnings.

<sup>21</sup> See <http://policy.practicalaction.org/policy-themes/disaster-risk-reduction/partnerships-drr/zurich-flood-resilience-alliance> and <http://policy.practicalaction.org/policy-themes/markets/participatory-market-systems-development>


<sup>22</sup> Katalyst Information Channels Sector Brief available here: <http://katalyst.com.bd/information-channels/>



#### Box 4 Suggested Roadmap for Strengthening Global, Regional and National Networks

- Analyse existing linkages / collaborations between global, regional and national institutions dealing with climate services in the South Asian region
- Create a platform to bring together climate information providers, intermediaries and users, to promote better understanding of the diverse and evolving needs of user groups –especially the last mile – and to jointly identify, design and implement strategies and actions targeted to improve the responsiveness of climate information and services to these needs
- Identify locations to implement pilot studies that engage a range of key partners at national and sub-national scales (see Annex 13)
- Package the information for end users based on their needs and taking into consideration such factors as communications methods, literacy and gender
- Establish methodologies to automatize value addition to sector-focused advisories, test these with end users to assess applicability and set up continuous feedback mechanisms for evaluation and improvement. It is very difficult to manually customize climate services to the needs of individual farmers. Hence, ICT based software programmes can be developed to automatically pick the weather based agro-advisory. This process involves the following steps:
  - i. Current weather information taken from AWS network and transmitted to the centralised server
  - ii. Weather data from AWS and forecasting models used to generate 6-day weather forecasts at block level
  - iii. Practical use of observed and forecasted weather data enhanced by value addition through agro advisory services. Pest and diseases forewarning based on this data with relatively usable accuracy can also be generated and issued to farmers
  - iv. Creation of block and (major/staple) crop specific agro advisory database
  - v. Registration of local stakeholders, including farmers, into the database along with their requirements for climate services
  - vi. Development of web-based software for selecting tailor-made agro advisories for individual stakeholders. This is automatically uploaded and sent as SMS/voice mail (which increases penetration level of the service provided) to end users in a timely fashion
  - vii. Impact assessment, monitoring and evaluation to provide feedback on relevance and timeliness of automatized agro advisory services
- Strengthen the use of ICTs to reach last mile user communities
- Frequently assess blockages and barriers for the uptake of climate services and test feasible options to overcome them
- Provide training to intermediaries for the effective communication of uninterrupted, timely, effective climate services

This component is also concerned with developing the technical capacities to design and deliver co-developed weather and climate monitoring and prediction products. The South Asia region is extremely diverse in terms of the availability and effective use of climate related information with India and Bangladesh currently leading the way (see Box 5). While many products are already available from regional centres, evidence indicates that these are not currently being taken up at the national level due to difficulties in interpreting and



applying the information. For example, the DFID Science for Humanitarian Emergencies and Resilience (SHEAR) scoping study revealed that further efforts are required to support development planners to understand and adapt risk assessments to sector plans, implementation and monitoring. Similarly, users frequently report difficulties in understanding the relevance of top-down climate data for their everyday lives.

**Box 5 Examples of Climate Information Services provided free-of-charge in India by the Indian Meteorological Department**

- **Daily Weather Forecasts:** Contain detailed forecasts (probability of rainfall and changes in temperature) for the following day. Also contain data on rainfall over the past 24 hours, as well as maximum and minimum temperatures of the previous day
- **Weekly Agro-meteorological Bulletins:** Contain observed climate statistics for the previous seven days, including spatial and temporal characteristics of rainfall, temperature, humidity and winds at national/sub-national levels. Also provide the weather forecast for the next seven days
- **Monthly Climate Outlooks:** Monthly updates of rainfall and temperature for different agro climatic zones. Contains statistics on observed weather parameters like rainfall and temperature against long-term means. Also provides probabilistic outlook for the next month as 'above normal/ normal/ below normal'
- **Seasonal Climate Outlooks:** Provided to farmers and the general public during the main rainfall seasons, June to September (Southwest monsoon), and October to December (Northeast monsoon). Information also given on the previous season in terms of rainfall and temperature, performance of crops and observed impacts. Other information includes the onset and cessation dates and distribution of seasonal rains based on selected analogue years. The South Asian Climate Outlook Forum (SASCOF), in collaboration with NMHSs of South Asian countries and partners provides a platform for interaction between providers and users of seasonal climate consensus forecasts downscaled to national levels for decision-making in agricultural production and food security, health, water and energy resources management
- **Special bulletins:** Provided according to need, containing climate updates and timely information on major regional climate stresses and impacts associated with extreme climate events such as drought and floods. During the time of cyclones, bulletins can provide a tracking of the progress including place and time of anticipated land fall and wind speeds, especially useful for emergency planners and humanitarian relief coordination
- **Tailored information:** In some of the South Asian countries like India tailored information is provided to farming communities using ICT tools and software. Insurance companies and Community Based Organizations also benefit from these services for strategic planning. Climate information provided includes onsets and cessation dates of different climatic aspects for localised places, distribution of rains including amount and time, climatological maps, climate change vulnerability assessment maps, observed climate change indices for specified places, and advice on types of crops to be grown for particular regions, among many others



## Possible Activities

- I. Strengthening Regional Climate Outlook Forums (RCOFs) and National Climate Outlook Forums (NCOF) focussing on their role in regional level coordination and dissemination of monitoring and prediction products, increasing the capacity of NMHSs and sector organisations to attend and contribute to the RCOF process. Since RCOFs are infrequent activities (typically 1-3 times a year) the theme would also be concerned with developing ways of maintaining coordination and services on a continuous operational basis. Special attention should be paid to ensuring the involvement of organisations representing women and vulnerable groups within these forums.
- II. Establishment of pilot projects for the co-production of climate information and services (see Box 6). Co-creation between users, intermediaries and suppliers would lead to the development of a suite of products tailored to different sectors and users, as well as toolkits and methodologies, all of which could be used to feed into training programmes in the same country(ies) and subsequently scaled-up to regional level. There are currently few initiatives in this area and DFID could add considerable value by building capacity amongst key user groups (development planners and 'last mile' users in particular, see Annex 13) to co-create, uptake and feedback on climate information and services. These processes would be expected to explore issues related to communicating and handling forecast uncertainty (such as integrating statements on the likelihood/ possibility of such occurrences). As such this links to component 3 research activity A XI. Organisations like the Bangladesh Centre for Advanced Studies (BCAS) are experienced in converting weather data (both micro and macro) into useful information to inform decision making in agricultural livelihoods. These experiences could be replicated in different contexts. Likewise, there is coordination potential with the planned extension of the WMO's Severe Weather Forecasting Demonstration Project (SWFDP) to South Asia. Special attention should be paid to ensuring the involvement of women and vulnerable groups, and their representative organisations, in these processes.

### Box 6 Transforming climate information for end user needs in the agriculture sector, possible steps

- Retrieving available past data for assessing agro-climatic zone specific trends
- Gathering data on a real time basis (from multiple sources AWS/ conventional / non-conventional) and archiving in a unified format
- Collecting climate information (different time and spatial scales) including seamless weather forecast information for specific agro-climate zones and archiving this in a unified format
- Creation of agro-climatic zone and crop-specific agro advisory database using crop weather interaction studies
- Development of software to generate tailor made weather based advisories for various stakeholders
- Upload agro advisory information onto a website or disseminate via other ICTs/ media channels (e.g. SMS / radio / voice mail) to increase penetration levels, provided with the help of appropriate business arrangements
- Conduct impact assessment (physical / economical / social) on the advisory services
- Continuous monitoring and validation of the advisory system



III. Deliver training and awareness raising programmes aimed at:

- i. Building capacity within the public sector for interpretation and application of climate information (including risks assessments) in planning processes. This should involve raising awareness around how to interpret and handle uncertainties in data and climate service products (linked to component 3, activity B VII).
- ii. Building capacity amongst producers and intermediaries to transform climate data into useable tools. This should be a participatory process and could form part of the pilot projects mentioned above. This will be complimentary to component 1.
- iii. Building skills amongst intermediaries (media, NGOs and extension services in particular) to close communications gaps between last mile users and climate information providers. This could involve testing and scaling-up work by the CGIAR CCAFS to develop good practice training materials for the communication of climate information services to farmer communities (May et al. 2013). Another option would be to develop agricultural/climate change/DRR journalism courses with national universities.
- iv. Raising awareness amongst last mile users of the possible impacts of short- and medium-term climate change on their decision making and livelihoods (see Table 2.1) and to evaluate the usefulness of climate services for making timely choices and mitigating negative impacts. This is linked to component 3, activity B VI.
- v. Supporting women farmers to connect to new sources of information (building on findings in CCAFS 2013 and WMO 2015a).

The supply/intermediary/demand interface would be strengthened as part of the pilot and training components by involving participation of the user groups mentioned under component 1 in co-production processes.

IV. Develop new and upgraded tools for transforming climate information into tailor made products. These could include:

- a. Spatial data services network to address natural resources management and sustainability concerns
- b. Automatic generation and communication of crop specific, location specific weather based agro advisory services (expressed in probabilistic terms) to the last mile through ICT innovations
- c. Developing open chain ICT networks with public, non-governmental and multilateral organizations
- d. Developing closed vertical ICT-enabled supply chain networks for agribusiness enterprises

V. As recognised at the Met Office workshop (Annex 12), strengthening demand is not the same as demonstrating the value of climate services (Box 7). Some tools have already been developed (e.g. WMO 2015 and CSP Working Group on Economic Valuation)<sup>23</sup> which could be used to pilot projects to showcase value-added by climate services in the agriculture and DRR sectors (and others). As noted in section 3, the WMO would be an obvious partner for growing capabilities in this area. Other potential partners include USAID, GFDRR and the Climate Services Partnership.

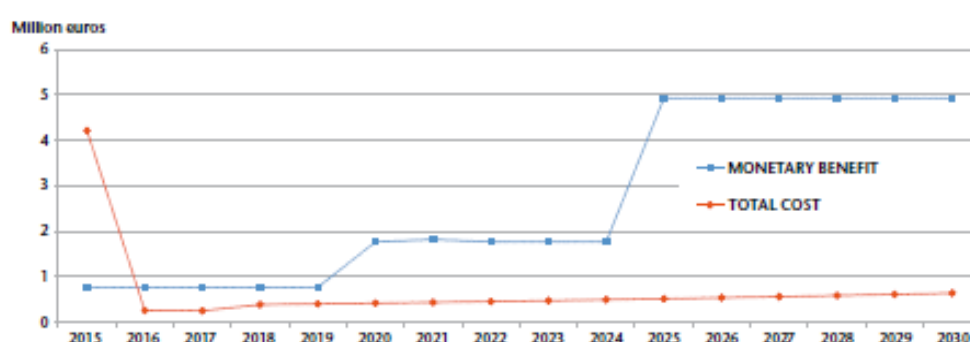
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<sup>23</sup> The WMO 2015 publication includes a range of case studies and references to recent efforts to quantify the benefits of climate services.

## Box 7 Socio-economic Evaluation of Improving Met/Hydro Services for Bhutan (WMO 2015)

The study covers the effects of climate, weather forecast and early warning services. The study is forward looking meaning that the assessed services are not yet provided. Therefore it provides an estimate of net socio-economic benefits generated once the observation, data processing and forecasting systems are installed and functioning, and the consequent new services are fully available.

The cost/benefit ratio based on the Net Present Value is approximately 3.1 when considering the high initial costs of modernizing the Department for Hydrology and Meteorology. The yearly benefit increases substantially in 2025, up to 8-9 when the benefits of historical data start to accrue.



**Figure E.5. Annual quantifiable direct benefits and costs of improved weather, hydrological and climate services in Bhutan**

Source: Pilli-Sihvola et al. (2014)

- VI. Similarly, pilot studies could be run for the participatory evaluation of climate services through action research involving communities and other key sub-national and national users (see Annex 13). The Climate Services Partnership Working Group on Climate Service Evaluation has been carrying out some initial investigations into climate service assessment methodologies.<sup>24</sup> Likewise, CCAFS and the World Agroforestry Centre (ICRAF) are leading the research-based monitoring and evaluation component of the Global Framework for Climate Services (GFCS) Climate Services Adaptation Programme in Africa, to assess the value and usefulness of climate services being provided to farmers and pastoralists in Tanzania and Malawi.
- VII. Replicate and scale-up successful initiatives for delivering climate services to the last mile through ICT and alternative interventions, with a particular focus on reaching the most vulnerable populations and ensuring gender issues are properly explored. This should include building on experiences with radio in Bangladesh and IT based systems in India (e.g. eAgromet) as well as exploring alternative options, such as through extension services, village knowledge centres, and pictorial communications that may be more appropriate for reaching out to illiterate farmers.

<sup>24</sup>

See (see: <http://www.climate-services.org/content/climate-service-evaluation>).



### **Geographic Focus**

Pilots could be developed, replicated and scaled-up across all DFID South Asia's priority countries to provide cross-contextual information on the effectiveness of different methodologies, toolkits and communications strategies in different sectors. India and Bangladesh appear to be fairly well-served by recent and on-going initiatives, thus an alternative option could be to focus on Burma, Nepal, Pakistan and Afghanistan only.

### **Timescale Focus**

Five years including a three year phase for pilot projects and a two year scale-up phase

### **Sector Focus**

The agriculture sector is strongly influenced by weather and climate in South Asian countries and employs the majority of people in the region. Focusing on agriculture would help to ameliorate possible future declines in agricultural productivity that could result from climate change.

Under future climate change scenarios it is likely that the frequency of extreme events such as cyclones, storms, floods and droughts will increase, thus the DRR sector also represents a logical focus for this component.

An alternative could be to focus on the productive sectors such as agriculture, energy and water.

### **Potential Key Outcomes**

- Strengthened links and data sharing between national, regional and international climate organisations – supported by service agreements;
- Strengthened regional service dissemination through RCOF and RCC activities – including more continuous services (updates), more seamless forecast provision, dissemination of more sector-focused products serving regional and national resilience planning.
- A long-term aim would be integrated climate services hubs disseminating a range of co-developed services covering, for example, agricultural, health, energy advisories as well as hydro-meteorological outputs.
- Increased demand for climate services from the last mile resulting in increased funding and support for NHMSs, user and intermediary organisations.
- Improved access to climate service by last mile user groups.
- Frameworks for improved “last-mile” delivery to local communities and improved social inclusiveness particularly with regard to women.

### **Potential Indicators**

- New and upgraded toolkits for transforming regional and global prediction information into climate and sectoral impact data.
- Increased numbers of trained personnel at NMHSs, Regional Climate Centres (RCCs), user and intermediary organisations in participatory processes of climate services development.
- An increase in the number of Regional Climate Outlook Forums (RCOF) meetings.
- Improved timeliness of co-produced early warnings.

- Improvements in agricultural productivity and/or resilience of farmers through the use of climate information<sup>25</sup>.
- Strengthened links and data sharing between national, regional and international climate organisations – supported by service agreements.

### Linking with other programmes

- *Can Seasonal Climate Forecasts Improve Food Security in Indian Ocean Rim Countries?* 2012-2014 project led by IRI University of Colombia and CSIRO and sponsored by AusAid. The work in India and Sri Lanka aims to enhance food security by reducing agricultural production risks associated with climate variability and climate change, and by developing a blueprint for improved climate information usage across case study regions in the Indian Ocean Rim. IRI's role and involvement focuses on improving seasonal climate forecasts, and testing their value in farming systems based on hindcasts. DFID could support scaling-up of testing seasonal climate forecasts in farming systems across South Asia."<sup>26</sup>
- *Scaling Up Climate Services for Farmers in Africa and South Asia*. CGIAR Climate Change and Food Security Initiative (CCAFS) with support from USAID, Climate Services Partnership, WMO. In 2014, the programme published *Scaling up climate services for farmers: Mission Possible. Learning from good practice in Africa and South Asia*, which presents lessons learned from 18 case studies that have developed and delivered weather and climate information and related advisory services for smallholder farmers. Key lessons from the 2014 report considered in the design of this component include:
  - Establish partnerships that bridge the gap between climate, agricultural research and farmers.
  - Exploit scalable communication channels to reach 'last mile' users. CCAFS experience indicates that "expanding access to climate services for smallholder farmers is best accomplished through a combination of leveraging the reach and cost-effectiveness of ICTs (e.g. SMS, rural radio, voice recordings, call services); and working through trained staff of boundary organizations (agricultural extension, NGOs, Community Based Organizations, agri-business) and farmer facilitators who can facilitate the face-to-face dialogue that is needed to deal with the complexities of seasonal climate information." (Tall et al. 2014).
  - Continuously assess to improve quality of service delivery, in particular to understand costs and benefits of climate services which can be used to build a case to governments and donors for continued and perhaps increased investment.
  - Proactively engage, and target the needs of, the most vulnerable and marginalized, particularly women.
- *Climate Research and Information Services in South Asia (CRISSA)*. Under this programme DFID is already funding research into operationalising integrated flood risk management in Eastern India, which could inform climate information transformation and co-production processes.

<sup>25</sup> Baseline information already collected by the CCAFS in South Asia could be used to measure whether farmers' resilience is rising or falling, and could be adapted to develop baselines on other 'last mile' user groups. See: <https://ccafs.cgiar.org/baselines#.VdC4iPI2EZh>

<sup>26</sup> See: <http://iri.columbia.edu/our-projects/can-seasonal-climate-forecasts-improve-food-security-in-indian-ocean-rim-countries/>



- A number of the *ICIMODs* regional projects have recently come to an end. Potential can be explored for scaling-up development and testing of climate service applications and products/rapid response mapping across the region, in particular supporting usage for decision making in priority sectors. ICIMOD has strong capacity in implementing training and transboundary and river basin initiatives in the region. Three information systems run by ICIMOD that can be tapped for this component are explained below:
  - “The MENRIS programme encompasses long-term monitoring, database development, and uptake of knowledge for the region. The system will use the concept of trans-Himalayan transects to help address the information gaps across the Hindu Kush Himalayan region. ICIMOD will work with partners to employ the information at community, national, regional, and global levels.”<sup>27</sup>
  - “The Regional Database Initiative (RDI) ensures the integrated management of centre-wide data and information incorporating geospatial, socioeconomic, and multi-thematic data at different levels. This initiative will develop appropriate policies for facilitating data and information sharing and technical specifications for the design, development, and management of data and information systems. RDI is proactively forging partnerships with a range of institutions and with other Regional Programmes and Initiatives for the development and operationalization of information systems. The Initiative is also interested in collaborating with national, regional, and global partners for product development and dissemination using emerging technologies.”<sup>28</sup>
  - “SERVIR is a regional visualization and monitoring system that integrates earth observation information, such as satellite imagery and forecast models, together with in situ data and other knowledge for improved and timely decision-making. Support scaling-up of training, testing and use of the SERVIR system. Sponsored by USAID, NASA and ICIMOD.”<sup>29</sup>
- *Science for Humanitarian Emergencies & Resilience (SHEAR)* funded by DFID, National Environment Research Council (NERC) and Economic and Social Research Council (ESCR) up until 2020. The gaps that SHEAR leaves are seasonal to sub-seasonal forecasting and in bringing existing knowledge and tools into operation, areas suggested for DFID intervention in components 2 and 3.<sup>30</sup> The work in Asia focuses on landslides and links to floods and earthquakes. It will look at how forecasting and EWS can be developed for specific hazards, especially linking risk models and forecasting to develop impacts based forecasting and multi hazard risk assessment. The focus will be in Nepal and Bangladesh.
- India’s Integrated Agrometeorological Advisory Service (AAS) programme has been operating since 2008, reaching more than three million farmers. The success of India’s AAS programme was a result of substantial investment in creating a network of strong centres of excellence in meteorological forecasting, as well as agricultural research, including human and technical capacity. It is recommended that DFID seek to transfer lessons from this experience to other countries across South Asia including:
  - Bridging the gap between climate forecasters, agricultural research and user communities and ensuring that climate information and advisory services are

<sup>27</sup> For further information see: <http://www.icimod.org/?q=9124>

<sup>28</sup> For further information see: <http://www.icimod.org/?q=9452>

<sup>29</sup> For further information see: <http://www.icimod.org/?q=9354>

<sup>30</sup> Interview with Nicola Ranger, Climate and Environment Advisor, DFID



- relevant to the decisions being made by stakeholders (covered under component 2)
- Integrating climate services with other development interventions to enable effective management of climate-related risk
- The Programme for Implementing the Global Framework for Climate Services (GFCS) at Regional and National Scales which is financed by the Department of the Environment of Canada. The Improved Climate Services and Frameworks at the Regional and National Scale in South Asia including the “3rd Pole” (Himalaya and Tibetan Plateau region) which includes:
  - Developing a plan for the establishment of domestic meteorological telecommunication networks with local stations for Afghanistan and Bhutan
  - Establishing National Climate Outlook Forums in selected countries
  - Part-funding up to three Regional Climate Outlook Forums(RCOFs) per year (one for each ‘season’)
  - The Asian initiative “Climate Himalaya” focuses on the countries of Bhutan, India, Nepal and Pakistan that aims at sharing knowledge, capacity building and climate adaptation.

### Potential Partners

- The Asian Development Bank established the Climate Change Fund (CCF) in 2008 to facilitate greater investment to effectively address the causes and consequences of climate change. Activities targeted include development of knowledge products and services related to climate change, although it does not appear much has been funded in this respect to date (see Section 3).
- The Coordinated Regional Climate Downscaling Experiment (CORDEX) Regional Downscaling run by the World Climate Research Programme Options under consideration for phase II indicate some shared priorities with the proposed regional programme, in particular:
  - Tailoring regional climate information towards updated regional climate assessments and truly operational regional climate services
  - Understanding the added value of regional climate information for decision making, and the challenges of uncertainty
  - Developing a critical mass of multi-model multi-method experiments to encourage uptake of CORDEX data for regional climate analysis and VIA assessment
  - End-to-end pilot studies over selected sub-regions to provide test - beds to explore a range of critical issues

CORDEX South Asia is headed by the Indian Institute for Tropical Meteorology (IITM), Pune, and any active collaboration would probably take place through this organization.

- SAARC Disaster Management Centre (SDMC). Runs a range of relevant training programmes, for example on geoinformatics for disaster management and incident command systems. The Centre is implementing the South Asian Disaster Knowledge Network (SADKN) portal which provides:
  - Access to clear, understandable and user-friendly information about real time, impending and historical disasters, details of hazards, vulnerabilities and risks



- of disasters in structured layers of digitized maps in WebGIS platform, and wealth of resources, references, images and videos.
- Instant geospatial support for assessing risks and communicating about hazards and the exposure that vulnerable people and infrastructure have to these hazards and assist them in locating disaster occurrences and probable fall outs, and taking important decisions regarding evacuation, damage and loss assessment, recovery and risk reduction.

In 2008, SDMC members agreed to creating a Natural Disaster Response Mechanism to adopt a coordinated and planned approach to meet emergencies. A draft agreement signed in 2009 but little action appears to have been taken.

With considerable political traction and engagement with different levels of government, scientific and technical organisations as well as local communities, the SAARC SDMC is a key partner for developing actions related to the DRR sector, particularly the development, dissemination and testing of risk management tools. DFID could explore opportunities to co-fund with USAID activities resulting in the implementation of the regional Natural Disaster Response Mechanism.

### **4.3 Component 3: Multi-disciplinary research to support co-design and development of climate services for the region and strengthen regional climate science leadership**

#### **Overall Objectives**

To implement a multi-disciplinary regional climate services research programme that promotes climate resilience, building on existing regional partnerships and promoting learning and exchange between policy makers and applied scientists.


The regional dimension will be reinforced in three ways: (i) focusing on regional or cross-border challenges in food security and/or DRR; (ii) involvement of regional climate centres working on seasonal forecasting, climate change or disaster risk management and (iii) involvement of researchers in two or more neighbouring countries.

In addition the overall programme could include a focus on a specific geographical area or areas, e.g. “small” trans-boundary, headwater river basins (e.g. the Kosi, Kandak, Teesta Rivers) that are often not the focus of attention, mountainous areas in Nepal, India, Burma or populous coastal zones of India, Bangladesh and Burma. This would increase the impact, as well as the value for money.

Climate resilience will be promoted at the operational scales of early warning systems, sub-seasonal and seasonal forecasting as well as ensuring that existing climate and climate change information is incorporated into long term decision making. The seasonal forecasting scale is perceived as a significant gap in the context of existing DFID research<sup>31</sup> and uptake of the outputs of existing regional centres could be strengthened.

Policy makers and other decision makers are more likely to be impacted if the research is organised around specific decision making processes (see examples below) or if there is secondment/exchange of research scientists into appropriate government departments or intermediaries such as NGOs. In addition co-production of research with vulnerable

<sup>31</sup> Based on discussions with DFID Research and Evidence Division that outlined the focus of other research programmes.



communities will lead to research outputs and eventually services that have a greater impact. This links to component 2.

The overall outcomes will include stronger links between institutions in different countries in agriculture, DRR and food security, stronger links between scientists (or other ‘producers’ of climate information and decision makers), improved longer term data sharing and use of seasonal forecasts and climate information to inform decision making.

## Research topics

This component incorporates research activities across two sub-themes:

- a) Research to promote implementation and use of existing “best data” and existing products and, where there are gaps, to co-design, develop and trial new services; the focus on existing information is pragmatic and reflects responses of interviewees who perceived the greatest barriers on the “demand side” of climate services<sup>32</sup>. As the focus is on the pull-through of existing climate science, this will involve social science and action research to ensure that climate information is communicated effectively, timely, salient and actionable<sup>33</sup>.
- b) Underpinning climate, impacts, adaptation and vulnerability research – filling gaps in understanding and modelling of the climate system needed to develop priority services in Asia. Priority areas include climate observations and monitoring, reconstruction of high resolution data, seasonal forecasting, downscaling regional information, statistical down-scaling techniques, integrating data from in-situ and remotely sensed data sources and development of climate and socio-economic scenarios for longer term planning.

The need to make better use of existing forecasting products was also highlighted in a survey of ASEAN NMHSs on long range forecasting, which was discussed at the ASEANCOF-1 meeting in 2014<sup>34</sup>. This could be the main research contribution of this programme and is likely to be lower risk than designing a programme that relies on improved data sharing or solely on capacity building of researchers in each country.


For underpinning research, universities and research centres in several South Asian countries (India, Bangladesh) are already advanced in climate services, for example in Indian Institute Of Tropical Meteorology and the energy and resources institute, TERI, interact with the Indian Government and play an important role in regional data provision. These institutes already have ongoing bilateral research with the UK and other countries (see Evidence Review). Research on the predictability of the Asian Monsoon or tropical cyclones could be an extension of ongoing research collaborations, which should have lower overheads and costs than developing new projects. Research capacity in other countries, such as Burma, needs to be developed further, potentially through secure tenured positions in climate adaptation and resilience and in environmental research in general.

## Possible Activities

<sup>32</sup> This was discussed with staff at DFID’s Research and Evidence Division but also reflects the fact that other research projects are focusing of the supply side, e.g. ADB is working with CSIRO on climate model data portals and similar portals have been developed by CCAFs specifically for agricultural and food security impacts work. See <https://ccafs.cgiar.org/spatial-downscaling-methods#.VaOy5P5FCCF>

<sup>33</sup> As promoted in the climate services literature, see the Evidence Review.

<sup>34</sup> <https://docs.google.com/presentation/d/1cW7Ozjf41uKrpLTk0puet6HtmOHY4wY7F7SdcjgFDIE/edit#slide=id.p15>

- 
- A. Research to promote implementation and use of existing “best data”<sup>35</sup> and existing products and, where there are gaps, to co-design, develop and trial new services (75% of research programme)
- I. Rapid scoping of current progress in ongoing regional initiatives such as CCAFS climate smart agriculture programme<sup>36</sup>, including climate impacts on agriculture, particularly rice production<sup>37,38</sup> and seasonal forecasting of crop yields<sup>39</sup>.
  - II. Identification of gaps and proposals for new research in agriculture and food security involving at least two neighbouring countries. The focus of agricultural research will be to increase productivity using climate information or to reduce risks (drought, pests and diseases, floods). This could build on work carried out by organisations such as Christian Aid for vulnerable communities in India have not only increased crop yields but reduced the levels of input required for irrigation, labour and biopesticides.
  - III. Research into the effective use of satellite information<sup>40</sup> and high resolution reanalysis<sup>41</sup> to provide trans-boundary data sets for DRR, agriculture, water and health including analysis of TRMM satellite data versus other gridded data products; development and validation of high resolution data of the past climate and demonstration of use in decision making, e.g. hydropower siting and design. Joint working with India, Nepal, Burma and Bhutan to develop an understanding of flood and water resources risks in mountainous environments and finally the development of open data on crop cover/types for input into national or regional risk models.
  - IV. Research to support development of effective RADAR for EWS in Afghanistan, Burma and Nepal; including research on the application on planned new installations (Nepal) and the development of business cases that highlight the benefits of effective forecasting in post-disaster situations.
  - V. Additional support for existing collaborations e.g. NERCs South Asian Monsoon research programme with India<sup>42</sup> or the Centre for Climate Research Singapore’s collaborative project with the Met Office Hadley Centre on the development of seasonal prototype products for the Southeast Asian region. This could involve secondment of scientists into the appropriate ministries (agriculture, water, disaster response) and/or be focused on making their ongoing research more demand led.
  - VI. Focussed research programme on regional agricultural drought for a range of crops and combining information on crop yields and weather indices to test

<sup>35</sup> The term “best data” refers to observations or model outputs that have been properly collected, checked and processed and are appropriate for task in hand. Anecdotal evidence suggests that lack of awareness, poor access to data, data loss etc. lead to the use of inappropriate or poor quality data in some contexts, e.g. dam designs based on very limited precipitation and flow data.

<sup>36</sup> <https://ccafs.cgiar.org/themes/climate-smart-agricultural-practices>

<sup>37</sup> <https://ccafs.cgiar.org/blog/project-helps-bridge-climate-science-policy-gap-southeast-asia#.VaOtxP5FCCE>

<sup>38</sup> <https://drive.google.com/file/d/0B5WDk-4vUwyZOC1LeHlyMWlsRm8/view?pli=1>

<sup>39</sup> <https://ccafs.cgiar.org/blog/new-tool-helps-monitor-crops-real-time#.VaOyMv5FCCE>

<sup>40</sup> The use of satellite data and planned C-band radar were highlighted at the Nepal country workshop

<sup>41</sup> High resolution reanalysis involves running numerical weather prediction or climate models at scales of the order of 4, 12 or 25 km and using coarser ERA-40 or ERA Interim reanalysis data as boundary conditions. This outputs more detailed historical data that reflects local conditions.

<sup>42</sup> “This programme aims to improve understanding of the variability of the South Asian monsoon. The focus is on developing a better understanding of processes driving variability, seasonality and predictability in the South Asian monsoon, with the goal of improving predictions on all timescales. This programme is a partnership with the Ministry of Earth Science (MoES) in India and will allow UK researchers to collaborate with Indian scientists to research the links between small-scale processes and larger-scale monsoon variability. NERC will fund the UK contribution to the programme and MoES the Indian contribution.” See: <http://www.nerc.ac.uk/research/funded/programmes/monsoon/>



- the applicability of index based insurance products (outside of India where they are quite well developed – see Evidence Review).
- VII. Research into access and use of information and effective communication of climate services in priority sectors such as agro-advisories and early warnings - especially for women and vulnerable groups. This may involve action research with vulnerable communities in selected countries to define their requirements, best modes of communication and possibly to redefine research goals for climate research on the monsoon<sup>43</sup>. Joint research with telecoms providers<sup>44</sup> on delivery of agro-advisories by mobile phone networks as well as radio and other communication channels. This links to the pilot studies described under component 2.
  - VIII. Development of appropriate tools, e.g. National Climate Information Centre (NCIC, UK) National River Flow Archives, land use surveys for curating regional and national data sets<sup>45</sup>. This may involve a trusted third party to curate regional data sets rather than immediate data exchange.
  - IX. Research with users in the agriculture and DRR sections to define user requirements and building on existing regional initiative such as SASCOF. Development of a climate service platform (such as Copernicus in Europe) to disseminate processed data and services may be an important aspect of components 1-4.
  - X. Research into how climate information can be effectively integrated into regional and national decision making including generating empirical evidence for improved decision-making in key sectors (in particular DRR, agriculture and water resources) predicated on the availability of climate data and services; of the relative efficacy of specific decision-making approaches using such data (e.g., RDM, real options analysis, adaptive management, portfolio analysis and so on); and on the implications of inherent and irreducible uncertainty in the use and interpretation of climate data. Development of information products could be incorporated in other existing programmes like CDKN or developed with existing regional centres, such as SASCOF, or selectively with national governments. Testing with a wide range of users.
  - XI. Research into understanding, communicating and handling uncertainties in data and climate service products in the DRR and agriculture sectors. This would involve at least two streams of activities: i) characterisation and quantifying of uncertainty components: ii) developing communications processes to convey the limits to predictability and managing the consequences of false alarms. Joint work between academia and climate information users (regional to last mile levels) will help strengthen co-production processes and feedback loops created within other activities suggested for this and component 2, in particular.
  - XII. Research to use data from in-situ and remotely sensed data sources<sup>46</sup> to i) inform impact assessments and consequent management strategies ii) provide climate monitoring datasets for some ECVs and iii) provide input to climate models for their simulations. This should draw on existing work funded through other channels (e.g. EU Copernicus Climate Change Service,

<sup>43</sup> For example, ongoing research by Bergen University and Bangladesh university partners has worked successfully with local communities in north-east Bangladesh to define user needs - <http://projecttracks.net/>

<sup>44</sup> There is considerable private sector activity in the mobile sector, even in Burma (see workshop report), that provide opportunities for delivery of climate services.

<sup>45</sup> The idea of third party curation of data was highlighted by one interviewee. This kind of approach has worked well in some major transboundary river projects in Europe (Rhine and Danube) and Asia (Mekong basin)

<sup>46</sup>



European Space Agency Climate Change Initiative (ESA CCI), European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT) Satellite Application Facility on Climate Monitoring (CMSAF). Satellite data sets are already available to be used (see <http://www.esa-cci.org/> or [http://www.cmsaf.eu/EN/Home/home\\_node.html](http://www.cmsaf.eu/EN/Home/home_node.html) or <http://www.copernicus.eu/main/climate-change>). This work could be particularly relevant to DRR and Early Warning in Afghanistan, Burma and Nepal where currently NHMS capacity is either very basic or basic.

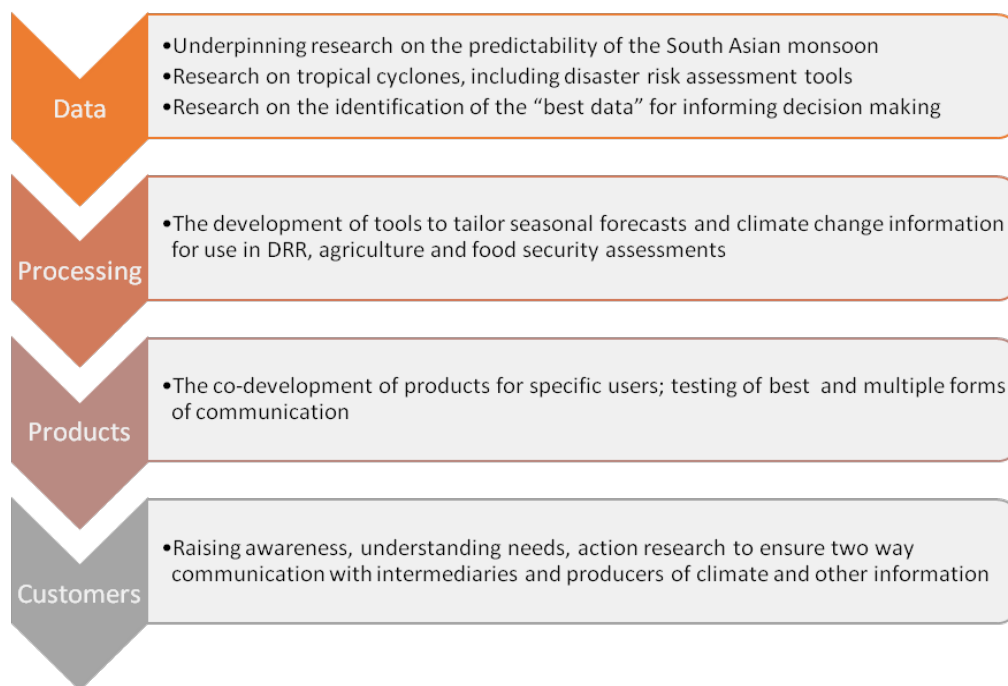
- XIII. Research the potential for remote sensing data to support the development of risk insurance schemes in the region.

B. Underpinning climate research (25% of research programme)

*Note that this research could be defined later in the programme after the needs of users are better understood.*

- I. Assessing and improving the skill of seasonal and sub-seasonal forecasting of the Indian Monsoon. Extension of ongoing UK/South Asia collaborations on the predictability of the South Asian monsoon.
- II. Seasonal forecasting of Tropical Cyclone activity and impacts of El Nino through further support of existing research programmes.
- III. Assessments to understand current RCM limitations when representing South Asia's complex topography at high resolution so that information is used with appropriate caveats.
- IV. Research to develop higher resolution Regional Climate Models (RCMs) for longer-term projections and policy planning, climate change risk assessment and multi-hazards assessment where these do not already exist.
- V. Research into statistical down-scaling techniques which might provide lower cost, less technical solutions, at least as an interim technology (to RCMs) (Wilby et al. 2009).
- VI. Research fellowship and studentship programmes for scientists in the least developed countries in South Asia e.g. Burma.
- VII. Research the availability or existence of impact relevant metrics to support decision making at different levels (see Table 2.1). For example, accurate seasonal forecasting of crop yields presupposes (ideally gridded) data on past agricultural productivity for model calibration (see for example, Kumar et al. 2004). Generating and/or collating this evidence will support the development of user-focused climate services within the agricultural section

In order to ensure adequate focus on users' needs, one possible approach is looking at the information chain and balancing the programme across the stages (see Figure 2 below, based on the flood forecasting process).



**Figure 2 Keeping user needs at the centre of climate information research**

### Geographic Focus

The need for assistance is greatest in Afghanistan, followed by Nepal and Burma. Having targeted research components that focus on specific areas within South Asia could prove effective. Examples of suitable geographically focused research topics include research into climate services to support risk assessment in cross-border areas in Nepal-India which would benefit farmers, or sustainable hydropower development (e.g. in terms of siting, hydrology, flood risk, firm yield) or climate services to support agro-advisories and risk assessments for farmers and fisherman in the Bay of Bengal, Irawaddy Delta, Rakhine State of Burma.

Notwithstanding, many of the research outputs, and in particular those under “underpinning climate research”, are best understood as regional public goods, since e.g., improved skill in forecasting the Southwest Monsoon is of benefit to all countries with climates influenced by the monsoon, irrespective of borders.

### Timescale Focus

Various climatic timescales, as described above. In terms of research duration, the timescale for such regional multi-disciplinary, research programmes should be a minimum of 36 months in order to guarantee that meaningful research can be carried out and generate impact.

### Sector Focus

The focus of the programme is on agriculture and DRR and the information requirements for these sectors were introduced in the Evidence Review (Chapter 3). Examples of the kinds of decisions that the research could focus on include:

- Emergency preparedness: Increasing the alert status if the monthly and 90 day outlooks indicate a risk of floods or droughts.
- Climate change adaptation policies: Development of allowances and design guidance for including climate change in the design of hydropower schemes or flood risk management programmes, including the use of consistent data and scenarios for schemes in the same catchment and across borders.

- Insurance: Risk assessment to support a rapid assessment of losses related to tropical cyclones, floods or droughts. This informs the level of humanitarian assistance required rapidly following a disaster as well as any index based insurance schemes.
- Agriculture: Providing information on the likely onset of the monsoon that may affect water management in large irrigation command areas, crop choice and planting dates.
- Food security: Crop productivity modelling to estimate yields and longer term food security.

### **Proposed Key Outcomes**

- Translation and wider use of existing seasonal forecasting products and climate change information and identification of gaps and requirements for new services.
- New monitoring and prediction climate services and user-led delivery formats co-researched and trialled with users and intermediaries.
- Development of translational science (“last mile” research) around social and behavioural issues to bridge gaps between climate science and decision making.
- Improved understanding and modelling of the South Asian climate system – including applications modelling and improved means of conveying prediction uncertainties and making decisions under uncertainty.
- Comprehensive assessment of weather and climate model performance – including relative benefits of statistical and dynamical seasonal forecasting systems.

### **Possible Indicators**

- The number of MSc and PhD graduates in climate service related subjects (e.g. meteorology, environmental science or climate change related fields) and number of job opportunities for these graduates.
- The gender balance of these graduates.
- Number of peer reviewed academic publications related to meteorology, environment or climate change.
- The increase in the number of scientists who are actively involved in international research programmes, conferences and co-production of academic papers at an international level.

Any research programmes should have a strong link to poverty reduction, economic development, health, DRR, agriculture (including forestry and fishery), and conflict reduction. For example, for a research programme focusing on the use and uptake of climate services in the agricultural sector, as well as having “academic-based” indicators detailed above, should also have more “pragmatic” indicators. For a climate services research programme focused on agriculture two examples could be: increases in crop yield, reduction in use of pesticides.

It is important that scientific research is translated into policy and practice. The importance of communicating research on climate services to decision makers and opinion leaders and policy makers is key in order for such research to be viewed as being “useful”. Measurable indicators could include:

- The number of policy briefs developed as a direct result of the research programme.
- How many methods generated by the research programme are put to regular use by relevant policy makers and other stakeholders connected directly to central and regional governmental bodies.

- The number of government institutions with strengthened research capacities to deal with climate challenges related to DRR, agriculture and health.

## Linking to other Programmes

For translational sciences, a range of on-going activities and pilots can be engaged with including the following. A special mention has already been made of SAWI as well as South Asia Climate Outlook Forum in the preceding sections.

- Zurich Programme on Flood Resilience – funded by Zurich and implemented by Practical Action group in Nepal, India and Bangladesh.
- CCAFS South Asia Programme implemented in several countries of the region including India, Nepal, Bhutan, Bangladesh, Burma etc. on promoting resilience in agricultural systems.
- University of Colombia research linking seasonal forecasting to food security and farming systems *Can Seasonal Climate Forecasts Improve Food Security in Indian Ocean Rim Countries?* The project was carried out in India and Sri Lanka to enhance food security by reducing agricultural production risks associated with climate variability and climate change, and by developing a blueprint for improved climate information usage across case study regions in the Indian Ocean Rim. DFID could support scaling-up of testing seasonal climate forecasts in farming systems across South Asia.
- University of Colombia *Decadal Prediction and Stochastic Simulation of Hydroclimate Over Monsoonal Asia*, which included, amongst others, work to create downscaled future climate scenarios to 2050, together with estimates of uncertainties via quantification of the full probability density function. Results and software should feed into any funded research into monsoon prediction and decision making, particularly relating to major reservoir management and irrigation schedules.
- During the first half of 2015, the JPI Climate and Belmont Forum launched a call to fund proposals to carry out collaborative research action on climate predictability and inter-regional linkages with a particular focus on “the drivers and mechanisms linking Poles and Monsoons for societal usefulness of climate services”.<sup>47</sup> Funding decisions will be announced early 2016 with projects expected to address one of more of the following 3 topics:
  - Understanding past and current variability and trends of regional extremes
  - Predictability and prediction skills for near-future variability and trends of regional extremes
  - Co-construction of near term forecast products with users

The amount of funding available is approximately 15 million Euros, with some support coming from NERC.

- CARIAS programme funded by IDRC and DFID and implemented by IDRC. The programme has network of consortia (comprising partners from the South and the North) conducting high calibre research and policy engagement in climate hot spots in Asia and Africa.

<sup>47</sup> The full announcement is available here: <https://igfagcr.org/cra-2015-climate-predictability-and-inter-regional-linkages>



- Consortium Hi-AWARE – Himalayan Adaptation, Water and Resilience – in Hindu Kush region of Himalayas. Toward short and long term climate trends and adaptation strategies, taking into account local and seasonal impact and responses. Implemented in Indus, Ganges and Brahmaputra river basins involving research groups in Bangladesh, India, Nepal and Pakistan.
- Consortium DECCMA – Deltas, Vulnerabilities and Climate Change. Implemented through research groups in Bangladesh and India, among others.
- DFID's Science for Human Emergencies and Resilience (SHEAR) programme.
- DFID's Building Resilience to Climate Extremes and Disasters (BRACED) programme.
- Return on Investment for Emergency Preparedness Study, a £5.6 million DFID funded research programme to quantify the cost and time benefits of a large and diversified investment portfolio of emergency preparedness interventions undertaken by UNICEF and WFP in 2014, covering Pakistan in South Asia. Covered Pakistan in Asia. Complementary research areas identified by the Final Report (The Boston Consulting Group 2015) include:
  - Further research into Early Warning system investments at a later stage of implementation or in other countries to demonstrate the cost savings from these interventions
  - Similar ROI calculations could be developed for preparedness interventions at the regional or global level
  - The differentiation between slow-onset emergencies (e.g., drought) and sudden onset (e.g., earthquake) and the relevant impact on preparedness approaches requires further exploration.

With respect to longer timescales, several NMHSs and technology institutes and universities are involved in climate change research including climate modelling and impacts, adaptation and vulnerability assessments. India has a large number of capable research institutes for climate research<sup>48</sup>, which are able to utilise a range of Numerical Weather Prediction and climate models. In addition, some of these institutes have well established bi-lateral research collaboration with the UK (see below). Other countries in the region are active in climate research, through NMHSs and universities, for example:

- Pakistan Meteorological Department (PMD) uses several international climate models, including the Met Office PRECIS model to produce regional climate information (Ilvas 2012; see Annex 2).
- Bangladesh Meteorological Department (BMD) has been working closely with the Met Office Hadley Centre to create a downscaled HadCM3 17-member ensemble from CMIP3 data, at 25km resolution on a domain covering all of South Asia, which provides projections for future regional climate (see Annex 2).
- Skymet (India) provides customised crop risk management through insurance services and has developed a credit risk analysis system for banks and financial institutions, that helps in targeting of priority sector lending.

<sup>48</sup> The National Centre for Regional Weather Forecasts (NCMRWF), The Energy Resource Institute (TERI), India Institute for Tropical Meteorology (IITM) and Universities such as Anna University's Centre for Climate Change and Adaptation Research.

- The Flood Hazard Model in Index-based Flood Insurance (IBFI) in South Asia (2015-2018) led by the International Water Management Institute will develop a meso-level IBFI scheme using flood hazard model and remote sensing data - to pre-determine flood thresholds that trigger speedy compensation payout. The project will involve national stakeholders like National Disaster Management Authorities, Ministries of Water Resources and Agriculture and private sector in particular insurance industry. At the local/village, the programme leverages from the field level experience of the CBOs, local civil society members, implementing NGOs, local government offices and local media to implement IBFI scheme.

### Possible Partners


- Working with the Asian Development Bank (ADB) on climate change knowledge and data portals, climate resilience and incorporation of climate change into investment decisions. ADB currently have projects with CSIRO on climate model data portals as well as many of the themes identified under component 3 working in all the target countries. This research could be linked to understand how users will make use of this information and how existing climate change portals might be extended further to include baseline and seasonal data. Other relevant projects include ADB Technical Assistance (TA) 7173: Strengthening Capacity for Managing Climate Change and the Environment; Component on Climate Data Digitization and Downscaling of Climate Change Projections for Nepal and the upcoming ADB TA 8572 on Action on Climate Change in South Asia, which will have climate services and climate data management components.
- Working with the World Bank on hydromet, transboundary early warning systems, and open data and with GFDRR on climate information for risk assessment. The World Bank has major programmes in these areas and DFID research could help to ensure that services developed are successful. DFID has developed a recent memorandum of agreement with the World Bank that included work in Bangladesh.
- Regional centres in South Korea and Singapore could be effective at providing research partners especially in the South-eastern part of South Asia to which they are geographically close.

## 4.4 Component 4: Improving Regional Trans-boundary Cooperation and Information Sharing

### Overarching Objectives

This component is concerned with fostering greater collaboration and political support for regional coordination leading to sustained improvements in climate data sharing across government ministries and agencies, with a focus on trans-boundary river basins as a starting point. This will lead to enhanced regional cooperation on climate services (generation, uptake and use) towards effective DRR, climate resilience and eventually sustained economic growth and development. The climate services will be effective, relevant, user-led and location specific. Improved regional trans-boundary cooperation and information sharing will also foster greater use of public domain (remotely sensed) data and tools.

While success could require high-level political leadership (Office of the Prime Minister/President/Ministers of Environment etc.), DFID's engagement strategy should also focus on facilitating local level interventions that produce direct and tangible benefits to communities in a short/medium term, likely to be popular amongst governments. One such example is the local level interventions being carried out by Practical Action under the Global



Flood Resilience Alliance, which, among other things, facilitates, implements and advocates cross-border flood risk management approaches between of Nepal and India (in the Koshi and Karnali River Basins as well as in Uttar Pradesh and Bihar). The project will document best practices, challenges and successes of bilateral and multilateral collaboration on information sharing and support for building community flood resilience.<sup>49</sup>

Other enabling factors such as institutional strengthening and improved technical, intellectual and intermediary resources are covered under other components.

Successful engagement of governments of the South Asian region will require evidence of the value of sustained regional trans-boundary cooperation for climate information and services – both in terms of safety of people and property and economic benefit. This is covered in components 2 and 4.

Shaping of climate services for river basins of major trans-boundary rivers would benefit from regional coordination, improved interface and standardised products and this is covered under component 2. This would allow for more seamless provision for trans-boundary applications and integrated involvement of Regional Climate Centres, while retaining NHMS autonomy on detailed national and sub-national services.

### Possible Activities

- I. Facilitating systematic regional dialogues among the governments/ para-statal/ other institutions at different levels, involving hydro-met data and information sharing towards DRR and early warning. This will include, for example, Ministerial level dialogues following up on the Bhutan Climate Summit for Living Himalayas of 2011, which had high level government support from Bangladesh, Bhutan, India and Nepal.
- II. Setting up regional knowledge platforms for peer-to-peer learning and sharing lessons and experiences building on existing functional networks such as the South Asia Climate Outlook Forums (national and regional). These forums should also be engaged in market development, co-production and research activities described in components 1, 2, and 3.
- III. Providing technical analysis to guide policy development at national level, on effective cross-border data sharing for EWS.
- IV. Explore opportunities for establishing training programmes between neighbouring countries to promote data sharing and joint work on modelling development of climate services for EWS.
- V. Bangladesh may not have adequate access to hydrological information from upper riparian countries but there are significant opportunities to develop early warning systems and forecasts from remotely sensed data (Hossain et al 2009). Satellite data sets are already available to be used (see <http://www.esa-cci.org/> or [http://www.cmsaf.eu/EN/Home/home\\_node.html](http://www.cmsaf.eu/EN/Home/home_node.html) or <http://www.copernicus.eu/main/climate-change>). There is planned work to provide a satellite precipitation dataset over the next 5 years as current datasets are limited.
- VI. Cross-regional links with the Association of Southeast Asian Nations (ASEAN) should be strengthened, noting that Burma is one of the ten member countries. Some exchange has already occurred (USAID-sponsored trip January 2015) and there is emerging dialogue and functional relations with some of the other countries covered in this scoping e.g. India<sup>50</sup> and Nepal.
- VII. Fund joint research projects between two riparian states. This can help to cement relationships and to open up lines of data sharing, as well as produce evidence

<sup>49</sup> See: <http://practicalaction.org/page/45644>

<sup>50</sup> See <http://www.asean.org/news/item/verview-of-asean-india-dialogue-relations> and <https://ideas.repec.org/p/iim/iimawp/wp00529.html>



showing/quantifying of the benefits of cross border collaboration for DRR/EWS as well as to strengthen resilience and greater socio economic development. This activity links to component 3.

- VIII. Fund pilot projects to improve communication across trans-boundary river basins and groundwater systems. There are models where various organisations within a region provide their data to an independent trusted third party that is then processed into a product that serves the whole region. This approach has been used in the Middle East to produce climate sets of rainfall and temperature extremes (Sensoy et al 2007). This activity links to component 2 and could be combined with piloting co-production processes.

## Geographic Focus

A programme of work could be established in one of the region's two major river basins covering Nepal/India/Bangladesh (e.g. Ganga basin) or Afghanistan/Pakistan. These areas are highly vulnerable to the impacts of climate change and disaster events (floods, landslides, earthquakes etc.) and, as such, DFID support to improve limited regional collaborations, especially with a focus on forecasting, early warning and communications, has the potential to impact at scale on lives, livelihoods, infrastructure and other economic assets.

These areas are accorded priority for the following reasons:

- A focussed initiative in these areas will bring about a step change in the uptake of services at the local level, owing to enhanced regional trans-boundary coordination.
- The areas have high population density, thus huge dividends and potential benefits likely in terms of saved lives and livelihoods and in promoting overall resilience.
- The relative vulnerability of these areas is high, while the adaptive capacities of the communities and local institutions is low.
- Even small interventions in these areas demonstrate potential for huge changes in mind set and orientations at different levels.
- There is considerable potential to mobilise and, if possible, integrate other regional frameworks and initiatives (SAWI of the World Bank, ICIMOD, South Asia Climate Outlook Forum, SAARC structures such as SAARC Disaster Management Centre and SAARC Meteorological Centre).
- Limited geopolitical barriers; starting in areas where the effort and investments required to bring the governments together will be modest.
- Strong groundswell for enhancing uptake of climate services in these areas, also because of the fact that these areas are repeatedly ravaged by floods, year after year.

A second option for geographical focus could be a programme of work that focuses on smaller trans-boundary headwater basins that are overlooked by recent and on-going initiatives (for example, in Nepal/India) and where the topography makes climate information more difficult. Another option would be to focus on the less studied but high risk trans-boundary basins like the Salween or Irrawaddy. Coastal areas represent a fourth option, with clear demand articulated from Bangladesh, Burma and India (see workshop proceedings), which are also pertinent given current refugee crises.

Other units of geographic focus might include islands in the Indian Ocean and transboundary aquifer systems (e.g. Gangetic alluvial system), soil, groundwater and wetland salinization (e.g. Sundarbans mangrove ecosystem), regional air pollution (e.g. Malé Declaration). The latter may provide an entry point for diversifying the sector focus (e.g. by involving health ministries in transboundary health- and air-quality projects).



## Timescale Focus

Given the potential overall objective of the Regional Climate Services project in South Asia, a possible approach could be to focus on timescales where the capacities already do exist and where the benefits for regional cooperation could be demonstrated expeditiously, sowing seeds for intensification of engagement in future. This will be in climate monitoring – from now-casting (for example for severe weather and flood situations) to medium term to sub-seasonal and seasonal in the face of climate variability (drought and potential floods).

## Sector Focus

The overall focus could be on improving communication, coordination and governance, hydromet data and information sharing and for translating climate information into impact indices across DRR, water, agriculture and to some extent health. Given the challenges in uptake at national and sub-national levels, it is suggested that the focus be on DRR, water and possibly agriculture. An alternative could be to focus on the health sector precisely because so little has been done there to date.

A peer review of the Stakeholder Analysis has highlighted a range of other concerns including transboundary aquifer management (e.g. Gangetic alluvial system), regional air pollution (e.g. Malé Declaration), as well as soil, groundwater and wetland salinization (e.g. Sundarbans Mangrove Ecosystem). Some may provide entry points for diversifying the sector focus (e.g. by involving health ministries in transboundary heat- and air-quality projects). It is recommended that DFID explore interest at national level since these issues were not explicitly raised at the workshops or during one-to-one consultations.

## Proposed Key Outcomes

- Deepened trans-boundary dialogues on enhanced regional trans-boundary cooperation on climate services, across disciplines (DRR, agriculture and water) and across range of stakeholders, including at ministerial level.
- Enhanced knowledge base on climate services at regional level.
- New incentives for increased sharing of climate data and relevant climate impact data held by non-meteorological agencies e.g. crop yield and malaria statistics.
- Increased demand for climate services from government resulting in sustained funding and support for NMHSs, user and intermediary organisations.
- Evidence showing the benefits of cross-border collaboration for DRR and EWS.
- Improved integration of national climate services and information exchange for trans-boundary units.
- Strengthening of links among national, regional and global climate organisations.

## Potential Indicators


- At least in three countries of the region, including India, freer data sharing and policies and guidelines towards regional trans-boundary cooperation are in place and functional.
- At least three NMHSs using and sharing improved data sets, supporting design and production of new and improved climate services.
- At least one regional forum for knowledge sharing strengthened/promoted.
- Several hundreds of thousands of households living in international river basins are able to use improved climate services developed through cross-boundary collaboration.

- At least 20 local organisations in the collaborating countries are reporting access to new and improved climate services developed through cross-boundary collaboration.
- At least three co-produced climate products, based on enhanced regional coordination, are being delivered on time to various organisations and reported to be effective.
- Greater use of public domain (remotely sensed) data and tools
- Greater interoperability of data, tools and platforms
- Increased number of joint research projects and personnel exchanges

### Linking with other Programmes

- Activities should complement recent/on-going trans-boundary work such as the South Asia Water Initiative (SAWI) in the Himalayan river systems, the Zurich Global Flood Resilience Alliance working in Nepal, India and Bangladesh, the South Asia Regional Hydromet Program, The Establishment of a Regional Flood Information System in the Hindu Kush Himalayan Region (HKH-HYCOS), and the South Asia Water Governance Programme (SAWGP), amongst others.<sup>51</sup>
- The ICIMOD HKH HYCOS programme, for example, promotes timely exchange of flood data and information for reduction of flood vulnerability within and among participating countries (China, India, Nepal, Pakistan, Bangladesh and Bhutan) through an established and functioning platform.
- The SAWI Phase II (2013-2017) expects to generate information around the data sharing required to operationalize flood early warning and hosts a biennial knowledge forum to build stronger collaborative relationships across the research community. There also appears to be scope to work alongside SAWI to provide knowledge and dialogue support to new cooperative agreements between countries. Lessons learned from phase one of the SAWI (World Bank, 2013) provide the following important pointers that have been considered in the selection of activities for this component:
  - Key ingredients for contributing to an enabling environment for regional cooperation include a combination of enhancing the knowledge base, cultivating a platform for high-level multi-stakeholder dialogues and enabling significant innovative investment and institutional development in different countries.
  - Strengthen partnerships and enhance capacity to build greater local acceptance, more needs-based and relevant activities, and greater impact at the policy and decision-making levels.
  - Regional and trans-boundary cooperation needs to be connected to national policy development and implementation, thereby addressing the concerns of individual governments in delivering sustainable, fair and inclusive development and climate resilience. As the same time, the ownership of the cooperation agenda must be entirely with concerned riparian countries, in order to ensure commitment and endurance. Invited third-party facilitation by trusted brokers and convenors can be useful.
  - Explore national and existing trans-boundary forums and mechanisms. Although regional programmes (such as ICIMOD) provide solid and effective partnerships, the range of engaged stakeholder groups should be widened to

<sup>51</sup> Full summaries of these programmes, their aims and achievements are included in Annex 4: Intervention Mapping of the Evidence Review



include civil society and to improve gender equity. Deliberative processes should reflect this diversity.

### **Potential Partners**

The principal donors and multilateral development banks providing funds for similar initiatives are the World Bank and ADB. Other donors include the UNDP, the Royal Norwegian Embassy, Australian DFAT, SDC, FAO, JICA, IFAD, and Zurich Insurance. World Bank and ADB show most potential for linking into and building on on-going work.



## Annex 1 Preliminary Intervention Options based on Evidence Review

**Table 7 Preliminary Intervention Options for Strengthening the Supply of Climate Services**

Priority Activities <sup>52</sup>	Scope	Timeframe	Opportunities	Challenges	Factors governing implementation	Complexity of implementation <sup>53</sup>
<b>Strengthen capability of NMHS to supply demand oriented climate services</b>						
Promote the development of a clear roadmap for climate services in South Asia tailored to the GFCS Framework and oriented to meet demand for information in the region	Regional	Long term	<p>This will provide a useful bridge between the global and national frameworks</p> <p>Considerable scope for value addition and contribution to regional cooperation</p>	<p>Huge diversity (in infrastructure, technology, knowledge, capacities, human resources) in the state of development of climate services in different countries in the South Asia region</p> <p>Translating concept to operational reality has enormous challenges</p>	Most challenging as geo political barriers are involved	3
Strengthen the capability of NMHSs to utilise available climate products from GPCs and RCCs for end-user interests	National	Short to medium term	<p>High potential for value addition with modest investment (a 'low-hanging fruit')</p> <p>Can be effectively combined with other activities to strengthen NMHSs</p> <p>Existing standard tools publicly available, such as those from the UK National Climate Information Centre.</p>	<p>Not enough existing knowledge about whether products from GPCs and RCCs meet current and future needs , especially in countries with least developed NMHSs</p>	<p>A number of actors engaged in this area already, with a number of ongoing programmes and interventions</p> <p>Complexities of interventions are manageable</p> <p>Geo-political factors do not offer any serious barriers</p>	1
Promote the development of standard climate services toolkits together with accompanying training modules designed to support	National and Regional	Short to medium term	<p>Good opportunity as this paves the way for effective regional exchanges and collaboration</p>	<p>Efforts required to produce tool kits relevant to the South Asian region as a whole</p>	<p>Number of actors already engaged is possibly small</p> <p>An unexplored area</p>	2

<sup>52</sup>

**First, Second, Third**

<sup>53</sup>

1 to 3 (Easy – Difficult – Most Challenging)



Priority Activities <sup>52</sup>	Scope	Timeframe	Opportunities	Challenges	Factors governing implementation	Complexity of implementation <sup>53</sup>
the generation and use of climate information and prediction products that meet user needs, especially women and vulnerable groups			<p>Helps set up standards and enforce the same at the regional level</p> <p>Contributes to building gender equality and supporting the empowerment of women and vulnerable groups in decision making processes</p> <p>Avoid proliferation of substandard and inconsistent tools by implementing set of standards and establishing certification process for new tools</p>	<p>Requires complementary activities</p> <p>Deep rooted gender bias in countries of the region</p>	<p>No major geo-political barriers</p> <p>Can capitalise on the lessons already available and ongoing work at the regional (i.e. CCAFS) and global levels</p>	
Support National Climate Outlook Forums and similar platforms to strengthen their presence and capacity and improve two-way communication between NMHSs and end users in priority sectors	National	Short to medium term	<p>Is in the nature of improving interface between producers and users</p> <p>This is fundamental to effective functioning of regional climate outlook forums</p>	No major challenge at the national level	<p>No major geo political barriers at the national level</p> <p>Political will is required for effective functioning of the regional forums</p>	1
<b>Strengthen Regional and National Observational Network Capacity</b>						
Support a more complete regional network for regional forecasting on various time scales and to provide better climate information for a range of applications including climate risk assessment	National/Regional	Short to medium term	<p>Closely linked with and complementary to the first priority action</p> <p>Offers good potential for enhancing the role of advanced regional Indian centres</p>	<p>Will need to be preceded by an assessment of the ground situation with regards to current infrastructure and capacity</p> <p>Will have to be in tune with national plans for strengthening NMHS and ongoing interventions</p>	<p>A number of actors engaged in this area already, with a number of ongoing programmes and interventions</p> <p>Complexities of interventions are manageable</p>	2



Priority Activities <sup>52</sup>	Scope	Timeframe	Opportunities	Challenges	Factors governing implementation	Complexity of implementation <sup>53</sup>
			<p>Opportunities to support existing programmes like SAARC, SASCOF, FOCRAII, APAN etc.</p> <p>Opportunity to strengthen regional integration of basic NMHSs like Afghanistan, Burma and Nepal, through regional and bi-lateral initiatives, as well as strengthening links with national governments</p> <p>Other regional and global providing centres, as well as other more developed NMHSs in the region, can be brought in as key partners</p>	<p>This alone will not automatically lead to enhanced regional cooperation on climate services</p> <p>Considerable capacity building involved at the national level</p>	Geo-political factors do not offer any serious barriers	
Raise the capability of least developed NMHSs (Burma, Afghanistan and Nepal) by at least one level, including the revival of silent stations, implementing new networks and exploring the use of non-traditional observations	National	Short to medium term	<p>Opportunity to strengthen the base for a meaningful regional initiative towards effective and demand-based climate services</p> <p>Helps in integration of non-traditional observations and private sector networks</p> <p>Opportunities to join hands with the WMO, World Bank, JICA, ADB, USAID and others who are active in weather and climate services</p>	<p>Will have to be preceded by an assessment of the ground situation with regards to current infrastructure and capacity</p> <p>Will have to be in tune with current national plans for strengthening NMHSs and ongoing initiatives</p> <p>Resource intensive</p> <p>This step alone will not automatically lead to</p>	<p>A number of actors are already engaged in this area, with ongoing programmes and interventions</p> <p>Complexities of actions are manageable</p> <p>No significant geo-political barriers</p>	1



Priority Activities <sup>52</sup>	Scope	Timeframe	Opportunities	Challenges	Factors governing implementation	Complexity of implementation <sup>53</sup>
			(including in strengthening infrastructure) in the region	enhanced regional cooperation  Considerable capacity building will be involved at the country level		
Support research to better understand RCM limitations when representing South Asia's complex topography at high resolution	Regional	Long term	Better application of regional models in weather forecasting and climate scenarios  Initial learning should be drawn from the Met office / Bangladesh project	Long time to yield impact	Global climate research and development organisations better placed to support this research	3
<b>Support innovative research programme that strengthens all aspects of climate services, while building capacity of South Asia research community</b>						
Launch an interdisciplinary research programme to respond to major knowledge gaps and build global-regional-national partnerships, learning and exchange. Priority areas include climate observations and monitoring, reconstruction of high resolution data, seasonal forecasting, and downscaling regional information and scenarios	Regional	Long Term	Inter-disciplinary research caters to knowledge gaps relating to both supply and demand side of climate information	Vast scope  Take long time to yield meaningful results	Essentially a technical research area, better left to the global research and technical organisations working in climate sciences and services	1
Promote research to explore potential of index based insurance facilities in South Asia. In particular, building capacity for estimating medium and long term hazard risks and supporting development and testing of	National / Regional	Long Term	Good opportunity to understand and address issues of risk transfer mechanisms to benefit the poor  Can draw on work being undertaken in South East	Long time frame to yield results  Index based insurance is effective only if backed by good functional infrastructure to provide information on indices	No significant geo-political barriers	1



Priority Activities <sup>52</sup>	Scope	Timeframe	Opportunities	Challenges	Factors governing implementation	Complexity of implementation <sup>53</sup>
risk insurance products for low income sectors.			Asia, funded by the World Bank, GFDRR and ADB	Needs to be backed up by adequate re-insurance facilities  Appetite for climate/weather insurance in South Asia region still poor.		



**Table 8 Preliminary Intervention Options for Strengthening Demand for Climate Services**

Priority Activities <sup>54</sup>	Scope	Timeframe	Opportunities	Challenges	Factors governing implementation	Complexity of implementation <sup>55</sup>
<b>Strengthen interface and relationships between providers of climate information, intermediaries and users, especially from priority sectors</b>						
Increase and improve meaningful interactions among actors in complex information chain involving primary producers, intermediaries that process and add value add to this information, making it more relevant and useful for different sectors and types of users	National	Short to Medium Term	<p>Enables sectoral (rather than generic) risk assessment</p> <p>Enhances relevance and applicability of climate services, if made available on a timely basis</p> <p>Comprehensive risk information for effective decision making</p> <p>Helps in tailoring and targeting products</p> <p>Potential for linking into and benefiting from ongoing activities and programmes such as SHEAR, Global Flood Alliance, South Asia Disaster Knowledge Network</p>	<p>Weak governance at the national and sub-national levels in different South Asian countries</p> <p>Will involve considerable investments in capacity building and communication systems</p>	<p>Work already in progress in various countries at the national/ sub-national level</p> <p>Can capitalise on global experiences on the subject</p> <p>No major geo-political barriers anticipated</p>	1
Strengthen inter-country communication systems and dissemination of climate information and services to priority users such as monsoon forum groups and the agriculture and health sectors	Regional	Medium to Long term	<p>Facilitates regional cooperation on information sharing</p> <p>Essential for coordination of DRR and effective and sustainable early warning systems</p>	<p>Will require political commitment at the highest level and sustained engagement at a regional level</p> <p>Equal participation of all South Asian countries required for success</p>	<p>Complexities involved in design and implementation</p> <p>Geo-political barriers represent a considerable challenge</p>	2

<sup>54</sup>

**First, Second, Third**

<sup>55</sup>

1 to 3 (Easy – Difficult – Most Challenging)



Priority Activities <sup>54</sup>	Scope	Timeframe	Opportunities	Challenges	Factors governing implementation	Complexity of implementation <sup>55</sup>
			Potential to join hands with SAARC Disaster Management Centre, SAARC Met Research Centre and other initiatives including those proposed by the World Bank (in Nepal, Bangladesh and Bhutan)		Initial efforts could be limited to a few countries along trans-boundary river basins (e.g. China, Nepal, India and Bangladesh)  Lessons and experiences gained could be put to use for scaling-up into region-wide efforts	
Promote de-securitisation and declassification of trans-boundary water and climate and data information in South Asia to enhance public access to this information and increase regional collaboration	National	Short Term to Medium Term	Offers immense potential for improving the effectiveness of early warning systems and disaster risk reduction, and eventually towards climate compatible development	Mistrust and extreme reluctance of the governments of the region to share water flow related information as regards trans-boundary rivers  This information is treated as confidential and sensitive by governments to protect national interests during water sharing conflicts and negotiations  Political will and transparency required at the highest level	Will involve considerable political will and sustained engagement	3
Support capacity building amongst priority user groups to translate and interpret risk assessments into clear recommendations or plans of action	National	Medium to Long Term	Offers considerable opportunity to improve take-up and use of existing tools by target user communities, as well as influence the design of future products  Potential for creating a meaningful space for exchange and learning between producers of climate	Weak governance issues at different levels  Diversity in terms of infrastructure, capacities, knowledge, skills, expertise, technologies and institutions in different countries among the key users of climate information and services	No major geo political constraints involved  Would mean working with national and sub-national actors and capitalising on global experiences and lessons  Part and parcel of National and Sub-	1



Priority Activities <sup>54</sup>	Scope	Timeframe	Opportunities	Challenges	Factors governing implementation	Complexity of implementation <sup>55</sup>
			<p>information together with users and intermediaries</p> <p>Fundamental for building the effectiveness of early warning, disaster risk reduction and climate adaptation efforts</p> <p>Twin benefits of DRR in the short term and climate adaptation in the long run</p> <p>Many potential partners could be brought on board e.g. World Banks, USAID, CGIAR, CSP</p>		National Climate Change Action Plans in many countries of the region	
<b>Strengthen regional networks to generate knowledge on climate products and services</b>						
Establish regional networks between farmers' associations, DRR practitioners and water user groups to enhance the exchange and use of climate knowledge products and services	National/Regional	Short to medium term	<p>Opportunities for promoting regional cooperation in climate services, on a sectoral basis, which is more effective</p> <p>Formation of regional user networks will help strengthen feedback mechanisms, thereby influencing the provision of climate services in such a way that they are in tune with the needs and priorities of different user communities</p> <p>ICTs available to facilitate networking</p>	Regional networks are effective when they involve face-to-face meetings in addition to virtual exchanges. A travel regulation between countries of the regions (especially visa requirements) represents a major constraint.	<p>Some experiences and lessons available on regional cooperation, especially in the area of water governance can feed into the design and planning of initiatives</p> <p>an area where not much information is currently available</p>	2



Priority Activities <sup>54</sup>	Scope	Timeframe	Opportunities	Challenges	Factors governing implementation	Complexity of implementation <sup>55</sup>
Support the establishment of regional advisory teams comprising subject matter specialists in priority sectors and NMHSs to help improve the relevance of climate information and services to priority sector decision making needs	National/ Regional	Short to medium term	<p>Opportunity to improve coordination with end users and enable service providers to design/modify their products their outputs in tune with the needs of users in priority sectors</p> <p>Will support cross-regional collaboration</p> <p>Regional advisory teams could provide an excellent platform for improved interaction between users, intermediaries and providers</p>	The interface and interactions between government departments and the NMHSs in most countries of the region are weak and ineffective, even at the national level	<p>Some experiences and lessons available on regional cooperation, especially in the area of water governance can feed into the design and planning of initiatives</p> <p>an area where not much information is currently available</p> <p>No significant geo political barriers</p>	2
Support collaboration and knowledge transfer between the regional CORDEX so as to strengthen the capabilities of stakeholders in each country in providing efficient and useful climate services to the end user communities	National/ Regional	Short to medium term	<p>The CORDEX model is showing strong buy-in from the science community and is gaining momentum internationally</p> <p>Opportunity for DFID to support an on-going programme of work, especially building understanding around the value of regional climate information for decision making, building the pool of available data for downscaling and supporting sub-regional pilot studies (see Annex 4 in Evidence Review)</p>		<p>Opportunity to build on the successes and learning from CORDEX Africa</p> <p>No significant geo political barriers</p>	2



Priority Activities <sup>54</sup>	Scope	Timeframe	Opportunities	Challenges	Factors governing implementation	Complexity of implementation <sup>55</sup>
			CORDEX South Asia represents a key research partner			
<b>Promote more effective use of ICTs</b>						
Supporting the integration of national climate information and ICT initiatives into everyday functioning of government, while at the same time investing in new and cost effective information and communication technologies	National	Short to medium term	Opportunities in this area include high level of growth/innovation of ICTs for development in some countries of the region such as Bangladesh and India (e.g. Climate Services through Community Radios)	<p>High level of capacity building required</p> <p>ICT infrastructure will involve financial investments</p> <p>High bandwidth connectivity will be required for some ICTs</p> <p>Rate of obsolescence of technologies is high</p>	<p>A number of actors are already engaged in this area, with ongoing programmes and interventions that DFID could build on</p> <p>Complexities of actions are manageable</p> <p>No significant geo-political barriers</p>	1
Support scaling up of successful experiences where ICT tools have been used for more effective and efficient dissemination of climate information to end users	Regional/ National	Long term	<p>Good opportunities for information and knowledge sharing on methods and methodologies</p> <p>Experiences are available in the region on effective use of ICT tools in dissemination of climate information</p> <p>Leveraging the full potential of ICTs for climate services, particularly agro-meteorological advisories to smallholders, would bring significant improvements in livelihoods in South Asia</p>	<p>Current capacity and infrastructure constraints will need to be dealt with</p> <p>High bandwidth connectivity required for some ICTs</p>	<p>Global climate research and development organisations better placed to support this research</p> <p>No significant geo-political barriers</p>	2



## Annex 2 Stakeholder Consultation Methodology

Stakeholder engagement has been conducted through workshops, semi-structured interviews and bilateral discussions involving a wide range of experts with interests over a range of socio-economic sectors including both users and providers of climate information in South Asia. A full list of interviewees and workshop participants is included in Annex 3.

Workshop delegates and interviewees were selected by national climate change and other sectoral experts within each of the focus countries to ensure broadly even representation from climate providers (NMHS and private sector), donors, national level government department/ministry officials (particularly from the agriculture, DRR and water sectors, as prioritised by DFID), academic, research and resource/knowledge organisations and NGOs, civil society organisations and other 'practice' organisations, with special attention paid to those who work with vulnerable groups. This selection was made with support from the core consultancy team and DFID advisors.

It is recommended that further consultations be held at sub-national levels to ensure that the views and opinions of the full range of users and intermediaries be incorporated into the design of programme activities taken forwards by DFID under the proposed programme. For a comprehensive list of intermediaries and users at sub-national and 'last mile' levels within the DRR, agriculture, water and health sectors, refer to Annex 13.

### Semi-structured Interviews

Semi-structured interviews were designed and conducted by core team members based in South Asia and the UK. A total of 67 face-to-face and telephone interviews of order 30 minutes duration were conducted, 32 with climate information users 11 with climate information providers, 32 with intermediaries and 24 with donor organisations.<sup>56</sup>

Users interviewed were involved in activities covering the South Asia region with interests in the five focus sectors of this scoping study, namely Disaster Risk Reduction, agriculture, water, health and energy. Climate service providers interviewed included National Meteorological and Hydrological Services (NMHSs) and the Regional Climate Centre - the Indian Meteorological Department (IMD). Together the climate providers have responsibilities for services to a wide range of users including regional, national and local governments, UN agencies, NGOs, water and river basin authorities, farmers groups, fishers, media and entities with regional remit – such as RIMES, were also consulted.

Wider consultations have taken place with international experts in a range of organisations covering broad categories of donors (e.g. World Bank, Asian Development Bank, USAID, DFID, CGIAR CCAFS) policy (e.g. WMO), climate service provision (e.g. WMO, UK Met Office), and INGOs with intermediary remit (e.g. Practical Action).

The semi-structured interviews were carried out during two phases: extension workers. Other

- i. During the Evidence Review (April to June) based around the discussion points below, with most emphasis on barriers and possible intervention options:
  - Key actions and decision dependent upon climate information and services;

<sup>56</sup> These numbers do not add up to 67 since many interviewees were from organisations that can be considered both intermediaries AND users. The same could be said for donors, however the distinction has been kept for the sake of providing this breakdown.

- Current use of and (future) need for climate information and services;
- Current capacity for providing/using climate information and services;
- Barriers to the provision and uptake of climate information.

The interview template is provided in Annex 4.

ii. During late June/early July, based around the two sets of preliminary intervention options that had been developed for the Evidence Review. These discussions were focused on exploring needs, priorities, challenges and opportunities related to the two sets of intervention options, as well as the questions included below. Opinions on the priority investments and activities needed were also canvassed.

- What are the regional initiatives currently under implementation in the area of climate services, as per your knowledge and information?
- Which initiatives are functioning well and why? Which ones are not doing well and the possible reasons?
- Are available climate services meeting the users' specific requirements in regards to formats, timings, details etc.?
- What forums are available at the national/regional level for the various stakeholders to interact and how effective are they?
- Do you see justification for furthering regional/ national cooperation in climate services in addressing DRR, early warning, climate adaptation etc.?
- Is DFID best placed to address these? Or could DFID collaborate with existing organisations and strengthen current on-going regional/ national initiatives

## Workshops

A total of four national workshops were held in New Delhi, Dhaka, Islamabad and Yangon. A full list of participants and summaries of discussions are provided in Annexes 5 to 8.

A total of 67 face-to-face and telephone interviews of order 30 minutes duration were conducted, 32 with climate information users 11 with climate information providers, 32 with intermediaries and 24 with donor organisations

After consulting with key stakeholders, it was decided that a workshop in Nepal would not be possible due to many actors being involved in on-going earthquake rehabilitation efforts and/or travelling out of the country. Similarly, the Afghanistan workshop could not go ahead due to security issues. Both the Nepal and Afghanistan workshops were replaced by semi-structured interviews (see Annex 3 for a list of interviewees).

The structure of the workshops focused around discussing and prioritising the two sets of intervention options, and covered the same guiding questions as were used in the semi-structured interviews as listed above. A sample agenda is provided in Annex 11.

Where it was deemed strategic and relevant, follow-up one-to-one discussions were also held with certain workshop participants after the events.

In addition, the Met Office held an internal workshop to discuss and prioritise the intervention options with specialists covering international development, observations, international meteorology and climate science. Notes from this workshop are provided in Annex 12.

### Annex 3 Interviewees

Name	Position/Institution	Organisation Type
Dr. Vidhisha Samarasekara	Senior Climate Change Specialist, ADB	Donor
Arif Md. Faisal	Environment Specialist, ADB	Donor
Prof Dr Syed Anwarul Huque	Professor (Retired), Department of Soil Science, Bangladesh Agricultural University (BAU), Mymensingh, Bangladesh. Formerly Senior Agriculture Specialist, Bangladesh Centre for Advanced Studies (BCAS)	Intermediary/User
Tohidul Islam	Associate Specialist Engineer, Flood Management Division, Institute of Water Modelling (IWM)	Intermediary/User
Dr Kamala Gurung	Gender and Social Inclusion (GESI) Coordinator, Practical Action South Asia Regional Office	Intermediary/User
Farhana Shamin	Programme Manager, Practical Action Bangladesh	Intermediary/User
Nicola Jenns	Climate and Environment Advisor, DFID	Donor
Tim Waites	Senior Livelihoods Advisor, DFID	Donor
Sarah Brown	Lead Consultant and International Projects Manager, Climate Change Adaptation and Disaster Risk Reduction, Practical Action Consulting UK	Intermediary/User
Nicola Ranger	Climate and Environment Advisor, DFID	Donor
MVK Shivakumar	World Meteorological Organization, Geneva	Provider
LS Rathore	Director General, India Meteorological Department (IMD)	Provider (NHMS)
BP Yadav	Scientist, IMD	Provider (NHMS)
KK Singh	Director, Agromet Unit, IMD	Provider (NHMS)
Leo Sebastian	Regional Program Leader, CCAFS, Southeast Asia	Donor
Udaya Regmi	International Federation of Red Cross and Red Crescent Societies, (IFRC) Burma	Intermediary/User
Catriona Clunas	DESA Livelihoods Advisor, DFID Burma	Donor
Noriko Takagi	Deputy Representative, UNHCR Burma	Donor
Mr.Kyaw Lwin Oo	Director, Department of Meteorology and Hydrology, Burma	Provider (NHMS)
Ahmed Kamal	Member, National Disaster Management Authority (NDMA), Pakistan	Intermediary/User
Dr. Qazi Talat	Director, Federal Flood Commission (FFC), Pakistan	Intermediary/User
Zahid Mahmood	Director, Water and Power Development Authority (WAPDA), Pakistan	Intermediary/User
Dr. Azmat Hayyat	Director, National Drought Monitoring Centre, PMD, Pakistan	Intermediary/User
Adil Naseer	Coordinator, APGA, All Pakistan Geoscientists Association, Pakistan	Intermediary/User
Dr. Sajidin Hussain	Senior Programme Officer, Area Development and Management Consulting (ADMC), Pakistan	Intermediary/User
Dr. Bushra	Associate Professor, Department of Environment International Islamic University, Pakistan	Intermediary/User
Chaudhry M. Aslam	Director, Agro-Meteorological Centre, Pakistan Meteorological Department	Provider (NHMS)
Mr. Muhammad Munir Sheikh	Head, Climatology & Environment Section, Global Change Impact Studies Centre (GCISC), Pakistan	Intermediary/User
Dr. Muhammad Mohsin Iqbal	Head, Coordination & Agriculture Section, GCISC, Pakistan	Intermediary/User
Mr. Mujahid Hussain	Director, People Empowering & Development Alternatives (PEDA), Pakistan	Intermediary/User
Anirban Ganguly	DFID India	Donor
Aloke Barnwal	DFID India	Donor



Name	Position/Institution	Organisation Type
Dr. Nafees Meah	RCUK	Donor
Ms Aditi Paul	India Country Programme Manager, CDKN	Donor
Rob Wilby	Professor of Hydroclimatic Modelling, Loughborough University	Intermediary/User
Peter Burgess	ECHO New Delhi	Donor
Mr. Talha Jamal	ECHO New Delhi	Donor
Juliet Field	BRACED, DFID	Donor
Fergus McBean	CHASE, DFID	Donor
Peter D'Souza	CHASE, DFID	Donor
Mr. A. P. Singh	TATA Chemicals	Intermediary/User
Mr. Asad Ahmed	TATA Chemicals	Intermediary/User
Ms. Aditi Kapur	Alternative Futures	Intermediary/User
Roger Street	Technical Director of UK Climate Impacts Programme at Oxford University and Special Adviser to the EC on climate	Intermediary/User
Simon Bor	World Bank	Donor
Jenny Frankel Reed	USAID (scheduled for 13 <sup>th</sup> August)	Donor



## Annex 4 Evidence Review Interview Template

<b>Interviewee (Name, Position)</b>	
<b>Contact</b>	
<b>Name and type of organisation<sup>57</sup></b>	
<b>Geographic scale of work (sub-national/ national/ multi-country/ regional/ global/ high risk areas?)</b>	
<b>Website</b>	
<b>Role of organisation in climate services (donor/ producer/ intermediary/ user)<sup>58</sup></b>	
<b>Sector (agriculture &amp; food security, water, DRR etc.)</b>	
What are the key activities and decisions that are dependent on climate and related information?	
What information do they need to make decisions/take action?	
What action do users take now to mitigate/adapt to weather and climate? What actions would they take if they: a) received timely, relevant information, and b) had the resources and opportunity to act on the information and services?	
How do they want to receive climate information and services?	
What barriers are they aware, which will impact or inhibit provision or flow of climate information?	
How do they want to be involved in the development of weather and climate information and services to better support their decision making?	
What capacity for <b>implementation of climate services</b> exists within the interviewee's organisation/ more generally within the country/region? Record any key points related to: <ul style="list-style-type: none"> <li>Type and sophistication of existing climate services</li> <li>Governance</li> <li>Level of capacity (or producers and users)</li> <li>Partnerships</li> <li>Dialogue, outreach, feedback, M&amp;E processes</li> <li>Strategy/plans for future engagement in this area</li> </ul>	
What are the key achievements/barriers and opportunities relating to <b>accessing climate data/services</b> within the interviewee's organisation/ more generally within the country/region? Record any key points related to: <ul style="list-style-type: none"> <li>Quantity/quality/timeliness</li> <li>Timescales of interest (historic/short/medium/seasonal/decadal+)</li> </ul>	

<sup>57</sup> For example: Donor, research institute, government agency, NGO, civil society organisation etc.

<sup>58</sup> Can be multiple categories



<ul style="list-style-type: none"> <li>• Focus (sector/scale/social groups – vulnerable groups, women etc.)</li> <li>• Access channels</li> <li>• Partnerships</li> </ul>	
<b>WHICH RECENT/ON-GOING/PLANNED INTERVENTIONS SHOULD WE BE REVIEWING AS PART OF THIS SCOPING STUDY?</b>	
<b>RECORD ANY OTHER ISSUES THAT THE INTERVIEWEE WISHES TO SHARE</b>	





## Annex 5 India Workshop Proceedings

### Stakeholder Consultation on Options Analysis for Regional Climate Services towards effective disaster risk reduction, early warning and climate adaptation

India Meteorological Department, New Delhi, 9<sup>th</sup> June, 2015

#### Introduction:


Chairing the National Consultation event, Dr Surinder Kaur of India Met Department (IMD) welcomed the participants. She mentioned that the South Asia region as a whole is intensely vulnerable to disasters as well as impact of climate change, which highlights the importance of timely, accurate and locally relevant climate information, which should promote effective measures towards early warning, disaster response, disaster preparedness and climate adaptation. She felt that the Consultation should help in exchange of ideas and perspectives on climate services, especially at the regional level, both from the supply and demand points of view. She thanked DFID and PAC for organizing the Consultation.

KR Viswanathan and Prof Geetha Lakshmi provided an overview of the current initiative and the progress achieved so far.

#### Summary of Discussions:


The views/ observations/ suggestions/ perspectives expressed by participant-stakeholder during the discussions which ensured are captured as follows:

- a. Several initiatives have been launched by the government, parastatal, non-government/voluntary as well as private sector in the country in the area of climate information/ value added climate services. We are not sure if anyone has the comprehensive overview of this. Nor are these fully documented, as many of such programmes are being implemented at a local level. **It is likely that some of these pilots and experiments have proven very useful and possibly have rich lessons to offer. It is, therefore, important to systematically document experiences** in the frame of these initiatives together with the local context in which these are implemented.
- b. In the last few years, the NMHSs in the South Asia Region have expanded their reach/services considerably and are constantly in the process of upgrading their observation systems, data analysis and processing together with dissemination of climate information through various sources and media. **The richness and frequency of climate information has gone up multi-fold in the country. Yet, neither the users nor those who could represent them (e.g. sectoral departments) are proactive in their engagement with the NMHS in effectively articulating the demand and needs of climate information of the users at the grassroots level.** This work is often left to the NMHSs themselves.
- c. While the importance of disseminating and sharing relevant climate information to all the potential users in all the areas of the country cannot be disputed, it is clear that **the immediate priority should be accorded to focus our efforts on the disaster prone regions eg. coastal areas, areas of the Himalayas, major river deltas etc.** As an extension of this argument, we could think of focusing our regional efforts



towards climate services in the major river basins (eg. Ganga, Brahmaputra, Indus etc), which are ravaged by trans-boundary flood events year after year.

- d. India has witnessed several mega disasters/ climate triggered extreme events in the last few years. The cloud bursts/GLOF in Uttarakhand region as well as the massive floods which inundated Kashmir valley are notable examples. While many analysts and observers have expressed the need for telescoping post disaster recover-response-rehabilitation activities to development, it is felt that we can **capitalize on the post-disaster situation to launch effective and efficient, user-responsive, localized and need based climate information as the receptivity and take at different levels for such initiatives is often maximum during the post disaster period.**
- e. While the current discussions are centred around the relevance of climate information on specific sectors such as water, agriculture and disaster risk reduction, **'climate information for human health' is acquiring significance**, also in the background of reports of weather related casualties (heat wave in parts of South India). In this connection, the participants recalled several initiatives (eg. Surat) where weather related information is used to pre-warn communities in the urban areas. Extreme heat can lead to dangerous and even deadly health consequences including heat stress and heatstroke. The city of Ahmedabad had a heat wave in May 2010 which lead to the death of 1344 people. The heat wave was a wakeup call to the effect that intergovernmental agency action, preparedness and community outreach were all needed to save lives. Rising to this challenge, **the Ahmedabad Municipal Corporation had worked to prepare health system and prepare residents against dangerous heat waves. A Heat Action Plan has been prepared by the Municipal Corporation in 2013 (and updated in later years) with the help of national and international academic experts and learnings from the global best practices on early warning system and heat adaptation.** The plan creates immediate and long term actions to increase preparedness, information sharing and response coordination to reduce the health impacts of extreme heat on vulnerable population. Among other things, the Municipal Corporation has created formal communication channels to alert government agencies, the health officials and hospitals, emergency responders, local community groups and media outlets of forecast of extreme temperatures. The participants felt that such good practices should be adopted in all early warning systems.
- f. Another good practice which was discussed relates to the collaboration/ agreement between Surat Municipal Corporation and India Meteorology Department. Under the aegis of this agreement, **Surat Municipal Corporation, with the guidance from IMD, has managed to set up several automatic weather stations in the urban area**, which collect local weather observations, with the help of which IMD is in a position to issue reliable and locally relevant forecasts and early warning of heavy rain fall and the potential for resultant floods.
- g. Capacity building at the community user level has become extremely significant and important in terms of creation of awareness on the effective use of climate information in decision making processes. **The users at the community level will need to be systematically engaged in terms of accessing climate information and using the same effectively and in a timely manner.**

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- h. **The format in which the relevant climate information is shared with the community is crucial.** As an example, the farmers may not be interested in generic information on maximum and minimum temperatures, relative humidity etc. On the other hand, they would be keen on knowing more about the changes/potential changes in the weather of the local area, that will have impact on sowing operations, irrigation, application of pesticides and fertilisers, time of harvesting, storage etc. (e.g. agro advisories rather than weather advisories). **The sectoral departments (e.g. Department of Agriculture, Water Resources, Livestock, Fisheries etc.) will have to play an important role, to ensure that the frequency, format and mode of communication (together with the levels of details) as per requirements of the farming communities is effectively conveyed to the NMHSs so that the generic information already in their possession is converted to user-friendly, locally relevant down-scaled information and conveyed to the user community.**
  - i. Local governments at the village, block and district level (village panchayat, block panchayat and district panchayats) have an important role to ensure availability of locally relevant, user-appropriate climate information to the community in general and farming community in particular. Further, climate information will also be useful in local planning actions (preparation of annual village development plans) at the level of the local governments. Hence **the role of local government is crucial as a key intermediary - both ways, in communicating the needs and demands of the local community to the sectoral departments and NMHSs and in conveying/ disseminating climate information/ advisories received from NHMSs to the communities on a periodical and systematic basis.**
  - j. A plethora of formal and informal organisations are now involved in generating and analysing climate data, which includes the private sector. Some of the local initiatives also involve setting up automatic weather stations and making use of this information for decision making purposes locally. On the one hand, this development could be considered positive in that it generates awareness and capacities at the local level. However, **aspects relating to calibration of data by an authorized organisation (IMD in this case) and validation of information will need to be kept in view in order to ensure that climate information that is disseminated conforms to certain accepted standards and quality.**
  - k. IMD generates a lot of weather/climate data and information, also as a regional outfit of World Meteorological Organisation and share the same with all the countries of the region. **Countries of the South Asia Region could/should make effective use of the information provided this way, in generating forecasts and advisories at the country and sub-national level. The work of RSMC (Regional Specialised Meteorological Centre – Tropical Cyclones) was also mentioned.** RSMC is located in IMD and provides comprehensive information to all countries of the region (Oman, Pakistan, Maldives, Burma, Bangladesh, Sri Lanka and Thailand) about the tropical cyclones in Arabian Sea and Bay of Bengal, including their movement.
  - l. Considering the limited time period available for options analysis, a key action that could form part of the regional project would be to **map the changing demand and supply of climate information (local relevance, formats, frequencies, timeliness, effectiveness, details) at the sub-national/national and regional level for specific areas e.g. DRR, agriculture and water. The stakeholders may**



**have diversity of views on this** and it is important that the mapping will need to be organised in several locations in a scientific and systematic basis to get unbiased evidence for future planning.

- m. As far as the agriculture sector is concerned, **local/national/regional level climate prediction (seasonal-short term-intra seasonal) is of considerable help in advancing contingency measures, especially in the face of deficient rainfall.**
- n. **Collaborative research is required** at the level to jointly pursue:
- Impact assessment
  - Enhancing capacities for downscaling of climate information
  - Developing action for enhancing adaptation capacities and pursuing adaptation action to climate variability and climate change
- o. **Historical and real-time information sharing among the countries of the region (especially riparian States) will be very useful in not only developing various future scenarios (after integrating socio-economic data etc.), but also in coordinating various early warning systems not only within the country, but also on a cross-border basis.** Support to institutions will be vital in this regard, apart from periodical exchanges of hydro met information on a systematic basis. Rainfall prediction at river basin scale will also help in modelling water in extended range (3-4 weeks).
- p. **Climate information will be vital for ensuring that the health of the river systems is adequately protected and maintained, to enable effective provision of ecosystems services.** Thus it is essential to strengthen climate information and integrate it adequately.
- q. It is a known fact that **sharing of climate information, especially among the riparian States of inter-State rivers, will help in effective design and planning of measures towards flood information. Climate information/hydro met information will also be essential on a cross-border basis in hydro power development.** Enhanced information sharing will help in conducting impact assessment more effectively as regards hydropower development.
- r. Several current/ ongoing/ planned regional initiatives in the area of hydro met were discussed. One such promising initiative that was highlighted relates to **South Asia Climate Outlook Forum**, which meets once (in a country in South Asia) between the period June and Sept in connection with monsoon prediction and behaviour. However, discussions are limited to monsoon behaviour.
- s. **Asian Ministerial Conference on DRR (AMCDRR)** was mentioned as one forum in which regional cooperation on DRR was discussed. The next meeting of the AMCDRR will possibly be held in New Delhi in January 2016. As per the mandate, SAARC –South Asia Association for Regional Cooperation is supposed to promote regional cooperation in the area of DRR, especially in sharing data and information, capacity building, dissemination of good practices, in investing in knowledge and good practice, in fostering partnership with key stakeholders in better implementation of the work programmes developed for DRR etc. The SAARC is also embarking on

an agreement on Rapid Response to Disasters (perhaps not yet ratified by all countries) that provides for any country to support another member country in the event of disasters. While SAARC Disaster Management Centre and SAARC Met Centre are engaged in promoting regional cooperation, owing to the official nature of the organisations and the resultant protocols involved and delays, the contribution of these organisations to regional cooperation probably is still sub optimal.

- t. ICIMOD's (International Centre for Integrated Mountain Development, an inter-Govtl organisation based in Nepal) **Hycos project** (Regional Flood Information systems in the Hindu Kush Himalayan region) was mentioned during the discussions. The programme promotes timely exchange of flood data and information for reduction of flood vulnerability within and among participating countries (China, India, Nepal, Pakistan, Bangladesh and Bhutan), through an established and agreed platform which is accessible and user friendly. The **project activities include strengthening framework of cooperation for sharing regional flood data and information among the members**, eventually leading to a regional project, owned by the countries of the region. While ICIMOD plays a coordinating role, **WMO** is involved in conceptual and technical backstopping. The first phase of the project, supported financially by Finland and US has come to an end. **The project may offer good lessons for regional cooperation**, especially from the point of view of supply of information. The participants felt that it will be useful to get information on the analysis of the impact of the project so far on flood resilience in the region.
- u. **A number of development programmes are being implemented by the Govt of India at the national level as centrally sponsored 'flagship' initiatives (eg. Mahatma Gandhi Rural Employment Guarantee Programme). It would be useful to link these programmes to climate information/ climate services, so that the activities under the programme and the assets created remain protected from the impact of climate variability and climate change.**

Prof Geetha Lakshmi thanked the participants and proposed a formal vote of thanks.

#### Participants:

Name	Position/Institution	Organisation Type
Dr Anirban Ganguly	Research Specialist, DFID	Donor
Dr Y.V.Ramarao	Deputy Director General NWP India Meteorological Department (IMD)	Provider (NHMS)
Mr Talha Jamal	ECHO, European Union	Donor
Mr Jyotiraj Patra	Regional Advisory, British High Commission	Donor
Ms Rita Sharma	Senior Advisor, British High Commission	Donor
Ms Geetika Singh	Senior Advisor, Centre for Science and Environment	Intermediary/User
Ms Barsha Dutta	Res Asst. Alternative Futures	Intermediary/User
Mr Virender Singh	Scientist, IMD	Provider (NHMS)
Mr SC Bhan	Scientist, IMD	Provider (NHMS)
Ms Surinder Kaur	Scientist, IMD	Provider (NHMS)
Mr KK Singh	Head, Agricultural Meteorology, IMD	Provider (NHMS)
Prof Geethalakshmi	Prof Agromet, Tamil Nadu Agricultural University	Intermediary/User
KR Viswanathan	International CC Specialist, Practical Action	Intermediary/User
Lalit Dashora	Flood Resilience Specialist, Practical Action	Intermediary/User
Ms Aditi Kapoor	Director, Alternative Futures	Intermediary/User
Mr D.R.Pattanaik	Scientist, IMD	Provider (NHMS)




Name	Position/Institution	Organisation Type
Mr SK Kundu	DDG IMD	Provider (NHMS)
Ms Sarah Lester	Asia Regional Climate Team, DFID	Donor
Mr AK Sharma	SatMet IMD	Provider (NHMS)
Mr SS Singh	Regional Meteorological Center, IMD	Provider (NHMS)
M Surie	Asia Foundation	Intermediary/User
Dr Joy Elamon	Intercooperation	Donor

**Stakeholder Workshop on Options Analysis for Regional Climate Services towards effective disaster risk reduction, early warning and climate adaptation**

**14<sup>th</sup> June 2015 held at Practical Action Bangladesh, Dhaka**


**Summary of discussions:**

1. Bangladesh Meteorological Department (BMD) has a network of observation stations, which include 35 weather stations. This number is expected to go up appreciably in the coming months, also as a result of support and collaboration with organisations such as the World Bank. Of these, ten are connected to Global Telecommunication Services for feeding the observed data into the global networks. Presently, the forecasting of weather information in the country covers the grid area of 25km x 25km. With an enhanced observation network in the foreseeable future, this will be brought down to a grid area of 5km x 5km, which should help in obtaining more localized weather information, benefiting the user community at large. Bangladesh also has a network of radars (including Doppler Weather Radars) and the number of such radars will also go up in the coming years, as a result of the ongoing process of modernization of meteorological services in Bangladesh. Presently, the BMD provides seven days weather forecast, with an extended forecast for seven more days. It is important that the staff concerned in the **Met Department at different levels will have to be suitably trained on the use of modern and contemporary tools of weather and climate services to make the information more relevant, user-friendly** and on a timely basis. Perhaps this recommendation may be applicable to the meteorological services of all the countries of the South Asia region. Bangladesh could also benefit a great deal from enhancement of facilities and capacities for computation of observed weather information.
2. Bangladesh has sizeable number of synoptic/surface observation stations and networks. The atmospheric observation is done through use of weather balloons. **However, the country needs to do substantially more in the area of ocean-based observations.**
3. **Any discussion on weather and climate services will remain incomplete, or even meaningless without considering the end to end aspect:** Starting with the weather observation networks at the global and regional levels, feeding the same into the country level meteorological services who in turn also benefit from their own in-country observations and networks, processing of the data into generic weather and climate products and dissemination of the same to the intermediate users and tailoring of the same to the needs of the sector (whether agriculture, flood warning or investment decision as for example) and the stakeholders concerned taking suitable decisions/ actions on the information on a timely basis. The error, delay or communication problem in any of the points on this chain will have impact on the whole chain.
4. While the NMHSs of the region, notably the meteorological services are specifically mandated with the responsibility of generation and analysis of climate information, we are not sure if they should be assigned with the responsibility of say making this information sector-relevant. Such a task is possibly best left to the sectoral




departments/ Ministries/ organisations concerned, which should interact/interface closely with the met department in ensuring that the generic weather related information provided by the met services indeed do meet the specific requirements of the sectoral departments, also in terms of the time scales. **A view was expressed to the effect that it will be too much to expect the highly specialized met departments to lay down sector specific thresholds for different thematic areas, either nationally or regionally.**

5. A strong view was advocated for **decoupling of the weather and climate information/ services**. Although the producers/ generators of the weather and climate information may be same, the level of uncertainties involved, the purposes for which these are generated, the level of urgency involved in communication of these, the extent to which these could be perceived at the level of the sectoral departments/ intermediate organisations as well as the type of action required to be carried out at the user level are quite different.
6. **Bangladesh is a lower riparian country which will benefit a great deal from the information** (especially on river flows etc.) from upper riparian countries such as India, Nepal, and China etc. In reality, however, Bangladesh does not get any hydrology related information from any of the upper riparian countries in respect of trans-boundary rivers with the result the country is not in a position to benefit from advance warnings or intimations that such an arrangements could otherwise confer. While the treaty between India and Nepal on sharing of information relating to river flow information of Ganges seems to work to some extent, **this arrangement appears incomplete without participation of upper riparian countries such as Nepal and china**. The arrangements that the countries of the riparian States of Mekong river of South East Asia have is a good example for the South Asian nations to emulate.
7. Among the countries of the SAARC region, **there is a lack of common understanding of the issues of climate change as well as disaster risk reduction**. As an example many of the agreed action plans in the Bhutan Climate Summit held a couple of years ago, with the participation of Bangladesh, Bhutan, India and Nepal continue to remain on paper. This is regrettable considering the fact that all the countries of the region stand exposed to the impact of climate variability and climate change more or less in similar ways and that **the cooperation and coordination among them to tackle the extreme events (like floods) will go a long way in promoting the climate resilience of the communities of the region**.
8. On the other hand, **other regional networks such as South Asia Climate Outlook Forum (SASCOF) and those coordinated by organisations like RIMES appear to be playing a very useful and constructive role**. SASCOF meets once a year on a regular basis. The meeting takes place in the month of April, not only with the participation of the NMHSs of the countries of the region, but also senior representatives/ scientists of major advanced climate information producing countries/centres such as Korea, Japan, University of Columbia (International Research Institute) etc. The SASCOF has largely been dealing with the prediction and behavior of the forthcoming monsoon every year. **On the other hand, there appears potential for enlarging scope of the SASCOF gradually, in including the participation of the stakeholders of the regions, who represent the user community**. In a similar vein, SASCOF also has considerable potential for covering



areas other than monsoon prediction, including the other aspects of climate services on an ongoing basis, **as for example monitoring of trans-boundary river flows through a regional network.**

9. The monsoon forums/ networks coordinated by RIMES could be potential starting points for the regional cooperation/ coordination to emerge. RIMES coordinated forums confine themselves to discussing monsoon and floods for the time being. **There is good scope for inclusion of other areas of climate services in the agenda and discussions of RIMES.** The existing national forums can easily feed into the proposed regional initiative.
10. **The South Asia region is a highly disaster prone region, which among other things, floods cause damage to lives and livelihoods on a recurrent basis.** Many countries in the region, notably Bangladesh, Nepal and India have gathered considerable experiences and lessons over the last two decades in effective design, planning and implementation of disaster risk reduction activities including those involving the communities in a substantial manner. Several experiences are available which link the grassroots experiences to science and policy level. **However, except through the medium of occasional forums like conferences, the lessons and experiences obtained from the South Asian region are not systematically analysed and documented.** This has limited the wider sharing of such experiences within the region. While there is rich data and information on flood risk management, **it is important to also cover the drought forecasting aspect in any future initiative.** Furthermore, the generic experiences in design, implementation and monitoring of successful initiatives such as **index based insurances** should be documented and disseminated among the countries of the region.
11. From the user point of view, **clear articulation of demand for precise weather / climate information was listed as a major constraint.** In principle, **the users at the field level lack the capacity to interpret generic weather information** and it is vital that their capacities are sufficiently built to enable them to have a good grasp of the usefulness and relevance of weather related information. **Thus one could safely say that there is gross underutilization of the available weather and climate products in the region.** This situation calls for sustained building of capacities at the user level to interpret the information in the local context and act on it on a timely basis. **As for example the farmers could be trained to interpret the weather data for taking informed decisions** on preparation of land/ soil, sowing, irrigation, application of fertilisers and pesticides, pest control measures, harvesting etc.
12. **There is a potential for interventions which help in building capacity of the users at different level to articulate and convey their requirements** in terms of weather and climate information to the intermediate agencies as well as to the generators. This should help the producers, generators and analysers of weather and climate information to ensure that demand based and user-relevant weather information is generated and made available in a format desired by the users. The participants felt that it is easy to get distracted by the range and number of weather and climate products available in nationally/ regionally; **on the other hand, it is vital to start from the demand end and see how best the demand can be met by the existing or new products.**

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13. An important requirement for designing any regional/ sub regional intervention in the area of weather/ climate services relates to **systematic assessment of institutional capacities at the national and sub-national levels.**
  14. **Grading up of the infrastructure and capacities of NHMSs** of the countries of the region, especially those which are listed as basic or even essential was felt an important pre-requisite for providing effective climate services at the national and regional level. In this context, an opinion was expressed that the countries which are a little more advanced **could offer help to at least one neighbouring country (where the NMHSs are less developed) on a bilateral basis.**
  15. **Alternative methods and channels of collection/ observation** of weather information should supplement more conventional methods. As for example we now have the high potential of using smart phones/ mobile sets to collect advanced weather information.
  16. It is important to analyse our experiences on flood management in the last few decades, **especially in terms of how and to what extent the various techno-scientific-social options have delivered.** Similarly organisations like BCAS (Bangladesh Centre for Advanced Studies) have experiences in converting weather products (both micro and macro) into information for pursuing livelihood options. Such experiences will be worth looking into in detail.
  17. The participants recalled several initiatives (many of them on a bilateral basis) in the region which involved strengthening of weather and climate services through measures such as strengthening of the observation and communication networks, analysis and interpretation of weather and climate information etc. **It is vital that an audit and assessment of all such activities will need to be pursued on an urgent basis, to ensure that the regional programme is well informed and designed accordingly.**
  18. **The emerging role of the private** sector not only in dissemination of value-added weather information (through inputs and services companies/agro vets) to the user communities, but also those engaged in generation/analysis and delivery of climate information should be explored in depth **to make them useful partners in the weather and climate services project.**
  19. There was a consensus on the diversity of weather and climate services in different countries of the region. The subject of weather and climate services also have the in-built complexity is that none of the institutions or groups on their own, are engaged in end to end consideration or delivery of the weather and climate information. This calls for a complete understanding of the links and connections involved at various levels – producers/ generators, processors, intermediaries, communicators, priority sectors and users.

## Participants:

Name	Position/Institution	Organisation Type
Md. Abul Kalam Azad	Institute of Disaster Management and Vulnerability Studies, University of Dhaka	Intermediary/User
Md. Kamruzzaman	Christian Commission for Development in Bangladesh (NGO) CCDB, Climate Change Unit	Intermediary/User
Dr. Dwijen Lal Mollick	Bangladesh Centre of Advanced Studies, Fellow, Climate Change	Intermediary/User
Mozharul Islam	Practical Action, Food, Agriculture and Markets Programme	Intermediary/User
Shaibal Barua	Practical Action, Food, Agriculture and Markets Programme	Intermediary/User
Sazzad Hossain Miah	Practical Action, DRR and CC Programme	Intermediary/User
Anisur Rahman Chowdhury	Practical Action, Food, Agriculture and Markets Programme	Intermediary/User
Nazmul Huq	UNU/BONN	Intermediary
Nathan Sage	USAID/Bangladesh	Donor
Noel Gurwick	USAID/Washington	Donor
Md. Tohidul Islam	Institute of Water Modelling	Intermediary
Craig Irwin	DFID	Donor
Helen O'Connor	DFID Bangladesh	Donor
Faruk UI Islam	Practical Action	Intermediary/User
Md. Shameem Hassan Bhuiya	Bangladesh Meteorological Department	Provider (NHMS)
Raihanul Haque Khan	RIMES	Provider
Farhana Sharmin	Practical Action, CC and DRR	Intermediary/User
Ishrat Shabnam	Practical Action Consulting Bangladesh	Intermediary/User
KR Viswanathan	Practical Action Consulting	Intermediary/User
Afsari Begum	Practical Action, Food, Agriculture and Markets Programme	Intermediary/User
MH Habibur Rahman	Practical Action	Intermediary/User
Mohammad Joynal Abedin	Practical Action	Intermediary/User
Md. Mehrab ul Gani	Practical Action	Intermediary/User
David Probin Rozario	Practical Action	Intermediary/User
AKM Muniruzzaman	Practical Action	Intermediary/User
Md. Mizanur Rahman	Department of Agricultural Extension	Intermediary/User
Rubel Ahmed	Practical Action	Intermediary/User
Md. Akash	Practical Action	Intermediary/User
Rothy Biswas	Practical Action	Intermediary/User
Mirza Khalil Jibran Tutul	Practical Action, Food, Agriculture and Markets Programme	Intermediary/User





## Annex 7 Burma Workshop Proceedings

### **Stakeholder Consultation on Options Analysis for Regional Climate Change Programme to Deliver More Effective Climate Services, Early Warning and Disaster Risk Reduction**

**29<sup>th</sup> June 2015 held at New Aye Yar Hotel Conference Hall, Yangon**

#### **Introductory session:**

The participants introduced themselves, the organization they represent and their experience in using, collecting, disseminating climate data in their projects, activities etc. The group had good participation from government stakeholders (from Department of Meteorology and Hydrology (DMH), Department of Agriculture), Donors (UNOPS, IFRC), international and national development organizations and partners.

DMH extended a warm welcome to the participants and requested a frank and open discussion. It was mentioned that climate change is hampering the livelihood of the people and thus preparedness on one hand and hazard planning (especially Tornados) on other is very essential. The project to link the national initiatives with regional context with a regional objective is probably the first of its kind being scoped in Myanmar.

PAC informed the audience about the project, its purpose and objective, the achievements and activities till date and the purpose of the ongoing workshop. The major sectors of DRR, Water and agriculture are the crucial sectors as identified by the NAPA of Myanmar, 2011 and thus having interest in these sectors, very less initiatives has been done.

#### **Summary of discussions:**

Current operations, projects and activities of the DMH were presented and discussed. Participants listed down possible issues and challenges relating to the intervention options. The main points are captured below:

- The placement of DMH under the Ministry of Transportation could be a mismatch as it might hamper the open flow of information, data to other ministries/ department- most specifically the Agriculture, Forestry, and Water Resources. The confusion over the placement has been there a long time. Between 1992 and 1999, it was placed under the aegis of the Ministry of Communication. The exact reason for this transfer and decision on placement is not known to the audience. An organizational review to clarify the setup of DMH is essential.
- The key objectives of DMH are:
  - To take precautionary measures against and minimize the effects of natural disasters
  - To promote safety, comfort, efficiency and regularity of air, land (rail & road), sea and inland water transportation.
  - To bring sustainable development of natural resources (hydroelectric power, forest produce, water use, wind energy, etc.)
  - To promote agricultural and food production.
  - To ensure efficient operation, planning and development of activities in natural defense, industry, health, social welfare and all sectors of national economy.

- To undertake international collaboration for all development activities and works of the DMH
- However, there is a huge gap in human resource capability as few have specialized skills or projects in this sector. A comprehensive institutional capacity development plan is required which can focus both technology transfers as well as soft and hard equipment required. Focus towards downscaling climate analysis, outlook or forecasts. **The officials from all levels of the department will have to be fittingly trained on the use of modern and contemporary tools of weather and climate services in all aspects of climate services- collection, processing, and output.**
- As of today, DMH has 39 Hydro/ Meteorological observatory, 63 meteorological observatory, 17 agrometeorological observatory and 1 upper air observatory. **DMH personnel do agree to the fact that the current number of stations is way under the required number, based on the difference in topography and hazards in different states.** The frequent repair and maintenance as well as upgrading of the existing systems is a challenge for DMH- includes both financial and HR capability
- Burma is frequently hit by cyclone, storm surge, high and low temperature, drought, extremely heavy rain, very strong wind etc. **The level of preparedness in extreme events (especially cyclones) has improved over the year** most specifically after the Nargis incident. The preparedness can also be credible to the quick transformation of society as well as improved infrastructures and services in information technologies. The Mahasen cyclone (Cyclonic Storm Viyaru) in 2013 saw the whole country aware and prepared for the same. However, the **internal capacity to predict other events (in fact the most common events- flood or rainfall and drought) is something that needs to be developed- i.e more flood and drought related trainings are required.**
- The early warning starts with DMH issuing weather related bulletins through radio and television, the RRD (relief and resettlement department) plans immediately for disaster response and reconstruction. **The major gap is the next to non-existence of feedback loops and inaccuracy of the predictions.**
- The medium and mode of dissemination of the information is a challenge that DMH and RRD constantly face. The rural part of the country has no reliable access to any of the medium. In fact, the social media (Facebook) is used by majority of the population and thus DMH has also created a Facebook page but transmitting emergency information become impossible via that channel. Not a major bulk of population use cell phones either. The exact data based on survey is something that is again hard to locate.
- **Regional Integrated Multi-hazard Early Warning Systems (RIMES)** are conducting **community-based pilot programmes** for training local communities to prepare for and respond to early warnings received from DMH and RRD.
- The United Nations Development Programme developed **multi-hazard risk assessments** for Ayeyarwady, Bago, Yangon and Rakhine Regions/States in 2011. The same recommendations in the assessment are being used with some changes based on experience and knowledge but not evidence-based experience.
- There are two major projects ongoing in DMH
- Development of Storm Forecasting Project with STSAT Satellite/ Storm Surge/ Forecasting Tools from Japan Meteorological Agency/ JICA
- WMO- RIMES project on reducing risk of tsunami, storm surge, large waves and other natural hazards in low elevation coastal zones.
- Planned projects include:
  - Cyclone Detecting Radar installation at Kyaukpyu, Yangon and Mandalay by Japan Grant Aid.(2013-2017)
  - 30 Automatic Weather Observing System by Japan (2013-2017)



- Earth Observation Satellite ground station set up by ODA (Japan)(within 3years)
- Regional Climate Model application by own activity.
- Norwegian Met (under MOFA, Norway) technological transfer (NWP-application) project to improvement Climate Information for Local communities.(2012-2016)
- End-to-End Early warning System Project for DMH &RRD by JICA (2013-2017)
- **Despite the planning on the above projects, by 2015 no major progress has been made thus, it will be of interest to DFID to have a bilateral discussion with the donors for joint actions moving forward**
- The regional linkages of DMH is with ADPC, RIMES, UNESCAP, SASCOF, SEASCOF- there are however windows for improvement and most crucially, the active participation of Myanmar DMH in the discussions. This includes both regular presence and sharing of issues or engaging in discussions in the forums. Apart from the knowledge gap, the language barrier also plays its part in regional forums.
- At national level, the agriculture, forestry, environmental conservation, irrigation, Relief and Resettlement Department are in communication. However, the level, frequency, relevancy for inter department communication has some windows for improvement. For instance, the DMH is developing a pilot MIS system for farmers which are not clearly updated to all Agriculture Department officials. The workshop had participation from both DMH and DOA who agreed that there are various communication gaps, repetition of works due to lack of better communication. **It was felt necessary that at least the most needy departments identified by NAPA- Agriculture, DRR and water, forests, be placed with a climate service expert who can demand the data from these departments.** At present, the demand side is unsure on what type of data is important to them or even what to do with the predictions, etc. some intervention in the demand side is thus necessary.
- The DMH was also found to mobilize extension team in field to disseminate 3 and 10 day forecast to farmers for agro advisories, but this service should have ideally come through the Department of Agriculture. There seems to be a mismatch in responsibility division. This service also covers information about pre and post monsoon climate for better agriculture planning. However, the portion of population with this access is unknown.
- A private telecom company OORREDOO is developing a mobile-based agro advisory as a part of its CSR.
- A project implemented by CORDAID funded by LIFT is working to disseminate information to farmers but the climate data usage is not appropriately considered. A possible partnership area for DFID.
- A project related to climate services is also being planned by GIZ. Details are not out yet.
- The IFRC and DMH seem to have communicating frequently in terms of climate data. DMH has available the data on daily basis, it is uploaded in the website and sent via email to the users who demand it. However, there were other organisations (INGOs) who were unaware of this service. **This leads to a requirement of a demand-supply mapping in Myanmar. The users do not know that these data are available in DMH and DMH doesn't have the list of organizations which might require the data.** The DMH would be happy to send the data to all who would approach for the same. Input of the data however is being used mostly for DRR purpose. The climate compatible development or agro advisory/ forestry/ livelihood are something that is left far behind. The information is not also used in long term planning of the country by the government.
- **Overall, the climate services system as a whole needs a thorough modification. Firstly, a clear roadmap on “who,what,when,how and where” in regards to the**

**collection, archiving, storage, modelling, downscaling, predictions, dissemination, and feedback is required to be developed. At present, there is no such roadmap which is the prime reason why all departments and ministries are under confusion.**

- The involvement of DMH in ocean-based observations is low and they fully rely on services or advice of other countries in the region. Due to this their capacity to be involved in these discussions remains underpinned. **A comprehensive system to observe ocean-based data would be required, most specifically to predict the strong winds incoming from ocean.**
- The linkage of DMH with the outputs of global models which are available for free to all national meteorological stations seems to be weak. **Some intervention to develop the institutional linkages with international and regional forecasting system is necessary.**
- The regional farmer's association meeting or DRR practitioners' meeting could also be considered for better understanding of the trends, issues etc. There are three big farmers' associations registered under the Ministry of Labour.

#### Participants:

Name	Position/Institution	Organisation Type
Daw Khin Cho Cho Phem	Director, Department of Meteorology and Hydrology (DMH)	Provider (NHMS)
Daw Mya Mya Wim	Assistant Director, Department of Agriculture	Intermediary/User
Daw Cho Cho Aung	Assistant Director, Department of Agriculture	Intermediary/User
War War Shein	Programme Manager, Oxfam	Intermediary/User
Khin Nyein Nyein Mon	Project Officer, MERN	Intermediary/User
Ei Ei Yi Mon	Resilience Advisor Oxfam	Intermediary/User
Paul Roelofsen	Country Director, Cordaid	Intermediary/User
Libera Antelmi	Livelihood Specialist, LIFT	Intermediary/User
Thein Oo	Project Manager, Air Transport Division	Intermediary/User
Nay Myo	Programme Office, LIFT	Intermediary/User
Moe Thida Win	Deputy Director, Myanmar Red Cross Society	Intermediary/User
Jewya C Delatena	Programme Coordinator, IFRC	Intermediary/User
Ms May Khin Chaw	DMH	Provider (NHMS)
Ms Sein Sein Yi	DMH	Provider (NHMS)
Ms Hla Tun	DMH	Provider (NHMS)
Jenny Swe Swe Myin	Programme Director, Plan International	Intermediary/User
W Shein Kig	Clean Cargo Workign Group	Intermediary/User
Thein Zaw	Mitsubishi companies representing The Institute for Environment Technology Promotion in Asia	Intermediary/User



## Annex 8 Pakistan Workshop Proceedings

### Options Analysis for Regional Climate Services towards effective Disaster Risk Reduction, Early Warning and Climate Adaptation

Islamabad, Thursday 25th June 2015

Dr. Hanif (Weather and Climate Expert from PMD), Dr. Azmat (Floods & Droughts Expert from PMD) and Mr. Ahmed Kamal (DRR Expert from NDMA) delivered talks and brief presentations to sensitize the participants and stakeholders before heading towards Group Discussions, Options and Recommendations.

#### Summary of Discussions:

#### Climate Service Providers in Pakistan – Challenges and Opportunities

##### ***Pakistan Meteorology Department (PMD)***

The Meteorology Department offers expertise and information on meteorological and geophysical matters with the objective of traffic safety in air, on land and sea. It provides weather forecasts, warnings and advisory services to the North Arabian Sea and territories falling within its area of responsibility, has the potential to forewarn the public of cyclones or tornadoes and predicts the amount of water in rivers from glacier melt.

##### Challenges and Opportunities

- Predicting climate shifts accurately, conveying the information in a timely manner and helping people by addressing the challenges posed by climate change.
- Communication Gap - Lack of coordination with stakeholders and end users, unawareness about understanding of climate information, particularly probabilistic forecasts.
- Lack of resources and funding for training and research activities in the organization.

##### ***The Global Change Impact Studies Centre (GCISC) Pakistan.***

The Centre was established in May 2002 as a think tank to help national planners and decision makers with strategic policy planning in consonance with the changing global environment. It focuses on areas such as climate, water, energy, food, agriculture, health, ecology and new technologies.

##### Challenges and Opportunities

- Lack of funding and investment by government- uncertainty about centre's existence due to ignorance.
- Lack of coordination with other organization.
- Centre remained a rolling stone among different ministries during last decade.
- Non-nationals posted at top levels
- The Meteorology Department should develop focused links with targeted departments such as irrigation and agriculture related departments to provide real-time information and warnings of impending adverse weather, such as strong storms and floods. The Meteorology Department and GCISC should also join forces to calculate the extent of climate change within Pakistan during the coming decades. If predicted climate shifts are significant, with drastic impacts on water and agriculture, GCISC could play a pivotal role in preparing the government and rest of the country to tackle and adapt to the changes.



### ***National Institute of Oceanography (NIO).***

The Institute is a scientific research organisation located in Karachi. It was established in 1981 through a Government Resolution to conduct multidisciplinary research in oceanography in the coastal and offshore areas of Pakistan (an Exclusive Economic Zone of 24,000 km<sup>2</sup>). It works on ocean biology/productivity, marine chemistry and environment, physical oceanography/coastal hydraulics, marine geology and geophysics.

#### **Challenges and Opportunities**


- In order to adapt to climate change and to reduce the risk from natural disasters, there is a need to implement comprehensive and integrated ecosystem approaches to manage sea and ocean coastal zones and aquaculture, by regular monitoring and reporting from this Institute.
- Lack of coordination and investment.
- Recommendation - The Institute should undertake assessments of local vulnerability and risk and build local-level ocean climate models. It should strengthen knowledge of the dynamics of biogeochemical, carbon and nitrogen cycles in aquatic ecosystems. This will support other concerned government departments to prepare for the impacts of global climate change on regional seas and oceans.

### ***The National Disaster Management Authority (NDMA) and Climate Services***

The NDMA is meant to strengthen the government's institutional capacity for disaster preparedness, response and recovery. Pakistan is vulnerable to a host of natural and man-made disasters. However, the NDMA's capacity to prepare for and respond to these disasters is limited and often dependent on external funding and technical assistance.

#### **Challenges and Opportunities**

- Lack of funding, lack of trained staff and lack of sectoral experts to understand climate information, its impact and true ownership by the government are the main challenges of NDMA. The government must invest in the capacity building of NDMA's staff and the adoption and use of modern technologies such as GIS and Remote sensing that can help with rescue and relief efforts. Apart from developing the efficiency of responses needed in the immediate aftermath of disasters, it needs to:
  - engage in more long-term efforts to relocate and rehabilitate victims of disasters;
  - move people away from locations at a high risk of facing disasters before the event occurs; and
  - help local communities in disaster prone areas develop evacuation, first aid and reconstruction plans.
- Satellite technology can also be applied for natural disaster management. There are several reasons for possible enhancement in the satellite technology for disaster management. Early warning and high-speed communications, together with effective and efficient satellite communications technologies facilitate disaster management. It is vital for preparedness and response operations for floods, earthquakes, droughts and desertification. The operational and communications system for natural disaster mitigation based on integrated satellite technology applications is needed for the establishment of the necessary infrastructure. Improved weather and climatological information based on satellite meteorology is essential for weather watch over a region vulnerable to natural disasters.
- NDMA totally depends on reliable and credible climate services. Reliable estimates of disaster damage, the location and extent of disaster-affected areas and an assessment of the post-disaster situation, facilitates effective disaster mitigation



measures. An effective flood control system relies on timely availability of accurate information on rainfall, river level, cloud cover, glacier melt and other data, in many cases over inaccessible areas. Remote sensing data identify flood risk areas as well as assess flood damages.

### **Pakistan's Climate Vulnerability and Climate Services, presentation by Dr. Azmat**

Pakistan presents a classic example of a developing country that is highly vulnerable to the adverse impacts of climate change but has done little to contribute to the problem. It ranks 16th out of 170 countries in a recent Climate Change Vulnerability Index and is located in a part of the world where the projected temperature increase due to climate change is likely to be higher than the global average. Consequently, Pakistan's major concerns with respect to climate change are related to adaptation, particularly in the areas of water, agriculture, energy and disasters and the country therefore must prepare itself for the impacts of climate change.

Due to changing weather patterns and seasonal rainfall trends, the frequency of extreme weather events is also likely to increase in Pakistan and South Asia in the future. Increasing frequency of series of natural as well as man-made hazards has badly influenced the economy of the country. Local, regional and government level stakeholders have identified Pakistan as vulnerable and focused risk zone against glacial surges, avalanches, cyclones, flash floods, droughts, epidemics, landslides and river erosion. The threats associated with the changing climate are the cause of major survival concerns for Pakistan, particularly in terms of country's water, food, health and energy security considerations. The continuous onslaught of disasters has compelled Pakistan to move away from a response centric approach towards preparedness and prevention thus bringing about a paradigm shift towards the improvement of climate services in its supply and demand chain.

### Significance of Climate Services


Climate services are the dissemination of climate information to the public or a specific user. They involve strong partnerships among providers, stakeholders, including government agencies, private interests, and academia, for the purpose of interpreting and applying climate information for decision making, sustainable development, and improving climate information products, predictions, and outlooks.

- The changing behaviour of climate with abrupt nature cannot be projected with full accuracy but the efficacy close to reality can be achieved by proper production and transmission of climate services.
- Timely communication of climate information helps in prevention of economic setbacks and humanitarian disasters that can be a result of climate extremes and long term climate change.
- Climate information also plays a crucial role in national development planning, for managing development opportunities and risks and for mitigation and adaptation. Efficient application of climate services requires that climate information become integrated into various sectors' policies.
- Health sector uses climate prediction services to provide early warnings and community information on extreme climate events such as heat waves.
- The Energy sector however, uses climate information to decide where and what type of power plant should be built in a particular location. The temperature forecasts may be used to manage the power supply.
- The agriculture sector needs timely climate services for the proper crop management including sowing and grasping of particular crop type.

- In Pakistan, women are likely to be strongly affected by climate change as majority of rural women are engaged in agriculture sector which is highly climate sensitive, and therefore climate services are equally important for poor vulnerable women.

#### Climate Services for Water, Energy, Agriculture Sectors and Vulnerable Gender

1. It is the responsibility of WAPDA (Water and Power Development Authority) to store the water in major reservoirs to use for agriculture and energy sectors. Pakistan continues to suffer from inadequate water storage facilities. The problem is heightened when there is below average rainfall and is of particular concern to the farming community, which depends on the regular supply of irrigation water. WAPDA should undertake infrastructure projects such as the Bhasha Dam in the Northern Areas and other long pending projects after weighing environmental concerns against economic returns. The Kala Bagh Dam could be redesigned as a barrage, giving it less height and hence, smaller water storage capacity, thus addressing concerns that a large dam could submerge agricultural lands.
2. IRSA (Indus River System Authority) is responsible for distributing water amongst the four provinces of Pakistan respectively. Most of the southern parts of Pakistan are continuously suffering from extremely dry conditions primarily because of El-Nino conditions frequent developing in the Pacific Ocean during last three decades. IRSA will need to devise a formula to alter water supplies between certain districts in Punjab and Sindh to ensure the timely supply of irrigation water. This may affect the pattern of crops grown in these areas but will guarantee equitable supplies of irrigation water in both provinces.
3. The water sharing between India and Pakistan is resolved by Indus Water Treaty. Any change in rainfall patterns and glacier melt could significantly alter the availability of water in rivers. However, the treaty does not account for this possibility, leading to continuous disagreements between Pakistan and India over the supply of water from the three western rivers. There is a need to strengthen bilateral ties with India by conducting regular meetings of Indus Water Commission representatives to assess the quantity of water in the river tributaries and canal head works on both Indian and Pakistani sides. A council of countries surrounding the Himalayas, including Bangladesh, India, Pakistan and China can be formed to conduct cooperative research on the accelerating effects of climate change in the region, particularly on the amount and distribution of water.
4. The Ministry of National Food Security & Research is mainly responsible for policy formulation, economic coordination and planning in respect of food grain and agriculture. It also includes procurement of food grains, fertilizer, import price stabilization of agriculture produce, international liaison, and economic studies for framing agricultural policies. Timely and reliable seasonal based climate information always remained a high demand of the ministry. The freak weathers such as excess and deficient rains and extreme temperatures are the challenges that significantly impact the agricultural productivity in Pakistan. There is need to strengthen the linkage with climate service providers to develop crop-yields modelling in Pakistan.
5. Like many other parts of the world, the changing climate in Pakistan also has a large impact on the poor, women, biodiversity, human health and future generations. Prevailing social norms in Pakistan also mean that the gendered dimension of the impact of climate change is hard to ignore. Water shortages usually hurt women more than men because the intra household allocation of resources favours men and in the event of falling agricultural productivity, it is often women whose nutritional intake is hurt most. In some disaster prone regions of the country, such as parts of



Azad Jammu and Kashmir, Khyber Pakhtunkhwa and Gilgit-Baltistan, a large proportion of the men work down country and it is the women who suffer the most from catastrophes such as GLOFs and avalanches.

### **Climate Services for DRR and Multi-hazard Early Warnings, presentation by Ahmed Kamal from NDMA**

Over the past five decades, economic losses related to hydro-meteorological hazards have increased, but the human toll has fallen dramatically. This is thanks to scientific advances in forecasting, combined with proactive disaster risk reduction policies and tools, including contingency planning and early warning systems in a number of high risk countries. In 2005, governments endorsed the Hyogo Framework for Action 2005 – 2015 to build the resilience of nations and communities to disasters. The paradigm shift from post disaster response to a proactive risk reduction approach requires meteorological, hydrological and climate services to support science-based risk management decisions, as well as investments in early warning systems.


Every year natural hazards cause significant loss of life, and erode or destroy development gains. From the ten most commonly reported disasters, nine are directly or indirectly related to weather or climate. Vulnerability to disasters is increasing as more people and assets locate in areas of high risk. In Pakistan, during last three decades, the proportion of people living in flood-prone river basins increased by 114 per cent and on cyclone-exposed coastlines by 192 per cent. Rapid urbanization and the growth of megacities will increase exposure to natural hazards. Climate change is expected to increase the frequency and intensity of the most severe weather related hazards in the decades to come.

Climate Services are therefore one of the high priorities for disaster risk reduction, to meet both the growing needs and opportunities to increase disaster resilience. With appropriate use of meteorological, hydrological and climate information as part of a comprehensive multi-sector, multi-hazard, and multi-level (local to global) approach, considerable achievements can be realized.

An essential starting point for reducing risks is a quantitative assessment which combines information about the hazards with exposures and vulnerabilities of the population or assets (e.g., agricultural production, infrastructure and homes, etc.). Equipped with the quantitative risk information, Pakistan needs to develop risk management strategies using early warning systems to reduce casualties; medium and long-term sectoral planning (such as land zoning, infrastructure development, water resource management, agricultural planning) to reduce economic losses and build livelihood resilience; and weather-indexed insurance and risk financing mechanisms to transfer the financial impact of disasters.

The emergence of climate prediction provides opportunities to increase the lead times of early warnings. For instance, seasonal climate outlooks help governments predict – and manage – excessive or deficient rainfall. Historical data has traditionally been used for analysis of hazards patterns. But this is no longer sufficient, because hazard characteristics are changing as a result of climate change. Weather and climate services with forecasts from the next hour to seasonal through to decadal time scales are therefore needed to inform long-term investments and strategic planning on, for instance, coastal zone management, development of new building codes and the retrofitting of infrastructure to withstand more frequent and severe hazards.

Investment in meteorological services and early warning systems has been demonstrated to help with reducing loss of life associated with meteorological hazards. Meeting today's climate-related risks is a pre-condition to being able to adapt to future climate-related



challenges including more intense precipitation and storm surges, droughts, heat waves as highlighted by the Intergovernmental Panel on Climate Change.

### Identified Gaps:

- District level forecast is required since only divisional level (3-4 districts) forecasts are provided at present.
- Only forecast of rainfall is provided, no forecast of extreme temperatures and wind speed/direction is available.
- Information of seasonal droughts, particularly for agriculture and water sectors, is not provided.
- Long range forecasts are not reliable.
- Climate information is mostly updated once in a day, it should be update twice a day.
- During weekend, sometimes old forecasts or poor quality forecasts are disseminated.
- Upper air data is not produced by PMD.
- Lack of observational network of PMD in Pakistan.
- No climate information is provided for different crops i.e., a general and very short forecast is produced for all farmers without understanding or mentioning the impact of rainfall, temp, winds and humidity.
- No information about changing climate is provided i.e., farmers are unaware about mystery of climate change.
- Radar network of PMD is out dated, not covering most of the vulnerable areas.
- Major focus of climate information is on the country's main cities – poor and rural areas are ignored.
- A general and common weather forecast of short and medium range is produced for all users groups without consideration for the different needs and requirements of end-users.
- Climate information is not produced for different user groups i.e., agriculture, water, fishermen, travellers, smallholder farmers, poor and vulnerable areas and communities etc.
- Lead-time of provided climate information is insufficient.
- Language of climate information is not easy; it is complicated and technical. Furthermore, most of the information is generated in English instead of national or local languages.
- Dissemination system of PMD is not very effective – Internet facilities are not accessible by poor and vulnerable communities.
- Radio and mobile phones are the most effective channels for disseminating climate information, however ICTs are not used in Pakistan.
- The limited interaction of the National Meteorological and Hydrological Services (NMHSs) with farmers, the inadequate dissemination of weather and climate products and services in a timely manner to the end users, language barriers in understanding the climate products and services, weak agricultural extension services and poor communication infrastructure, remain as some of the main barriers in the provision of weather and climate information to smallholder farmers
- With few exceptions climate information is not effectively incorporated into development decisions.
- Problems due to weakly expressed demand coupled with inadequate supply of climate services for development.
- Climate information providers could not convince the local media to allocate the time for weather and climate information for the public.
- Lack of linkage among concerned organizations and end users.



## Challenges and Threats:

The identified threats or possible consequences of climate change in Pakistan would be:

- Increased monsoon variability.
- Recession of glaciers in the Hindu Kush-Karakoram-Himalayan (HKH) region that would threaten Indus River System water flows.
- Rising snowlines and glacial melt that will reduce the capacity of natural reservoirs.
- Loss in reservoir capacity from the increased siltation of large dams.
- Reduction in agricultural productivity and power generation because of water and heat stress in arid and semi-arid regions.
- Adverse impact on coastal agriculture, mangroves and fish breeding grounds because of the intrusion of saline water into the Indus Delta.
- Higher risk of droughts and floods.
- Due to rapidly changing climate and frequent occurrence of extreme weather, farmers, especially small holder farmers in Pakistan are facing enormous challenges in carrying out their farm activities.
- The projected climate change will further accentuate the problems for the farming communities.
- Increasing vulnerability of coastal areas due to greater cyclonic activity because of the higher temperature of sea surfaces and sea level rise.
- Increased risks of Extreme Events (floods, droughts, cyclones, extreme high / low temperatures etc.);
- Severe water- and heat-stressed conditions in arid and semi-arid regions leading to reduced agricultural productivity.
- Increased intrusion of saline water in the Indus delta due to sea level rise; Risk to mangroves and breeding grounds of fish.
- Health Risk, particularly for poor women and children.
- Climate variability, climate change, weather extremes, rainfed agriculture with low productivity, deteriorating soil quality and weak extension services are all challenges that the farmers in Pakistan and South Asia are facing and that they impact negatively the agricultural productivity in both the regions.
- Most farmers in Pakistan and South Asia are resource-poor smallholder farmers often with limited access to technologies and resources, which leaves them increasingly vulnerable to weather and climate fluctuations.
- In spite of advances, the seasonal climate variability, impacts of climate change and weather and climate extremes still continue to impose serious limitations on the realization of potential crop yields in Pakistan with negative ramifications for other sectors of agriculture.
- The resulting food insecurity and social instability across Pakistan are threatening the livelihoods of people and the national economy.
- Climate change is expected to increase the workload of women engaged in agriculture production and other subsistence activities such as collecting fuel wood and water. Further, women are found to be more vulnerable during extreme climate events and disasters.

## Recommendations

- Workshop participants unanimously agreed that there is a need to improve climate services for the stakeholders.
- Observational network of PMD should be extended up to district levels, and should also upgrade the existing network with all facilities such as computers and internet with an arrangement of regular radio sounded upper air data.

- Radar network should be upgraded, and at least three more radars should be installed in vulnerable areas.
- Specific climate services (impact based forecasts) should be provided for different user's groups i.e., farmers, fishermen, water managers, travellers etc, twice a day in easy national and local languages.
- To address the issue of improved climate services and applications, there is an urgent need to enhance the capacity building of climate service providers and users of climate service.
- The workshop recognized the potential of ICT applications in the farming sector to enhance interactions with climate service providers to increase agricultural productivity.
- All efforts should be made to strengthen the meteorological observation networks and to produce accurate weather forecast at different scales, especially at the districts level.
- The rapid advances in Information and Communication Technologies (ICTs) today need to be effectively employed to disseminate weather and climate information and services in a timely manner to farmers, especially to the small holder farmers in the semi-arid regions of Pakistan.
- Community based FM Radio Channels should be established in the vulnerable districts to disseminate the warnings to minimize the life and property losses.
- A series of documentaries about significance of climate services to grasp the socio-economic benefits and awareness about climate should be prepared in national and local languages, and to be displayed in schools and colleges on regular basis.
- Workshop participants agreed on the urgent need to set up the network of Farmers Associations at the National Level to facilitate improved interactions between the farmers and the service providers of the country.
- Development of an appropriate mechanism for feedback system and sharing of success stories from the users was also recommended.
- To provide improved climate services to farming community there is a need to enhance Public Private Partnership (PPP).
- There is a need to identify appropriate climate products and services for improving agricultural productivity at provincial and national levels.
- It is recommended that urgent efforts are to be made to improve the interactions between farming community and Meteorological Services on a regular basis to generate and distribute demand driven services.
- Media should be involved in operations and functions of networks and in the provision of national and regional climate services to the farmers.
- It is recommended to start a regular campaign through schools, colleges, universities, communities, and media about awareness of climate change, impacts and the significance of climate services to grasp the socio-economic benefits.
- It is highly recommended to integrate DRR and CCA to avoid the overlapping and confusions.
- National and sub-national level newsprint about DRR may be generated and circulated. Also recommended to establishment of network on social media to share regional level DRR knowledge.
- National and regional level success stories on different issues of DRR and CCA related issues should be documented and circulated among group members.
- It is highly recommended to establish an effective Early Warning System at national, provincial and district levels.
- Organization of training seminars to stakeholders on climate variability and climate change can improve the relevant aspects related to climate information and services.
- Establishment of advisory teams comprising subject matter specialists in agriculture and NMHSs to interact with farmers in a timely and organized manner on a regular



basis can help improve the weather and climate information and services to the farming communities;

- Regular meetings with users to understand the users' needs, for the users' to understand what climate information is available for their needs and the uncertainty associated with the data. The main goal is to provide relevant, user friendly climate services.
- Pakistan fully recognizes that women are powerful agents of change. It is therefore indispensable to ensure participation of women and female gender experts in all policies, initiatives and decisions relating to climate change.
- Develop climate change adaptation measures on local and indigenous knowledge particularly held by women. There is need to develop and implement climate change vulnerability-reduction measures that focus particularly women's needs.

#### Participants:

Name	Position/Institution	Organisation Type
Dr. Muhammad Hanif	Director Forecasting, PMD	Provider (NHMS)
Dr. Azmat Hayat Khan	Director, Flood & Drought, PMD	Provider (NHMS)
Jan Muhammad Khan	Director, Planning, PMD	Provider (NHMS)
Ch. M. Aslam	Director, Agro-met, National Agro-Met Center, PMD	Provider (NHMS)
Ahmed Kamal	Member, DRR, National Disaster Management Authority	Intermediary/User
Dr. Shaukat Ali	Global Change Impact Studies Centre (GCISC)	Intermediary/User
Miss Nusrat Batool	National Agriculture Research Council	Intermediary/User
Adil Naseer	Bahria University, Environment	Intermediary/User
Mujahid Hussain	People Powering Development Alternatives (PEDA), Pakistan	Intermediary/User
Shahzada Adnan	Drought, PMD	Provider (NHMS)
Dr. Bushra Khalid	Independent health consultant	User
Toseeq Haider	C.E.O. Black Box Foundation	Intermediary/User
Prof. Dr. Gul Muhammad	Center of Excellence in Climate Change	Intermediary/User
M. Adnan	GCISC	Intermediary/User
Naveed Mustafa	Pakistan Agricultural Research Council	Intermediary/User
Dr. Faisal Saeed	Asst Professor, Comsats Institute for Information Technology (CIIT)	Intermediary/User
Dr. Shaheena Tariq	Chairperson, Meteorology Dept, CIIT	Intermediary/User
Dr. Arjumand Nizami	Intercooperation-Pakistan	Donor
Dr. Jawad Ali	Intercooperation-Pakistan	Donor
Dr. A.D. Khan	Pakistan Council of Research in Water Resources (PCRWR)	Intermediary/User
Dr. Ashfaq A. Sheikh	PCRWR	Intermediary/User
Sqd. Ld. M. Tanveer	Aviation Met.	Intermediary/User
Mahmood A. Jilani	JICA	Donor
Dr. Khalid Riaz	CIIT	Intermediary/User
Dr. Manzoor Ahmed	PCRWR	Intermediary/User
Aleem-ul-Hassan	Head, Flash Flood Warning Center, PMD	Provider (NHMS)
Farooq Dar	Operational Meteorologist, PMD	Provider (NHMS)
Zeeshan Haider	DRR, GCISC Expert	
Nadir Gurmani	KTN TV, Local (Sindhi) Channel	Intermediary
Shams Pervez	Weather & Sports Reporter, PTV	Intermediary
Prof. Dr. Gul Muhammad	Center of Excellence in Climate Change	



## Annex 9 Afghanistan Interviews Summary

### Current work by key stakeholders

- The Afghan Meteorological Department's aim is to observe the weather according to World Meteorological Organization procedures every day, including public holidays. The department is active in 30 provinces. The first meteorological weather stations were installed by the Ministry of Transportation in 1953 in selected locations around the country. These were subsequently rendered non-functional due to many years of conflict and warfare. Today, the Meteorological Department of the Ministry of Transportation collect and monitors hydro-meteorological data, relying on a network of weather stations located around Afghanistan, a large proportion of which are located on MAIL property. The observation network of Afghanistan includes five complete automatic stations, five classic stations, 106 rain gauges, 15 French component classic stations, five ICARDA automatic stations, three ISAF automatic stations and three further classic stations.
- IOM supports disaster risk mitigation in policy making and project implementation
- UN-OCHA supports a number of organisations in DRR, works in disaster affected communities in rural areas of Afghanistan and supports internally displaced people
- The Afghanistan Sustainable Energy for Rural Development - ASERD - is working on renewable energy for rural communities of Afghanistan.
- Climate change program change -MAIL -is a new project by the UNEP that will cover most of the provinces of Afghanistan. UNEP is also working in limited number of provinces on DRR.
- The Agro Meteorological Project In Afghanistan (AgroMet) plays a critical role providing climate information, validation of satellite monitoring and crop forecasts. Both the Meteorological Department and AgroMet are collecting climatic data. FEWS Net and AgroMet are analysing climatic information, with a particular emphasis on food security.
- INGOs such as Afghan Aid, Oxfam and others are working on climate change and DRR with funds from the UK government
- Afghan Aid SARCAD project (DRR and CCA)
- GIZ-IDEA program - Renewable Energy and Energy Efficiency: funded by German Government
- UNEP Climate Change – Renewable Energy and Climate Change. This project will build public awareness on Renewable Energy and strengthen the capacity of the Government authorities and will work toward promotion of this sector.

### Projects in the pipeline

- ANDMA plans to work with Afghanaid and the IOM in areas highly vulnerable to disasters and climate change including providing early warning and awareness, and training on DRR to local communities.
- Two DRR projects will be implemented in Afghanistan: one by JICA and the other by the IOM
- Technical Assessment – Renewable Energy: funded by ADB
- Technical Assessment - Renewable, Water and Agriculture: funded by ADB
- USAID-Dutch Development –Renewable Energy Program for Afghanistan



## Key gaps

- According to Afghanistan's meteorological department, they need sophisticated technologies for a precise weather forecasting in accordance to the international standards and presently department is lack of technical and financial facilities. All stakeholders agreed that the Afghan Met Office does not have the latest up-to-date to date technologies to use for information collection, early warning and dissemination to the public. Another key gap is the lack of qualified staff and experts who require capacity building how to use technology.
- Interface and communication between Afghanistan's Meteorological Department and other departments and ministries, particularly the Department for Disaster Planning, is required. These ministries and departments include: Transport and Civil Aviation, National Environmental Protection Agency, Ministry of Energy and Water. Ministry of Agriculture Irrigation and Livestock and Ministry of Rural Rehabilitation and Development. Likewise, interaction between the NHMS and regional/international organisations is low.
- The NEPA is not acting according to its mandate and a lack of capacity and coordination exists, for example between NGOs and NEPA as a funding source. Poor NRM management is key issue highlighted by stakeholders. Most of the country's resources are being wasted and there is no policy for protecting NRM like wild trees and forests. Afghanistan is full of natural resources, because of the poor management these resources may disappear in near future like trees, 58% of urban and 62% of rural communities are using wood and animal dungs as fuel source. Green MASS plantation is disappearing due to less reforestation.
- Although DRR and climate services are a priority for the Government of Afghanistan, there is little focus on awareness raising amongst communities
- Poor integration of DRR, early warning and climate services into development sector planning and implement resulting in inefficiencies in terms of resource allocation and implementation
- Parts of Afghanistan (Northeast) are extremely vulnerable to Landslides during winter's and spring's rain and to Flash Floods during spring's and summer's rain. Vulnerable areas yet have not been identified by the decision and policy makers. No information and climate services are provided to the poor vulnerable communities to minimize the losses by occurrence of such events.
- Afghanistan is mostly affected by mid-latitudinal weather systems coming from the west during the whole year. The major rainy season is the winter season, and there is an on-going requirement for winter forecasting – particularly snowfall.
- Afghanistan should be a member of NECOF. WMO should take the notice of such anomaly.

## Options for DFID engagement in Afghanistan

- Improve the observational network
- Facilitate greater engagement by the private sector in climate change arena. The role of private sector is key not only in dissemination of weather information (through inputs and services companies/agro vets) to communities, but also as a more active partner in all aspects of climate services- climate forecasting, dissemination, early warning and preparedness.
- Enhance regional cooperation through skill and information sharing arrangements The SAARC is the most appropriate regional mechanism to strengthen and improve representation of Afghanistan, however among SAARC members there is a lack of common understanding of the issues of climate change and DRR as well as a trust deficit.

- Install advanced agro-meteorological stations to improve early warning systems, hazard mapping, and surveys, assessments and projections of the impacts of deep wells on the water table and future water supplies.
- Build capacity and expertise for assessment of climate change adaptation, including technical capacity to monitor and analyse climatic trends, plan and implement adaptation activities, improve forecasts and inform policy makers.
- Invest in and strengthen indigenous community weather forecasting mechanisms and link to spatial data to preserve the knowledge of remote communities in Afghanistan.
- Prioritize community based awareness raising programmes on disaster management with greater focus on disaster prone and natural resource-rich areas
- Identify a mechanism to make climate or weather related information more demand driven and to support communities to take an interest and build understanding of available information and cooperation with authorities
- Strengthen coordination between government and non-governmental organizations
- The Ministry of Finance should channel funding for improving climate services and should also lobby donors for further fund raising
- NEPA should play a stronger role in coordinating financial resources and technical capacity needs to be improved
- Support the government to translate climate change and DRR priorities into policy that is implemented
- The farming sector is a priority to strengthen food security in the long run
- Establish Early Warning Systems with effective dissemination strategies using local TV channels, radio and other ICTs (such as SMS).
- Establish a centre to coordinate early warning and disasters in order to inform communities and government
- Support ANDMA to conduct a geographical to identify the most vulnerable areas to flash floods and landslides. Many projects are being implemented without this information.
- Support ANDMA in terms of equipment and offices to reach all the communities easily and build the capacity of governmental related staff of ANDMA.
- Work with the Ministry of Education to incorporate DRR and climate services in the curriculum for wider public awareness
- Facilitate practical discussions between the Governments of Afghanistan and Pakistan to solve the climate based issues.
- Build the capacity of AMS staff with the support of PMD. Pakistan's and Afghanistan's climates are similar and therefore Pakistani forecasters have good potential to provide training to AMS staff. AMS staff are interested in receiving training on weather forecasting based on Global and Regional Models from USA, Europe and the UK. Some staff travelled abroad in the past for such trainings but they did not return to serve in their country.
- Support AMS and the PMD to establish a Flash Flood Warning Centre in Kabul, based on the experience of the Flash Flood Guidance System developed for Pakistan with the support of PMD & HRC.
- Build local capacity for understanding DRR, climate change and climate services, there are not enough young Afghan project coordinators and project managers skilled in these issues.
- Climate change proposal writing is complex. Small investments in proposal writing training will bring big rewards for Afghanistan.

## Interviewees

Name	Position/Institution	Organisation Type
Sato Mio	Senior Program Officer, International Organization for Migration	Intermediary/User
Dr M.Nasir Malikzai	Humanitarian Affairs Office, UN-OCHA	Donor
Habibullah Habib	DRR specialist and National Coordinator, Afghan Aid	Intermediary/User
Amanullah Ghalib	Renewable Energy Director, Ministry of Energy and Water	Intermediary/User
Mr. Mohammad NasimMuradi,	Afghan Meteorological Authority	Provider (NHMS)
Andaro Scatlon	Program Manager, UNEP	Donor
Eng. Sultan Ali Javi	Afghanistan Sustainable Energy for Rural Development Director (ASERD), Ministry of Rural Rehabilitation and Development	Intermediary/User
Marco Menestrina	Emergency Program Manager, Danish Refugee Council	Intermediary/User
M.Qasim Haidari	Deputy of Planning and Policy, ANDMA	Intermediary/User
Javlon Hamdamov	Country Director, ACTED	Intermediary/User



## Annex 10 Nepal Interviews Summary

**A. Summary based upon interviews with Deputy Director General, Department of Hydrology and Meteorology, Government of Nepal and Assistant Project Director for Building Resilience to Climate Related Hazards (BRCH) under the Pilot Program for Climate Resilience (PPCR), along with Hydrologists at the Flood Forecasting Division.**

The interviewees discussed climate and weather services interventions developed in Nepal along with updates from the BRCH, PPCR Project - World Bank.

Their organisations provide prior information regarding extreme hydrological and meteorological events - various weather forecasting and flood forecasting models are utilized having differential spatial resolution and temporal scales – however, if the input observed data are not good then the forecast outputs would ultimately suffer from inaccuracies and uncertainties.

Increasing the spatial resolution of forecast products has its own challenges associated with computational power required to generate the output – and approximation with regards to input variables that are used to feed the model at boundary state conditions.

Lack of data to provide inputs for Initial atmospheric conditions for Nepal (upper atmospheric measurements) hinders modeling approach and results

Ideally, in Nepal Climate and Weather Services can be enhanced by using a combination of:

- Satellite Data on Precipitation
- Upper Air Atmospheric Measurement
- Data from Radar Sensors
- Observations from Real Time Stations

Data from these aforementioned sources needs to be utilized and fed into the weather models to generate forecast outputs. Long term and good quality data is critical to provide better service delivery for EWS and DRR.

Radar sensors (c band) are currently being planned to be put across the West, Central and East Nepal along the appropriate three locations. Once installed, nowcasting can be done up to a horizontal distance of 200 km and provide real time weather forecasts at a temporal timescale of hours.

Topographical variation in the Nepal is very high and density of hydrological and meteorological stations is poor and data is collected manually that impacts the quality and timeliness of data that can be used for modeling purposes.

End products of weather and climate services shall usually be freely available for general users. Quality and timeliness would have direct impact in the agriculture (food security), water and health sectors. The clients of weather and climate services shall be Department of Water Induced Disasters, Nepal Electricity Authority, Ministry of Irrigation, and Ministry of Agricultural Development etc. – who are involved in designing projects related to Hydropower Development, Embankments and Irrigation Canals. Also, the project aims to deliver forecast based services to private sector who need specific information – but this is a longer term plan – once the objectives of the PPCR – BRCH is fully operational.



## Institutional and Governance Challenges

- To develop such a sophisticated system to deliver timely climate and weather services to a range of users across various thematic areas across the government, non-government, private users and general public – capacity building of hydrologists and meteorologists at DHM would be key to run and operate the system.
- Flood early warning systems in Nepal are based upon observations and are not informed by meteorological forecasts. To develop a community based end to end early warning system – precipitation forecast products need to be coupled with a suitable hydrological model which would require test runs, iterations and ultimately validation from observed hydrological data during floods to test its reliability.
- Lack of Research and Development Unit within DHM which currently hinders application of novel techniques and pilot new technologies

**B. Summary based upon interviews and consultations with colleagues at RIMES, ICIMOD, IWMI, NARC and inputs from researchers working in the irrigation, water resources management and hydropower sector.**

### Strengthening the Demand

The demand for weather and climate services from the users will come when users are aware regarding the services that are available to them and how these services can add value to their everyday geographies. The users are from the thematic area of agriculture, water resources management, irrigation and health. Users might be planners and developers working in the hydropower sector or farmers working in the agricultural sector that require data on sunshine, rainfall, solar radiation and other climatic data that would impact harvesting.

- Critical to raise awareness of the users at various ministries and departments working in the aforementioned thematic areas and sensitize them regarding the usage of climate and weather services.
- Demand can be demonstrated by piloting projects that require the usage of these services; later the demand can be accessed and services can be up-scaled when demand is there.
- Piloting, up-scaling and user sensitization is required to access the demand side


### Opportunities in South Asia (Nepal Focus)

- In South-East Asia, there exists huge opportunity to customize weather and climate services relevant to the users.
- The major hindrance is that information and data are not customized in a format that is usable for the users working in different sectors.
- Sector wise customization of weather and climate services is an opportunity and has immense potential in the agricultural, water resources management, energy and disaster risk management sector.
- Information available from various sources needs to be collated and there must be a formal dissemination mechanism at the national level
- Dissemination and Customization of information must be sector specific
- Drought forecasting is now being piloted in the Koshi Basin by ICIMOD
- In case of India and Nepal the state agencies in Bihar and Uttar Pradesh are open to dialogue and discussions for collaboration but willingness of state authorities needs to be reflected at the central government level for effective engagement



## Challenges in South Asia (Nepal Focus)

- The major challenge is that the capacity of the national hydrological and meteorological departments is not sufficient due to problems inherent in the institutions and problems associated with staff-turnover and under staffing.
- Technical competence is also lacking along with financial investments by the respective governments to strengthen the national hydro-met systems
- Also, there are significant gaps regarding both the software and hardware components – and database required to manage the data coming from weather and climate services
- In Nepal there is lack of end to end EWS and in between the process of monitoring and dissemination that entails data collection and delivery of warning messages, there exists a disconnect at the local level as users have differential knowledge and government agencies lack capacity to understand the warning messages to deliver effective EWS services – Chain on Information flow is weak
- No safe failure or contingency mechanisms for community based early warning systems on floods and due to a single failure mode - the whole system collapse during extreme events
- High altitude monitoring in Nepal is in a nascent stage and much of the stations have been destroyed after the earthquake, very difficult to manage and gather data due to harsh weather conditions in the Himalayas
- In the agricultural sector, lack of appropriate institutional set up that can generate and process climate related information
- There is weak coordination between public and private sector stakeholders
- Changing scenario of public on water use and opportunities regarding future water availability is a complex issue that needs to be addressed by the interventions that provide astute analysis regarding future water demand-use scenarios for proper planning
- Problem associated with the changes occurred in agricultural technologies after recommended in certain agro-ecological domain; lack of understanding within and between the agricultural ministries and research councils
- Capacity and systems of the government institutions to undertake the agenda of DRR and CC in Nepal is weak; inter-linkages and coordination between the ministries is weak; there are numerous plans and policies in place but implementation is an issue. There are systems in place but unfortunately plans are rarely implemented from the government level due to numerous constraints. While data collection might not be an issue, the capacity and process to analyze them is generally not there.
- There is a major chunk of gap regarding the dissemination of information regarding the impacts that a forecast might bring - such as what amount of rainfall will lead to what impacts (in the water sector(hydropower and irrigation), agriculture, floods , etc)
- There are lot barriers at the central governance level; for example whose responsibility to do what in a project and what has been set out to achieve as there are vested interests in various government departments and many projects do not work. Therefore it makes sense to get to the crux of the problem but that again is hampered by staff turnover and transfers so institutional memory is low in government organizations.
- Complex and multiple stakeholders along with differential understanding lead to mixed responses at the government level. Accountability is simply not clear and not there at the central level. Need a systems approach rather than doing projects that have funding which often hinders sustainability in the long run
- Resource and capacity constraints will always be inherent in Nepal



## Knowledge on Climate and Weather Services

- Users need to have access to long to short duration forecasts and integrate this information to take rational decisions regarding early warning and inform actions related to disaster risk reduction. Most users are not aware that temporal forecasts ranging from months, days to hours are complementary.
- However, it is important to understand that short term forecasts are more accurate and lead time for impending hazard might be increased but there are instances when accuracy is decreased due to uncertainties in the climatic models and the forecasts generated
- In the case of Nepal – there is now-casting and real time data available , however this is very limited as it is provided for the aviation industry

## Input from RIMES

With support from RIMES, Bangladesh has hydrological forecast product and advisories on flash floods for over 40 locations informed by weather forecasts and climate models for Ganges, Meghna and Bhramaputra rivers. Also, they provide monthly hydrographs which is useful for hydropower and water resources management. A similar output is expected for Nepal after the RIMES project is fully operational. RIMES is now supporting the Department of Hydrology and Meteorology in Nepal for a three year project that has the following components:

- Upgrading the monitoring system in Karnali, Babai and Narayani Basins – install hydro-met stations in these aforementioned basins
- Hydrological Modeling using HEC-HMS with Meteorological Inputs
- Training and Capacity Building for DHM Hydrologists and Meteorologists
- Developing National Dissemination Protocol to Communities and Users to meet their needs – generate advisories and bulletins for specific sectors on EWS, DRR and water sectors (Irrigation and Hydropower via hydrographs)

The end product after this association would be to not only develop the capacity of the hydrologist and meteorologists at DHM, but also train them to build and customize the model, and improve the capacity for DHM to provide meteorological forecasts that can be used to input in the hydrological model.

There are numerous challenges in terms of data acquisition for Nepal as most of the stations are operated manually and density of hydro-met stations is usually poor. Moreover, data recording mechanism is not good coupled with inconsistencies associated with recording during extreme weather events as data is not continuous.

## Conclusions:

- Collaboration with ongoing projects rather than duplication to add value to ongoing interventions
- Projects via the PPCR and RIMES are focused on strengthening the national hydrological and meteorological services
- ICIMOD works on regional collaboration with focus more on the policy level yet there are constraints regarding sharing of trans-boundary data that hinders
- SAARC Met Research Offices and Disaster Management need to be actively engaged at the regional level

## Interviewees

Name	Position/Institution	Organisation Type
Dr. Arun Shrestha	ICIMOD	Intermediary/User
Dr. Dilip Gautam	RIMES	Provider
Mr. Utsav Bhattarai	IWMI (Consultant)	Intermediary/User
Mr. Saraju Baidya	Deputy Director General, DHM	Provider (NHMS)
Mr. Binod Parajuli	Hydrologist, Flood Forecasting Section, DHM	Provider (NHMS)
Mr. Sam Rose	DFID Nepal	Donor
Ms. Vidhisa	ADB Nepal	Donor
Ms. Poonam Pillai	World Bank Nepal	Donor
Ms. Sudha Sapkota	National Agricultural Research Council	Intermediary/User
Mr. Rocky Talchabadel	DHM	Provider (NHMS)
Prof. Dr. Bal Krishna Sapkota	Climate Change and Development Program, Tribhuvan University	Intermediary/User



## Annex 11 Workshop Agenda

### **Options Analysis for a Regional Climate Change Programme to deliver more effective Climate Services, Early Warning and Disaster Risk Reduction**

#### **Objectives:**

1. Discuss and agree the core themes/outputs for the South Asia Climate Services programme.

*Draft core programme themes (emerging from literature review and consultations):*

- Strengthening observational network & Climate data management for generation of weather and climate information in south Asia region
- Strengthening the capacity of NMHS in generating, enhancing the quality of climate products through innovative research programme that builds the capacity of South Asian research community
- Translation of climate / risk information into decision options and enhancing communication for better climate services in South Asian region
- Enhancing linkage between NMHS and user communities in South Asia region
- Regional cooperation for enhancing climate services to different sectors in South Asia in addressing regional / sub regional issues

2. Prioritise key activities under each theme to form programme of intervention options.

#### **Agenda:**


Time	Item	Lead
10:30 – 10:35	Introductions	All
10:35 – 10:45	Introduction to South Asia Climate Services programme	DFID
10:45 – 10:55	Overview of activity on project so far	PAC
11:00 – 12:00	Agree core themes for project	In groups
12:00 – 12:30	prioritisation of activities under each theme (5 groups)	In groups
12:30 – 13:30	Groups to present back ideas for wider group discussion	All
13:30	Lunch	



## Annex 12 Met Office Workshop Notes

### Summary of discussions:

1. In general, the intervention themes and activities make sense and are required. In the DFID CIASA project, a couple of areas were higher priority, for example *Governance and supporting an enabling environment for provision/uptake of climate services*, promoting activities such as raising the profile of NHMSs across Government and providing incentives / supporting mechanism for data sharing. One support mechanism may be providing better information on the benefits of information sharing to influence at both regional and national levels.
2. A key point, made previously, is that intervention themes/options require more detail. Some are very generic and could apply to any country. For example, rather than referring to 3-5 pilots we should actually make suggestions for where these could be and what they could focus on. Following on from the DFID CIASA project, a couple of programmes have are being funded (see info on WISER below), this includes a focus on Lake Victoria as a case study, where there was already considerable momentum e.g. WMO SWFDP and Nowcasting projects and a focus on the East Africa region.
3. Terminology is key. For the DFID (WISER) Weather and climate Information and Services for Africa (which is the follow on to CIASA see link - <http://devtracker.dfid.gov.uk/regions/> - the term “end users” is avoided (implying a chain / flow in one direction) and the term co-production is used for developing climate information services.
4. For strengthening links between providers, intermediaries, users etc., there should be a “pre-activity”. Mapping and identifying the needs of different groups - For example would you look at Nepal, Bhutan other Himlayan countries together to identify common characteristics, community needs and responses etc? See comment on starting to identify what the case studies could be – this sort of characterisation could inform case study selection and focus.
5. For “strengthening regional networks to generate knowledge on climate products and services” – Firstly it was felt that this should be priority number 1. It will also be important to ensure this covers sub-regional and national / sub-national levels.
6. Regional advisory teams (noting comment re. sub-regional) should also include other players such as academic / research institutes (as information providers) and e.g. National Parks, Irrigation and water boards as well as NMHSs – show a better understanding of who the key stakeholder would be at the various levels.
7. The role and importance of universities and research centres in South Asia should be noted. These are much stronger than for Africa. Interventions should focus on the full range of information providers rather than the current focus on NHMSs. This is supported in previous comments from DFID at the last meeting. For example in Indian Institute of Tropical Meteorology (<http://www.tropmet.res.in/>) and the energy and resources institute, TERI (<http://www.teriin.org/>) interact with Government and play a role in data provision.
8. There is confusion over CORDEX, noting that it is the countries themselves that are mandated to provide information. What specifically would this provide, how would it enable other activities?

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9. One thing that came under the Governance and Enabling theme for Africa was the need to provide assistance to NMHSs to develop 5 year plans – these should look ahead and help identify and coordinate potential donor investments in a structured way, rather than reactively. A similar activity (noting comment about including other key stakeholders, made here and by DFID also) should be included.
  10. In Africa there is ANCOMET <http://www.wmo.int/amcomet/> whose objective is to raise awareness on weather issues at Ministerial level. There are varying views on how effective this is but the point is there is a regional body / activity that has a mandate to raise awareness on weather and climate – it is not clear whether anything similar exists for South Asia, but this could be useful.
  11. Suggest that we link the intervention themes and activities to how they will contribute to delivery of DFID objectives. This will be important to inform business case development. So suggest this could include linking to:
    - Delivery of Sustainable Development Goals  
<https://sustainabledevelopment.un.org/topics/sustainabledevelopmentgoals>. Latest proposal for the SDGs (to be confirmed in September in NYC at the UN General Assembly) – there is a Post-2015 summit happening around this time a <https://sustainabledevelopment.un.org/sdgsproposal>
    - Most information relating to DFID business objectives online relates to the 2011-15 business plan. E.g. link measures to Departmental remit and priorities - <https://www.gov.uk/government/organisations/department-for-international-development/about>
    - Review the recent Sendai post 2015 framework for DRR  
<http://www.unisdr.org/we/coordinate/hfa-post2015>. See attached the highlighted Sendai Framework for Action – key references to science engagement for DRR on here.
  12. Consider making reference to the Association of Southeast Asian Nations (ASEAN) noting that Burma is one of the ten member countries and that there is emerging dialogue with some of the other countries we are covering e.g. India  
<http://www.asean.org/news/item/overview-of-asean-india-dialogue-relations> and Nepal <https://ideas.repec.org/p/iim/iimawp/wp00529.html>. How can these inform, link to / facilitate a regional programme of activity?
  13. Additional information points on current / planned interventions include:
    - USAID announced the launch of a new public-private partnership, Climate Services for Resilient Development.
    - Check the UNDP /GEF Multi-country Support Programme to Strengthen Climate Information for Resilient Development and Adaptation to Climate Change in Africa (CIRDA) <http://www.undp-alm.org/projects/cirda>. This may have some useful activities that could inform design of the programme for South Asia.
    - World Bank South Asia Programme: Focus countries are Nepal, Bangladesh, Bhutan, Sri Lanka and India – Nepal has received funding from the Pilot Programme for Climate Resilience to get this programme up and running – the UK Met Office is supporting part of the big project by working with Finnish



Meteorological Institute (FMI) and the local met service to improve their capacity for EWS.

- World Bank Hydromet Support Programme for Myanmar, Cambodia and Laos. There are three key focus countries at the moment where they are hoping to establish 'Systems Integrator' projects so ensure better coordinated funding for support to countries to improve their water management systems and also some funding going to improving capacity of hydromet services.
- World Bank WMO Socio Economic Benefits of Met Services publication which may be of interest. Also, see below a link to the WB WMO SEB publication and another which WB shared with the UK Met office recently which may also be of interest. [http://library.wmo.int/opac/index.php?lvl=notice\\_display&id=17225#.VWcEPxBBvqB](http://library.wmo.int/opac/index.php?lvl=notice_display&id=17225#.VWcEPxBBvqB)
- Otherwise there are a lot of water supply, water management programmes being supported by the World Bank across Asia – it may be worth contacting the country offices in each country to get their views on any regional programmes which support their endeavours.
- UNDP – ECCA ASIA - <http://www.undp-alm.org/projects/ecca-asia> - A capacity building programme on the Economics of Climate Change Adaptation (ECCA) in Asia is a cooperative effort between UNDP, the USAID ADAPT Asia-Pacific Project, the Asian Development Bank (ADB), the Global Water Partnership (GWP) and Yale University. It addresses a consensus reached during a 2012 Regional Consultation that a more comprehensive approach to mainstreaming climate change risks into planning processes was needed to ensure economically-efficient climate change strategies at the sectoral, sub-national and national levels. Reports/Publications which might be useful: <http://www.undp-alm.org/projects/ecca-asia/reports-and-publications>. There are some Community of Practices coming out of this programme: <http://www.undp-alm.org/projects/ecca-asia/meetings-and-workshops>
- Finally see article on water scarcity which may be of interest – UNESCO: <http://www.in.undp.org/content/india/en/home/presscenter/pressreleases/2015/03/20/world-water-day-2015.html>
- The WMO Severe Weather Forecast Demonstration Projects provides useful learning <http://www.wmo.int/pages/prog/www/swfdp/>. There are plans to extend this to South Asia.

14. Some perspectives on donors/funders (individual views):

- UNDP seem focused on older ways of funding i.e. funding equipment rather than capacity development/supplying equipment which is the same as existing equipment not being used.
- UNISDR are not a donor as such/DRR policy organisation only but relevant in terms of development agencies being keen to demonstrate how they are tackling the wider DRR global issues.



- World Bank – understand the need to change its programme approach and is making changes – i.e. hydromet support programme for Africa – clear assessment and design in place before programme delivery.
15. Increasing demand of climate information. Would it not be better to talk about strengthening value or use of climate information rather than demand?
  16. The comment about co-producing information still stands however, that should not replace the term end users. Co-production should be promoted as this will increase likelihood of uptake / use by end-users (for a number of reasons e.g. increased buy-in, product is user designed/orientated, better sense of co-ownership and therefore more trust , confidence etc.)
  17. It should be clarified whether (from DFIDs perspective) this programme is on weather and climate or just climate.
  18. Activities relating to ICT:
    - It could be very hard or impossible for DFID to achieve anything here – so suggest lower down priority chain than activities relating to strengthening governance, promoting benefits, improving understanding and uptake by communities, supporting applied research etc.
    - If keeping this would fall under both supply and demand
  19. May be worth engaging WMO GFCS leads directly on what they have planned and what they see as gaps in the region (this has been done for CIASA).



### Annex 13 User and Intermediaries and their Information Needs

This table has been compiled based on a website search and by drawing on the stakeholder interviews and workshops. It has also benefited from input provided by the consultancy team members and their professional contacts, which include experts working in the priority sectors across the focus countries of this scoping study.

Sector	Type	Level	Stakeholders	Type of climate information required	Decisions and actions dependent on this information	Incentives and drivers to use climate information and services
All Sectors	Intermediaries	Regional	Agriculture Consulting and Training (ACT); Asian Development Bank (ADB); Australian Agency for International Development (AusAid); Climate and Development Knowledge Network (CDKN) Asia; Coordinated Regional Climate Downscaling Experiment (CORDEX); DFID Asia Regional Team; European Commission (EC); European Union (EU); Global Environmental Facility (GEF); Gesellschaft für Internationale Zusammenarbeit (GIZ); International Centre for International Agricultural and Rural Development (IARD); Integrated Mountain Development (ICIMOD); International Union for Conservation of nature (IUCN); Practical Action South Asia; PricewaterhouseCoopers (PWC); Red Cross Climate Centre; South Asia Association for Regional Cooperation (SAARC); SAARC Meteorological Centre; South Asia Climate Outlook Forum (SASCOF); Swiss Agency for Development and Cooperation (SDC); Swedish International Development Cooperation Agency (SIDA); United Kingdom Agency for International Development (UKaid); United Nations Development Programme (UNDP); United Nations Environment Programme (UNEP); United States Agency for International Development (USAID); World Bank	<ul style="list-style-type: none"> <li>a. Weather outlook at regional / national / local scales</li> <li>b. Observation networks for precise observational records</li> <li>c. Historical records on climatic extremes and its impact on different sectors</li> <li>d. Climate change vulnerability and risk assessment and climate proofing</li> <li>e. Accurate climate observations</li> <li>f. Historical climate records</li> <li>g. Frequency of occurrence of extreme weather events and impact on various sectors</li> <li>h. Changes in monsoon rainfall</li> <li>i. Information on changing climate trends</li> <li>j. Disaster prediction and warning</li> </ul>	<ul style="list-style-type: none"> <li>a. Guiding development of strategic frameworks for sectoral management</li> <li>b. Regional programme and policy design</li> <li>c. Guiding research priorities</li> <li>d. Guiding short, medium and long-term investment decisions</li> <li>e. Conducting climate change impact assessments and risk assessments</li> <li>f. Developing and prioritising adaptation options</li> <li>g. Strengthening public management systems</li> <li>h. Development of climate services products</li> <li>i. Strengthening early warning systems</li> <li>j. Developing regional climate outlooks</li> </ul>	<ul style="list-style-type: none"> <li>a. Improved understanding of regional climate</li> <li>b. Better capacity to design and deliver sustainable sectoral strategies</li> <li>c. Helping avoid the runaway costs of climate change</li> <li>d. Improving free exchange of climate data</li> <li>e. Building the resilience of societies</li> <li>f. Enhancing national, regional and global security</li> <li>g. Delivering benefits to low-income households</li> <li>h. Optimizing long term investments</li> <li>i. Fewer losses in lives and assets due to improved accuracy in prediction of climate factors</li> <li>j. Improving preparedness for and response to disaster events</li> </ul>



Sector	Type	Level	Stakeholders	Type of climate information required	Decisions and actions dependent on this information	Incentives and drivers to use climate information and services
	Intermediaries	National	India Meteorological Department Afghanistan Meteorological Authority Bangladesh Meteorological Department Bhutan Department of Hydro-meteorological Service Nepal Meteorological Forecasting Division Pakistan Meteorological Department Burma Department of Meteorology and Hydrology	a. Climate change trends and short/medium/long-term projections b. Past impacts of climate change c. Early warning of extreme weather events d. Frequency and probability of extreme events e. Onset of monsoon f. Prolonged wet and/or dry spells g. Cyclone tracking h. Monitoring heat waves and cold waves	a. Providing climate information to national and sub-national users b. Providing short, medium and long range climate forecasts c. Providing information on extreme weather events to national EWS d. Development of climate services products	e. Better understanding of national and local climate conditions f. Improvements in forecasting skills g. Strengthening early warning systems h. Reduction in losses relating to lives, assets and infrastructure i. Better capacity to deliver timely and quality climate information and services
Agriculture	Intermediaries	Regional	International/regional agricultural research institutes International Crops Research Institute for Semi-Arid Tropics (ICRISAT), International Agriculture Research Centres; CGIAR centres; The World Vegetable Center (AVRDC); International Centre of Insect Physiology and Ecology (ICIPE); International Fertilizer Development Center (IFDC), ICIMOD; Tropical Agricultural Research and Higher Education Center; International Center for Bio-saline Agriculture (ICBA); Centre for Agricultural Bioscience International (CABI); Crops for the Future (CFF); Asia–Pacific Association of Agricultural Research Institutions (APAARI); Agricultural Research for Development (ARD) in South Asia; The Borlaug Institute for South Asia (BISA); International Center for Agricultural Research in the Dry Areas (ICARDA); Global Change Impact Studies Centre (GCISC); Private providers: E.g. Skymet, Thompson Reuters	a. Short, medium and long range climate trends and forecasts, including seasonal climate forecasts b. Frequency and probability of extreme weather events c. ENSO status d. Monsoon status e. Historical impacts of climate change f. Early warning of extreme weather events g. Monitoring heat waves and cold waves	a. Guiding research priorities b. Climate change vulnerability and risk assessment c. Development of risk identification policy d. Strengthening early warning systems e. Identification of good agricultural practices f. Strengthening agricultural education, training and knowledge transfer	a. Enabling inclusive and sustainable growth in agriculture sector in the region b. Enhancing agricultural sector productivity c. Ensuring regional food security d. Optimizing investments



Sector	Type	Level	Stakeholders	Type of climate information required	Decisions and actions dependent on this information	Incentives and drivers to use climate information and services
Agriculture	Intermediaries	National	<p>Agricultural research institutes/councils</p> <p><i>Afghanistan: Agricultural Research Institute of Afghanistan (ARIA)</i></p> <p><i>Bangladesh: Bangladesh Agricultural Research Council (BARC), Bangladesh Agricultural Research Institute (BARI)</i></p> <p><i>Bhutan: National Agriculture Training Institute</i></p> <p><i>Burma: Yezin Agricultural University</i></p> <p><i>India: Indian Agricultural Research Institute (IARI), Indian Council of Agricultural Research (ICAR), International Society for Tropical Ecology (ISTE)</i></p> <p><i>Nepal: Nepal Agricultural Research Council (NARC)</i></p> <p><i>Pakistan: Asian- Pacific Weed Science Society, Agriculture Research Institute, Agriculture Training Institute, Central Cotton Research Institute, Pakistan Agricultural Research Council (PARC), Central Agricultural University</i></p> <p>NGOs: e.g. M.S.Swaminathan Foundation</p>	<ul style="list-style-type: none"> <li>a. Historical climate data</li> <li>b. Seamless weather forecast information</li> <li>c. Future climate prediction at different time scale</li> <li>d. Hydro meteorological forecasts</li> </ul>	<ul style="list-style-type: none"> <li>a. Production of hydro meteorological forecasts</li> <li>b. Packaging climate information into climate services</li> <li>c. Seamless weather forecast information with agro-advisories</li> <li>d. Development of adaptation strategies</li> <li>e. Training and capacity building</li> <li>f. Risk and vulnerability assessment</li> <li>g. Provision of climate services data to national and sub-national stakeholders in the agricultural sector</li> <li>h. Strategic framework for agriculture management</li> <li>i. Emergency / contingency planning and coordination with aid agencies</li> </ul>	<ul style="list-style-type: none"> <li>a. Ensuring food security</li> <li>b. Enhancing agricultural productivity</li> <li>c. Build resilience by empowering farmers to anticipate and manage climate related hazards</li> <li>d. Providing more relevant and useful climate services</li> </ul>



Agriculture	Intermediaries	Sub-national	<p>Agricultural universities and research institutes</p> <p><i>Afghanistan:</i> <b>College of Agriculture and Natural Resources</b>, Kabul University</p> <p><i>Bangladesh:</i> Bangladesh Agricultural University; Bangladesh Centre for Advanced Studies (BCAS)</p> <p><i>Bhutan:</i> College of Natural Resources (CNR)</p> <p><i>Burma:</i> Yezin Agricultural University</p> <p><i>India:</i> State Agricultural Universities (SAUs) including: Agro Climate Research Centre, ANGR Agricultural University (Andhra Pradesh), Tamil Nadu Agricultural University, Punjab Agricultural University, Hissar Agricultural University (Haryana), Keral Agricultural University, Acharya N. G. Ranga Agricultural University (AP), Professor Jayashankar Telangana State Agricultural University (PJTSAU), Mahatma Phule Krishi Vidyapeeth (Maharashtra), Dr. Panjabrao Deshmukh Krishi Vidyapeeth (Maharashtra), Marathwada Agricultural University (Maharashtra), Nimbkar Agricultural Research Institute (Maharashtra), Orissa University of Agriculture and Technology (OUAT), Jawaharlal Nehru Krishi Vishwa Vidyalaya (MP), Rajmata Vijayaraje Scindia Krishi Vishwavidyalaya (MP), G. B. Pant University of Agriculture and Technology (UP)</p> <p><i>Pakistan:</i> University of Agriculture, Faisalabad; Faculty of Agriculture Gomal university, D.I. Khan; University College of Agriculture and Environmental sciences, Bahawalpur; University of Agriculture, Peshawar; Lasbela University of Agriculture, Water and Marine Sciences, Othal, Lasbela District; Sindh Agriculture University, Tando Jam; University College of Agriculture, Rawalakot; Dera Ghazi Khan College of Agriculture, University of Agriculture, Faisalabad; University of Poonch Rawalakot, Azad Kashmir; University College of Agriculture, University of Sargodha, PMAS-Arid Agriculture University, Rawalpindi, Agriculture Research Institute (ARI), Quetta</p>	<ul style="list-style-type: none"> <li>a. Normal or average climate conditions (local scale)</li> <li>b. Forecasts of air temperature, sky conditions, precipitation probabilities, Wind speed and wind direction</li> <li>c. Weather disease and weather insect interactions</li> <li>d. ENSO status / condition and its expected impact on crop production</li> </ul>	<ul style="list-style-type: none"> <li>a. Production of hydro meteorological forecasts</li> <li>b. Packaging climate information into climate services</li> <li>c. Seamless weather forecast information with agro advisories</li> <li>d. Development of adaptation strategies</li> <li>e. Training and capacity building</li> <li>f. Risk assessment</li> <li>g. Provision of climate services data to sub-national stakeholders</li> <li>h. Strategic framework for agriculture management</li> <li>i. Emergency / contingency planning and coordination with aid agencies</li> <li>j. Provision of agro-advisories for key crops and livestock</li> <li>k. Issuing early warnings to communities and other players as necessary</li> </ul>	<ul style="list-style-type: none"> <li>a. Ensuring food security</li> <li>b. Enhancing agricultural productivity</li> <li>c. Build resilience by empowering farmers to anticipate and manage climate related hazards</li> <li>d. Providing more relevant and useful climate services</li> <li>e. Ensuring safety of the fishermen community</li> </ul>



Sector	Type	Level	Stakeholders	Type of climate information required	Decisions and actions dependent on this information	Incentives and drivers to use climate information and services
			<i>Nepal:</i> Agriculture and Forestry University (AFU), Institute of Agriculture and Animal Science (IAAS)			
Agriculture	Users	Regional	<p>International Financial Institutions: The CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS); International Centre for Tropical Agriculture (CIAT); International Fund for Agricultural Development (IFAD) Bi-lateral and multilateral donors SDA; DANIDA; UNEP; International Food Policy Research Institute (IFPRI) mission in South Asia; SAARC; Global Fund; USAID Extension services: Agricultural Extension in South Asia (AESAs) Emergency planners Ministry of Agriculture, Department of Agriculture &amp; Cooperation, Natural Disaster Management, Soil conservation agencies Erosion technology council, USDA-ARS National erosion research laboratory(India, USA), Regional NGOs Practical Action South Asia, BRAC Media and telecommunications, and communication services</p>	<ul style="list-style-type: none"> <li>a. Seasonal climate forecast</li> <li>b. Probability of occurrence of extreme weather events like flood, drought, extreme temperatures, cyclonic events in the season</li> <li>c. Progress of monsoon</li> </ul>	<ul style="list-style-type: none"> <li>a. Regional agricultural and food security development plans and operational policy</li> <li>b. Strengthening public management systems</li> <li>c. Determination of short / medium / long term investment and financial support</li> <li>d. Developing climate services</li> <li>e. Provision of in-situ networks</li> <li>f. Improving free exchange of climate data</li> <li>g. Risk assessments</li> <li>h. Introduction of climate resilient crop varieties</li> </ul>	<ul style="list-style-type: none"> <li>a. Improving regional food security</li> <li>b. Increasing agricultural productivity</li> <li>c. Improved environmental health</li> <li>d. Improved rural livelihoods</li> <li>e. Enhanced adaptive capacity in agriculture, natural resource management and food systems</li> </ul>



Agriculture	Users	<p>Government Ministries of Agriculture, Food Security and Rural Development and extension services:  <i>India:</i> Krishi Vigyan Kendra (KVKs); <i>Nepal:</i> <b>Directorate of Agricultural Training (DAT), Nepalese Farming Institute, Nepalese Training Centre of Agriculture; Bangladesh:</b> <b>Department of Agricultural Extension</b>            NGOs: <i>India:</i> M.S. Swaminathan Research Foundation, Green Care Foundation (Tamil Nadu), Action for Food Production –AFPRO (AP), Agricultural Development &amp; Training Society- ADATS (Karnataka), Action For Agricultural Renewal in Maharashtra (AFARM), <b>Action For Social Development (MP), Centre for Advanced Research and Development (MP)</b>, Belal Welfare Association (UP), Bright Way Foundation (UP), Society For Eradication Of Rural Poverty through Agro-Livestock Services (SERPALS), Professional Assistance for Development Action (PRADAN), Pragati Koraput, Voluntary Association for Rural Reconstruction &amp; Appropriate Technology (VARRAT), the BAIF Development Research Foundation, Samaj Pragati Sahayog (SPS), ACCESS Development Services, and Action for Social Development (ASA); <i>Nepal:</i> Bio-organic Agriculture Center in Nepal, CEPREAD, RRN, <i>Afghanistan:</i> Agha Khan Foundation; <i>Bangladesh:</i> BRAC, CARE Bangladesh, World Vision, Winrock International            Seed distributors: State agricultural departments; Agricultural marketing boards such as Andhra Pradesh State Seeds Development Corp. L , Palamoor Seeds; Namdhari Seeds, R K Seeds Farms, National seed association of India, <i>Tamil Nadu:</i> Rasi seeds, <i>Maharashtra:</i> K.Shanti Seeds Company, <i>Uttar Pradesh:</i> U.P. Seeds &amp; Tarai Development Corporation Ltd, <i>Haryana:</i> Haryana Seeds Development Corporation Limited</p>	<ul style="list-style-type: none"> <li>a. Inflows into reservoirs</li> <li>b. Monsoon status, departure of monsoon rainfall from the normal conditions</li> <li>c. Seamless weather forecast information</li> <li>d. Coastal flood warnings</li> <li>e. Warnings to fishermen community</li> <li>f. Early warning of extreme events (hurricane, flood, tornado, drought, heat wave, cold wave, winter storms, ice storms)</li> </ul>	<ul style="list-style-type: none"> <li>a. National level policy and development plans</li> <li>b. Building the capacity of Met department staff on cyclone tracking and weather predictions</li> <li>c. Provision of climate services data to national and sub-national stakeholders</li> <li>d. Strategic framework for agriculture management</li> <li>e. Emergency / contingency planning and coordination with aid agencies</li> <li>f. National and state level inputs operations policy</li> <li>g. Planning for the purchase of inputs</li> <li>h. Developing and implementing agriculture risk management/ plans</li> <li>i. Planning risk insurance operations</li> <li>j. Weather based crop insurance product development</li> <li>k. Inform communities of crop production risks</li> <li>l. Producing agro advisory bulletins, as well as information on crops and livestock choices, technologies, adaptive management practices (irrigation, crop management etc.)</li> <li>m. Warning relevant players about extreme events</li> </ul>	<ul style="list-style-type: none"> <li>a. Improved food security</li> <li>b. Increasing agricultural productivity</li> <li>c. Building resilience by empowering farmers to anticipate and manage climate related hazard</li> <li>d. Empowering farmers to manage uncertainties, inherent in climate forecasting</li> <li>e. Increasing profitability of agribusinesses (e.g. seed companies, input/supply companies, feed companies, food and biofuel companies)</li> </ul>
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Sector	Type	Level	Stakeholders	Type of climate information required	Decisions and actions dependent on this information	Incentives and drivers to use climate information and services
			<p>Fertilizer industry: <i>India</i>: Nagarjuna Fertilizers and Chemicals Ltd; Zuari Agro Chemicals Ltd; SPIC fertilizer company; K.P.R. Fertilisers Limited; Multiplex; Fertilizers Pvt. Ltd; Shiva Global Agro Industries Ltd.; Gujarat Narmada Valley Fertilizers &amp; Chemicals Ltd</p> <p>Risk Insurance companies: <i>India</i>: Agricultural Insurance Corporation; <i>Pakistan</i>: United Insurance Company of Pakistan Ltd; National Insurance Company Ltd (NICL); <i>Bhutan</i>: Royal Insurance Corporation</p>		<p>n. Vulnerability mapping and risk assessments</p> <p>o. Estimating agricultural productivity</p>	



Agriculture	Users	Sub-national	<p>State Government Ministries of Agriculture; District level agricultural sector managers; Agrometeorological Field Units (AMFUs); Agricultural universities;</p> <p><b>Emergency planners;</b> District administration</p> <p><b>Extension services:</b> <i>Afghanistan: Agriculture Extension General Directorate, Ministry of Rural Rehabilitation and Development (MRRD) and the Afghanistan Institute of Rural Development (AIRD)</i> <i>India: State Department of Agriculture, Krishi Vigyan Kendra (KVKs),</i> <i>Nepal : Nepalese Farming Institute, Nepalese Training centre of Agriculture</i> <i>Bangladesh : Department of Agriculture</i></p> <p><b>Extension</b> <b>Farmers and farmers organisations</b> <b>Pakistan : Pakistan’s extension services under Ministry of Agriculture, Private extension field staff</b> <b>Bhutan: Dzongkhag Extension Service, Department of Agriculture with Research and Development Centres</b> <b>Local NGOs:</b> (for example) <i>India: Development of Humane Action (DHAN) Foundation (Tamil Nadu), Nanndi Foundation (AP), Agriculture, Man and Ecology (Karnataka), Jai Kisan Krishi Shikshan Sanstha (Maharashtra), <b>Action For Social Development (MP)</b>, Chambal Ghati Gramya Jeevan Vikas Parishad (UP), Jan Sahyog Evam Gramin Vikas Sansthan (UP)</i> <i>Nepal: The women’s foundation Nepal; Bio-organic Agriculture Center in Nepal</i> Farmers and farmers association: Bhutan: Smallholder Dairy Farmers’ Group Development, Bangladesh: CARE</p> <p><b>Media and telecommunications, and communication services</b></p>	<ul style="list-style-type: none"> <li>a. Seasonal climate prediction</li> <li>b. Seamless weather forecast on rainfall, temperature, wind speed, cloud cover</li> <li>c. Anticipated wet and dry spells, temperature extremes, Onset and withdrawal of monsoon rainfall</li> <li>d. Weather based Pest and disease forewarning</li> <li>e. Early warning of extreme events (hurricane, flood, tornado, drought, heat wave, cold wave, winter storms, ice storms)</li> <li>f. Forewarning of occurrence of cyclone with wind speed, quantum of rainfall, time and location of land fall including tracking of cyclonic path</li> </ul>	<ul style="list-style-type: none"> <li>a. State and local level operations policy</li> <li>b. Planning for the purchase of inputs</li> <li>c. Warning relevant public and private sector players of any potential emergencies</li> <li>d. Warn communities about impending hazards</li> <li>e. Producing agro advisory bulletins, as well as information on crops and livestock choices, technologies, adaptive management practices (irrigation, crop management etc.)</li> <li>f. Raising awareness amongst communities about the impacts of climate change, especially for women</li> <li>g. Provide community training</li> <li>h. Production and communication of climate information and advisory services</li> <li>i. Use of crop simulation models and pest and disease forewarning models for agro advisories</li> <li>j. Risk and vulnerability mapping</li> <li>k. Estimating agricultural productivity</li> </ul>	<ul style="list-style-type: none"> <li>a. Increase input use efficiency</li> <li>b. Increasing household income</li> <li>c. Increasing household food security</li> <li>d. Avoiding crop losses</li> <li>e. Enhancing income from livestock sector</li> <li>f. Reduction in cost of cultivation</li> </ul>
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Sector	Type	Level	Stakeholders	Type of climate information required	Decisions and actions dependent on this information	Incentives and drivers to use climate information and services
Agriculture	Users	Last Mile	Pastoralists, farmers, farmers clubs/ associations, fisher folk, fisherman forums	<ul style="list-style-type: none"> <li>a. Location specific data including:</li> <li>b. Real time weather information</li> <li>c. Temperature outlook (weekly, sub-seasonal and seasonal)</li> <li>d. Bi-weekly/weekly agro advisories on key crops and livestock prepared and disseminated at local level in local languages through different channels, such as television, websites, SMS, radio, call centres, public address systems, meetings and village knowledge centres</li> <li>e. Potential impacts of climate change on crops/livestock/management practices</li> <li>f. Sea conditions and significant weather patterns like wind speed and direction, rain, poor visibility, storms, etc.</li> <li>g. Likelihood, timing and potential impacts of severe weather events</li> </ul>	<ul style="list-style-type: none"> <li>a. Selection of cultivars</li> <li>b. Choices regarding cropping patterns, irrigation practices, infrastructure construction, pest management etc.</li> <li>c. Livestock selection and management practices</li> <li>d. Decide timing of application of fertilizer, pesticide etc.</li> <li>e. Determine right harvest time and manage risks in harvest operations</li> <li>f. Purchase appropriate seeds</li> <li>g. Anticipated wet and dry spells, temperature extremes</li> <li>h. Estimating crop/livestock/fishery yields</li> <li>i. Longer term forecasts required to advise on perennial costs and other investments such as soil erosion infrastructure</li> <li>j. Some farmer use the information to decide whether to work on their own farms or opt for manual labour</li> <li>k. Early warning of drought conditions to reduce moisture stress</li> </ul>	<ul style="list-style-type: none"> <li>a. Improved yields</li> <li>b. Improved access to food</li> <li>c. Reduce input costs (water/irrigation, fertilizer, pesticides, labour etc.)</li> <li>d. Increase income</li> <li>e. Better fodder conservation</li> <li>f. Reduced losses due to damages</li> </ul>



Sector	Type	Level	Stakeholders	Type of climate information required	Decisions and actions dependent on this information	Incentives and drivers to use climate information and services
DRR	Intermediaries	Regional	<p>SAARC Disaster Management Centre, South Asia Region Disaster Risk Management and Climate Change Unit (World bank Group), United Nations International Strategy for Disaster Reduction (UNISDR); Global Facility for Disaster Reduction and Recovery (GFDRR); International Strategy for Disaster Reduction (ISDR); Asian Disaster Preparedness Centre (ADPC); ISDR Asian Partnership on Disaster Reduction (IAP); Asian Disaster Response Center (ADRC); Worldwide Fund for Nature; World Vision</p> <p><b>Bilateral Agencies:</b> Australian Agency for International Development (AusAID); Canadian International Development Agency (CIDA/ACDI); Department for International Development; European Commission (EC); Royal Ministry for Foreign Affairs, Norway; Swedish International Development Cooperation Agency; Swiss Agency for Development and Cooperation; United States Agency for International Development</p> <p><b>NGOs:</b> Duryog Nivaran; BOND Disaster Risk Reduction Group (UK); Action Aid, Action against Hunger UK, British Red Cross, CAFOD (Catholic Fund for Overseas Development), CARE UK, Christian Aid, HelpAge International, Islamic Relief, ITDG (Intermediate Technology Development Group), Oxfam, Red Cross Regional Centre CARE (Bangladesh), Action Aid (Bangladesh), Oxfam (Bangladesh), Practical Action, CARITAS (Bangladesh), Concern Worldwide; Lutheran World Relief; Mercy Corps; Americares; Counterpart International; Plan International; Relief International; Samaritan's Purse</p>	<ul style="list-style-type: none"> <li>a. Climate and weather changes in the region</li> <li>b. Frequency and occurrence of natural disasters</li> <li>c. Early warning / Forecasting natural disasters</li> <li>d. Early detection of extreme events (drought / flood)</li> <li>e. Migration of ITCZ</li> <li>f. Real-time information on disaster events</li> </ul>	<ul style="list-style-type: none"> <li>a. Guiding scientific research priorities on hot spot areas / disaster prone regions</li> <li>b. Development and implementation of regional DRR policy and plans</li> <li>c. Guiding short, medium and long-term investments</li> <li>d. Forecasting natural disasters</li> <li>e. Real-time information on disastrous elements</li> <li>f. Hazard and disaster mapping</li> <li>g. Vulnerability and risk assessment</li> <li>h. Early detection of extreme events (drought / flood)</li> <li>i. Training and capacity building</li> </ul>	<ul style="list-style-type: none"> <li>a. Prevention, preparedness, response and recovery of disaster</li> <li>b. Saving lives</li> <li>c. Reducing asset and property loss</li> <li>d. Reducing infrastructure damage</li> <li>e. Protecting investments</li> <li>f. Reduced expenditure for management of contagious diseases</li> <li>g. Enhancement in emergency response capacity</li> <li>h. Strategic investment</li> </ul>



DRR	Intermediaries	<p><b>National</b></p> <p><b>National research institutes</b>  <i>India:</i> National <i>Institute of Disaster Management</i>, All India Disaster Mitigation Institute, National Disaster Management Authority, State Disaster Management Authority, National Disaster Response Force, <b>Centre for Disaster Management</b>, Centre for Disaster Risk Reduction, National Institute of Technology Karnataka  <i>Pakistan:</i> National Disaster Management Authority, District Disaster Management Authority, National <i>Institute of Disaster Management</i>  <i>Nepal:</i> <i>Nepal Centre for Disaster Management</i>, <i>Institute of Engineering</i>  <i>Bhutan:</i> Department of Disaster Management, Asian Disaster Reduction Centre, <i>Bhutan National Disaster Management Authority</i>  <i>Afghanistan:</i> <i>Afghanistan National Disaster Management Authority</i>, Disaster Management Centre  <i>Bangladesh:</i> Institute of Disaster Management and Vulnerability Studies, <i>Disaster Management Institute</i>  <b>Consulting companies:</b> WoTR, PAC  <b>NGOs:</b> MBPI (India); Integrated Development Foundation (Patna, India); RedR (India); SEEDS (India); NSET (India), Swaminathan Foundation (India); DPNet (Nepal); MARD (Vietnam); Bangladesh Centre for Advanced Studies (BCAS);  <b>Bangladesh:</b> NAPA, BCCSAP  <b>Nepal:</b> NGOs Federation of Nepal  <b>Pakistan:</b> Concern Worldwide Pakistan (CWP); Doaba Foundation; Eco Friends Society; Focus Humanitarian Assistance (FHA); Hamdam Development Organization; International Organization for Migration (IOM); International Union for Conservation of Nature (IUCN) International Rescue Committee (IRC); Islamic Aid; Islamic Relief; Jhelum Valley Human Welfare Society (JVHWS); Khwendo Kor Laar Humanitarian Development Programme (LHDP); Mercy Corps; Muslim Aid; Pakistan Fisher Forum (PFF); Pakistan Participatory Development</p>	<ul style="list-style-type: none"> <li>a. Forecast Information on tropical Cyclone/Hurricane, Heavy Rainfall/Flood</li> <li>b. Prediction of High Surf (Based on tropical cyclones/hurricanes)</li> <li>c. Drought prediction – onset of drought, intensity of drought</li> <li>d. Seasonal rainfall forecast</li> <li>e. Forecast on temperature and wind speed trends</li> </ul>	<ul style="list-style-type: none"> <li>a. Sensitize communities</li> <li>b. Development and implementation of regional DRR policy and plans</li> <li>c. Design and implementation of early warning systems</li> <li>d. Strategic investment in short, medium, and long-term</li> <li>e. Effective deployment of assessment teams</li> <li>f. Risk assessment</li> <li>g. Train volunteers</li> </ul>	<ul style="list-style-type: none"> <li>a. Reduce the number of deaths, injuries and impact from disasters.</li> <li>b. Increase local community, civil society and Red Cross Red Crescent capacity to address the most urgent situations of vulnerability.</li> <li>c. Promote respect for diversity and human dignity, and reduce intolerance, discrimination and social exclusion.</li> </ul>
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Sector	Type	Level	Stakeholders	Type of climate information required	Decisions and actions dependent on this information	Incentives and drivers to use climate information and services
			Initiatives (PPDI); Pakistan Red Crescent Society (PRCS); Pattan Development Organization Plan International Roots Work ; Rural Development Policy Institute (RDPI); Sangi Development Foundation; Sangi Welfare Society; Sindh Agricultural and Forestry Workers Coordinating Organization (SAFCO); Tharparkar Rural Development Programme (TRDP); Young Sheedi Welfare Organization; Yar Muhammad Sameejo Education and Development organization (YMSESDO)			
DRR	Users	Regional	<b>International Financial Institutions</b> (World Bank, DFID), <b>Bi-lateral and multilateral agencies</b> (UNISDR; Community Based Disaster Risk Management (CBDRM); Cyclone Preparedness Programme (CPP); Asian Disaster Preparedness Centre (ADPC)) <b>NGOs and humanitarian aid agencies</b> (International Red Cross and Red Crescent Movement; Duryog Nivaran; Practical Action, Care) Media and telecommunications, and communication services	a. Climate Change forecasts b. Hydro-meteorological hazards c. Prediction on Landslide (Based on heavy rainfall event) d. Near term climate forecast	a. Emergency response planning b. Developing strategies and initiatives regarding trans-boundary natural hazard management c. Determination of short / medium / long term (strategic) Investment and financial support d. Emergency response planning e. International policy negotiation f. Building networks g. Informing communities of risks h. Disseminating emergency plans and advisories.	a. Reduction in loss of lives and property b. Reduce the number of deaths, illnesses and impact from diseases and public health emergencies. c. Better management of trans-boundary natural hazards



DRR	Users	National	<p><b>National Disaster Management Authorities:</b> Ministry of Disaster management and Relief (Bangladesh); National Disaster Management Authority (NDMA) (India); Nepal Centre for Disaster Management (NCDM); Afghanistan National Disaster Management Authority (ANDMA); National Disaster Management Authority (NDMA) (Pakistan); National Disaster Management Authority (NDMA) (Burma)</p> <p><b>Hydropower agencies</b> E.g. Tamilnadu Energy Development Agency</p> <p><b>NGOs: Eg:</b> <i>India:</i> RedR India, Pune BJS, Delhi; TNTRC, Chennai; SMS, West Bengal; Sampradan, New Delhi; DMI, Ahmedabad; CYSD, Bhubaneswar; SMRC, Bhubaneswar; CRS, Chennai GRC, Bhubaneswar; COVA Hyderabad CARE, New Delhi; SPHERE Chennai ActionAid Bangalore; SEEDS India</p> <p><i>Pakistan:</i> Action Against Hunger; Aga Khan Planning and Building Services (AKPBS); Anjuman-e-Islah; Association of Physicians of Pakistani Descent of North America Balochistan ; Environmental Foundation; CARE International; Church World Service (CWS); Citizen's Foundation; Concern Worldwide Pakistan (CWP); Doaba Foundation; Eco Friends Society; Focus Humanitarian Assistance (FHA); Islamic Aid; Islamic Relief; Pakistan Fisher Forum (PFF); Pakistan Participatory Development Initiatives (PPDI)</p> <p><b>Risk insurance companies</b> <i>India:</i> Agriculture Insurance Company of India Ltd. (AICI); General Insurance Company (GIC); National Bank for Agriculture and Rural Development (NABARD); National Insurance Company Ltd.; New India Assurance Company Ltd.; Oriental Insurance Company Ltd; United India Insurance Company Ltd. <i>Bangladesh:</i> IFC, Green Delta Crop Insurance <i>Pakistan:</i> Silver star Insurance company Ltd., Bank of Punjab's crop insurance scheme; Adamjee Insurance <i>Bhutan:</i> Royal Insurance Corporation of Bhutan Ltd.,</p>	<ul style="list-style-type: none"> <li>a. Sea level rise</li> <li>b. Extreme weather event forecasts (cyclones, flooding, droughts etc.)</li> <li>c. Prediction of wild fire (Based on temperature extremes, wind speed and wind direction predictions)</li> <li>d. Weather forecasts on Hurricanes, blizzards, windstorms, other extreme weather</li> </ul>	<ul style="list-style-type: none"> <li>a. Develop national DRR and DRM strategies, regulations, policies and programmes</li> <li>b. Sectoral preparedness planning through strategic planning &amp; scenario building</li> <li>c. Coordinating emergency response</li> <li>d. Government risk financing (trust funds, early warning systems, etc.)</li> <li>e. Warning relevant players of any potential emergency</li> <li>f. Training and awareness raising</li> <li>g. Executing rescue operations</li> <li>h. Risk insurance companies making compensation plans against the property loss</li> <li>i. Inform communities of risks,</li> <li>j. Disseminating early warning bulletins</li> <li>k. Advisories on protection measures</li> </ul>	<ul style="list-style-type: none"> <li>a. Optimize infrastructure investment</li> <li>b. Reduce mortality rates</li> <li>c. Reducing asset and property loss,</li> <li>d. Reducing infrastructure damage</li> <li>e. Quick recovery after the disastrous event</li> </ul>
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Sector	Type	Level	Stakeholders	Type of climate information required	Decisions and actions dependent on this information	Incentives and drivers to use climate information and services
			<i>Nepal:</i> Nepal Insurance Company Ltd., Prabhu Insurance; Shikhar Insurance Co Ltd., United Insurance Co. Ltd.,			
DRR	Users	Sub-national	State /District level emergency planners, Hydrological emergency managers Disaster response and recovery agencies (Community workers, NGOs), Basic service providers Media and telecommunications, and communication services	<ul style="list-style-type: none"> <li>a. Sea level rise</li> <li>b. Extreme weather event forecasts (cyclones, flooding, droughts etc.)</li> <li>c. Near term climate forecast</li> <li>d. Seasonal forecasts on Rainfall - Temperature –Cyclones</li> <li>e. Intra-seasonal forecasts Wet/Dry Spells Heat/Cold waves</li> <li>f. Forecast on Flash floods, hail storms and tornadoes</li> </ul>	<ul style="list-style-type: none"> <li>a. Making preparedness plans (evacuation plans)</li> <li>b. Planning for safety (dikes, barriers, etc)</li> <li>c. Warning relevant players of any potential emergency</li> <li>d. Planning and executing emergency response operations</li> <li>e. Informing communities of risks</li> <li>f. Dissemination of real time information</li> </ul>	<ul style="list-style-type: none"> <li>a. Reduce fatalities, losses of livelihoods, assets and property</li> <li>b. Strengthening community-based EW</li> <li>c. Prevention, preparedness, response and recovery of disaster</li> <li>d. Saving live</li> <li>e. Reduced expenditure for management of contagious disease</li> <li>f. Enhancement in emergency response capacity</li> </ul>
DRR	Users	Last mile	Community-operated EWS (watchtowers, communications operators, local DRR leaders) Community radio Residents Farmers, pastoralists, fisher folk Health workers	<ul style="list-style-type: none"> <li>a. Sea and water level rise</li> <li>b. Extreme weather event forecasts (cyclones, flooding, droughts, hail storms, tornadoes etc.)</li> <li>c. Near term climate forecasts</li> <li>d. 5 or 7 day forecasts</li> </ul>	<ul style="list-style-type: none"> <li>a. Developing preparedness and evacuation plans, locating emergency shelters</li> <li>b. Informing community members of risks</li> <li>c. Purchase of emergency materials (e.g. lifejackets, lifeboats)</li> </ul>	<ul style="list-style-type: none"> <li>a. Better protection of homes, cultivated land, stored food, livestock and human life</li> </ul>



Sector	Type	Level	Stakeholders	Type of climate information required	Decisions and actions dependent on this information	Incentives and drivers to use climate information and services
Water	Intermediaries	Regional	South Asia Institute (Water and Climate Series Seminar); Remote Sensing Centres; South Asian Regional Meteorological Centres; Integrated Drought Management Programme for South Asia; International Centre for Integrated Mountain Development (ICIMOD); The South Asia Water Initiative; International Water Management Institute (IWMI); Mekong River Commission (Burma is a Dialogue Partner); South Asian Climate Outlook Forum (SASCOF)	<ul style="list-style-type: none"> <li>a. Precipitation monitoring,</li> <li>b. Snow monitoring</li> <li>c. Information on climate variability</li> <li>d. Hydrologic outlooks</li> <li>e. Water supply forecast</li> <li>f. Correlation between precipitation (quantity and intensity) and stream flow</li> <li>g. Peak flow forecast</li> </ul>	<ul style="list-style-type: none"> <li>a. Scientific research on water related issues</li> <li>b. Regional trends in the status, quality and quantity of water resources and improving access to water</li> <li>c. Development of optimization of strategies to be adopted under unfavorable or extreme weather conditions</li> <li>d. Decision on keeping end-of-year storage above carryover goal in case of systems that are vulnerable to multiyear drought</li> </ul>	<ul style="list-style-type: none"> <li>a. Conserving water resources</li> <li>b. Improving access to clean, potable water in the region</li> <li>c. Sustainable freshwater supply</li> <li>d. Mitigating damage from high and low water flows</li> <li>e. Efficient allocation of water supply for various sector demands</li> </ul>



Sector	Type	Level	Stakeholders	Type of climate information required	Decisions and actions dependent on this information	Incentives and drivers to use climate information and services
Water	Intermediaries	National	<p>Ministries of Agriculture, Irrigation and Livestock in the south Asian countries</p> <p><b>Researchers from National Institutes:</b></p> <p><i>India:</i> Indian institute of water management, Bhuvaneshwar, Jawaharlal technological university, Hyderabad, Water and land management training institute, Hyderabad, water and land management institute, Aurangabad; <b>Tamil Nadu:</b> Water resources organization(PWD), Tamil Nadu water and drainage board, Irrigation Management and Training Institute (Tamil Nadu)</p> <p><i>Pakistan:</i> Water Management Research Center at the University of Agriculture, Faisalabad; Pakistan Research Council for Research in Water Resources</p> <p><i>Nepal:</i> International Water Management Institute</p> <p><i>Bhutan:</i> College of Natural Resources</p> <p><i>Afghanistan:</i> Goethe-Institute</p> <p><i>Bangladesh:</i> Institute of Water and Flood Management, Institute of Water Modeling</p> <p><b>NGOs</b> working on water issues such as Practical Action (in all countries).</p> <p><b>Consultancy companies</b></p> <p>Unity Consultants (Pune); WAPCOS; Kaiketi Institute; Karnataka Urban Water Supply and Drainage Board (Bangalore); Nippon Koei India Pvt Ltd (New Delhi)</p>	<p>Real-time weather data</p> <p>Changes in snowpack (quantity and timing)</p> <p>Hydrological extremes of flood and drought</p> <p>Variation in precipitation and temperature</p> <p>Periods of prolonged, unexpected dry spells</p> <p>Flood warning, watch, and outlooks</p> <p>Long records of catchment rainfall and river flows</p> <p>Frequency of heavy rainfall</p> <p>Probable Maximum Precipitation for given periods and flood events,</p> <p>Flood forecasting and water resources assessment.</p>	<p>Climate-informed Sectoral policy and planning at National level</p> <p>Understanding the impacts of climate change on the water sector</p> <p>Developing adaptation strategies</p> <p>Training and capacity building</p> <p>Water demand projections</p> <p>Scientific research on hydrological risk assessment</p> <p>Developing and implementing river basin management plans</p> <p>Planning for water sharing among urban, agriculture and other sectors</p> <p>Drought Hazard Index mapping</p> <p>Planning for sustainable freshwater harvesting</p> <p>Planning hydro-power production</p>	<p>Enhance economic returns on investment</p> <p>Reduce vulnerability to climate shocks</p> <p>Improved management of hydro-climatic risk</p> <p>Effective management of water for agriculture at the farm, river basin and national levels.</p> <p>Increased Agricultural development resilient to climate variability and change.</p>



Sector	Type	Level	Stakeholders	Type of climate information required	Decisions and actions dependent on this information	Incentives and drivers to use climate information and services
Water	Users	Regional	<p>International Financial Institutions (World Bank, DFID, USAID); Bi-lateral and multilateral agencies (SDA, DANIDA, UNEP); Integrated Drought Management Programme for South Asia; The South Asia Water Initiative; International Centre for Integrated Mountain Development (ICIMOD);</p> <p><b>Soil conservation agencies</b> (International erosion control association, USDA- ARS National soil erosion research laboratory (Indiana,USA) , USDA- ARS wind erosion research (Kansas, USA)</p>	<p>Real time water flow data (stream flow)</p> <p>Probabilistic forecasts for seasonal temperature and precipitation anomalies</p> <p>Medium and extended range rainfall forecast</p> <p>Flood and drought forecasting</p> <p>Early warning of extreme weather events like cyclones and flood probability</p>	<p>Regional water sector development policy and plans</p> <p>Regional monitoring systems (water quality, water quantity, sediment load, water distribution)</p> <p>Real time water flow data (stream flow) collection and sharing of information</p> <p>At the river basin scale, climate-based hydrologic monitoring, forecasting and decision support will guide operational water management (e.g., scheduling, reservoir management) and provide early warning of hydroclimatic hazards such as flooding.</p> <p>Monitor impacts of the hydropower dams downstream and cross-border</p>	<p>Conserving water resources</p> <p>Improving access to clean, potable water</p> <p>Improving freshwater supplies</p> <p>Resolving issues related to trans-boundary water sharing and natural resource management</p> <p>Better decisions on short / medium / long term (strategic) investment and financial support</p>



Sector	Type	Level	Stakeholders	Type of climate information required	Decisions and actions dependent on this information	Incentives and drivers to use climate information and services
Water	Users	National	<p>Government Ministries of Water Resources, Ministries of Rural and Urban Development, Ministries of Water and Power and emergency planners, Department of Health and Family Welfare (water quality)</p> <p>Flood Forecasting and Warning Centre (Bangladesh)</p> <p>Institute of Water Modelling (Bangladesh)</p> <p>Federal Flood Commission (Pakistan);</p> <p>Bangladesh Inland Water Authority;</p> <p>Bangladesh Water Development Board;</p> <p>Flood Forecasting and Warning Center (Bangladesh);</p> <p>Industrial and urban water sectors (Public and Private)</p> <p>Department of Drinking Water Supply in the Ministry of Rural Development (India)</p> <p>Directorate of the Institute of Preventive Medicine's</p> <p>Department of Water &amp; Waste Water Analysis</p> <p><b>Hydropower agencies</b> (e.g. Indian Renewable Energy Development Agency Ltd and Tamilnadu Energy Development Agency)</p>	<p>Real-time weather data</p> <p>Hydrological extremes of flood and drought</p> <p>Periods of prolonged, unexpected dry spells</p> <p>Flood warning</p> <p>Drought probability</p> <p>Frequency of heavy rainfall</p> <p>Probable Maximum Precipitation for given periods and flood events</p> <p>Stream flow data</p> <p>Stream flow forecast</p>	<p>National water policy and development plans</p> <p>Developing and implementing national water management, flood protection plans and drought management plans</p> <p>Planning for physical infrastructure (i.e., dams, reservoirs, water delivery systems)</p> <p>Warning relevant players of any potential emergency</p> <p>Water quality mapping in the states</p> <p>Keep river stage between flood and minimum thresholds</p> <p>Safe reservoir release rates through time to avoid uncontrolled spill</p> <p>Set hydropower generation duty schedules</p>	<p>Enhancing water and agricultural productivity "more crop per drop"</p> <p>Enhanced availability of good quality water</p> <p>Ensuring protection to life and property from floods and drought</p> <p>Improved management of hydro-climatic risk and more effective management of water for agriculture at the farm, river-basin and national-policy levels</p> <p>Better investment on Physical structures (dams, reservoirs)</p> <p>Self sufficiency in meeting hydro-power demand</p>



Sector	Type	Level	Stakeholders	Type of climate information required	Decisions and actions dependent on this information	Incentives and drivers to use climate information and services
Water	Users	Sub-national	State /District level emergency planners, Local hydrological emergency managers Emergency response and recovery agencies (community workers, NGOs), Local government water service providers Farmers Households Water users associations and their members Hydro-electric power producers Off-grid hydro power schemes Power distribution authorities (electricity department) Farmers Households Water User Associations Media and telecommunications, and communication services	Location specific information including: Water availability in storage structures/shortage Monsoon departure Flood and drought forecasts Water flow details in the rivers and streams Information of extreme weather events	Local water planning Planning for infrastructure safety (dikes, flood barriers, etc) Warning relevant players of any potential emergency Understanding the status of water availability for crop production choices Monsoon forecast for crop choice Water availability in storage structures (dams, tanks etc.) for irrigation Producing hydrological bulletins and advisories. At the level of farming communities, climate information and advisory services will support strategic decisions about land allocation, crop selection and input use at the start of the growing season Designing programmes to enhancing water use efficiencies	Improving household access to clear water resource Efficient management of scarce water resources Enhance economic returns on investment Reduced vulnerability to climate shocks Foster sustainable water use leading to improved livelihoods for smallholder farmer Lessen the negative consequences of climate variability on agriculture with better management



Sector	Type	Level	Stakeholders	Type of climate information required	Decisions and actions dependent on this information	Incentives and drivers to use climate information and services
Health	Intermediaries	Regional	<p><b>Researchers from Regional Institutes:</b> Consortium of Universities for Global Health (CUGH); South Asian Community Health Services (SACHS);</p> <p><b>International Financial Institutions:</b> The Global Fund to Fight AIDS, Tuberculosis and Malaria; Joint United Nations Programme on HIV/AIDS (UNAIDS); World Bank; World Health Organization (WHO)</p> <p><b>Advocacy/Policy Organizations:</b> Center for Strategic and International Studies (CSIS) Global Health Policy Center; The Earth Institute – Columbia University; Global Alliance for Chronic Diseases (GACD); Global Health Council;</p> <p><b>NGOs:</b> Global Health Technologies Coalition (GHTC) - A group of more than 30 nonprofit organizations working to increase awareness of the urgent need for technologies that save lives in the developing world.</p> <p><b>Foundations:</b> Bill and Melinda Gates Foundation; UN Foundation (UNF); Wellcome Trust</p>	<p>Information on heat waves</p> <p>Intensity of hurricanes and storms</p> <p>Information on air quality</p> <p>Level of environmental pollutants including persistent organic pollutants, metals, and pesticides.</p>	<p>Developing regional health sectors policy and plans</p> <p>Guiding short, medium and long-term investment choices</p> <p>Risk Identification policy</p> <p>epidemiological surveillance</p> <p>Develop health measures and integrate them into plans for adaptation to climate change,</p> <p>To develop future adaptation strategies</p> <p>Making investments to improve health</p> <p>Shaping the health research agenda</p>	<p>Reducing health burden</p> <p>Building healthy and vibrant communities</p> <p>Brings together the people and tools needed to address some of the world's most difficult problems, from climate change and environmental degradation, to poverty, disease and the sustainable use of resources</p>



Sector	Type	Level	Stakeholders	Type of climate information required	Decisions and actions dependent on this information	Incentives and drivers to use climate information and services
Health	Intermediaries	National	<b>National research institutes:</b> <i>India:</i> All India Institute of Medical Sciences (AIIMS); Christian Medical College & Hospital (CMCH) Vellore; Kasturba Medical College (Manipal and Mangalore); Jawaharlal Institute of Postgraduate Medical Education and Research (JIPMER); Armed Forces Medical College (AFMC); St. John's Medical College (Bangalore) and National Institute of Mental Health and Neurosciences (NIMHANS); National Academy of Medical Sciences, <i>Pakistan:</i> Pakistan Medical and Dental Council (PMDC); Services Institute of Medical Sciences; Army Medical College; <i>Nepal:</i> College of Medical Sciences, Nepal; Kathmandu University School of Medical Science, Kathmandu Medical College <b>Institute of Medicine (IOM), Kathmandu, National Medical College</b> <i>Bhutan:</i> Bhutan Medical and Health Council, Royal Institute of Health Sciences (RIHS), Thimphu Institute of Traditional Medicine Services, Thimphu, Bhutan Institute of Medical Sciences (BIMS), Thimphu <i>Afghanistan:</i> Kabul Medical University, Kabul <i>Bangladesh:</i> Bangladesh University of Health Sciences (BUHS), Mirpur; Bangladesh Institute of Health Sciences (BIHS), Mirpur	Sea level rise Changes in precipitation and resulting from flooding and drought Disease forewarning Vector borne diseases prediction Extreme temperature and rainfall forewarning	Epidemic surveillance including early detection of disease outbreaks Produce maps of the climatological conditions for malaria and other climate dependent diseases Disease forewarning and epidemic early warning systems To develop future adaptation strategies Training and capacity building Design and implement interventions Identifying where and when to implement more	All people lead healthy, productive life Increase in life time expectancy Reduced expenditure on health maintenance



Sector	Type	Level	Stakeholders	Type of climate information required	Decisions and actions dependent on this information	Incentives and drivers to use climate information and services
Health	Users	Regional	<b>International Financial Institutions</b> (WHO, World Bank, DFID, USAID, UNICEF) <b>Bi-lateral and multilateral agencies</b> (SDA, DANIDA, UNEP) Global Health Initiatives and investors, donor community (Global Fund, Health and Climate Foundation) Media and telecommunications, and communication services	Forewarning extreme weather events Seamless forecasting of rainfall, temperature, wind speed and relative humidity	Regional health policy and programming Determination of short / medium / long term Investment and financial support Warning relevant players of any potential emergency as necessary	Reducing health burden Protecting human populations from negative impacts of climate variability Minimising health hazards due to climate induced vector borne diseases, infectious diseases, diarrhea, and malaria Reduced expenditure on health maintenance
Health	Users	National	Government Ministries of Health (Ministry of Health, National Health Mission, National Urban Health Mission); Emergency planners, Public health care / service providers; Disease control program staff; Emergency response and recovery agencies (Community health workers, NGOs, MINDS Foundation), Service providers (emergency medical services, fire and rescue) Media and telecommunications, and communication services	Seasonal cumulative rainfall Temperature range Relative humidity – diurnal variation Seasonal weather variability	National health policy and planning Planning for the purchase of drugs Warning relevant players of any potential emergency Vector control strategies Inform communities of risks Health bulletins and advisories	Increasing community awareness of epidemic risk Reducing health impact due to extreme weather events such as heat waves, hurricanes, floods and drought Reduction in mortality rate Lower health maintenance expenditure Reducing vulnerability amongst children, the elderly etc. to disease




Sector	Type	Level	Stakeholders	Type of climate information required	Decisions and actions dependent on this information	Incentives and drivers to use climate information and services
Health	Users	Sub-national	<p><b>Researchers from Regional Institutes:</b> Consortium of Universities for Global Health (CUGH); South Asian Community Health Services (SACHS);</p> <p><b>International Financial Institutions:</b> The Global Fund to Fight AIDS, Tuberculosis and Malaria; Joint United Nations Programme on HIV/AIDS (UNAIDS); World Bank; World Health Organization (WHO)</p> <p><b>Advocacy/Policy Organizations:</b> Center for Strategic and International Studies (CSIS) Global Health Policy Center; The Earth Institute – Columbia University; Global Alliance for Chronic Diseases (GACD); Global Health Council;</p> <p><b>NGOs:</b> Global Health Technologies Coalition (GHTC) - A group of more than 30 nonprofit organizations working to increase awareness of the urgent need for technologies that save lives in the developing world.</p> <p><b>Foundations:</b> Bill and Melinda Gates Foundation; UN Foundation (UNF); Wellcome Trust</p> <p>Health workers, health centres</p>	<p>Information on heat waves</p> <p>Intensity of hurricanes and storms</p> <p>Information on air quality</p> <p>Level of environmental pollutants including persistent organic pollutants, metals, and pesticides.</p>	<p>Sub-national level health policy and development plans</p> <p>Planning for the purchase of drugs</p> <p>Warning relevant players of any potential emergency</p> <p>Vector control strategies</p> <p>Inform communities of risks</p> <p>Health bulletins and advisories</p>	<p>Increasing community awareness of epidemic risk</p> <p>Reducing health impact due to extreme weather events such as heat waves, hurricanes, floods and drought</p> <p>Reduction in mortality rate</p> <p>Lower health maintenance expenditure</p> <p>Reducing vulnerability amongst children, the elderly etc. to disease</p>



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