Output 4 Options Analysis:

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

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Acronyms

ADB	Asian Development Bank
AMA	Afghan Meteorological Authority
ANDMA	Afghanistan National Disaster Management Authority
APAN	Asian-Pacific Adaptation Network
ARTF	Afghanistan Reconstruction Trust Fund
ASEAN	Association of South East Asian Nations
AWS	Automatic Weather Stations
BMD	Bangladesh Meteorlogical Department
BRACED	Building Resilience and Adaptation to Climate Extremes and Disasters programme (DFID)
CCAFS	Climate Change, Agriculture, and Food Security (Research programme by CGIAR)
CFSv2	Coupled Forecast System model version 2
CGIAR	The Consultative Group for International Agricultural Research
CIF	Climate Investment Funds
CLIMATISE	CLIMATe and Information SErvices for South Asia Programme
COFs	Climate Outlook Forums
CORDEX	Coordinated Regional Climate Downscaling Experiment
CRISSA	Climate Research and Information Services in South Asia
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CSP	Climate Services Partnership
CSRD	Climate Services for Resilient Development
DMH	Department of Meteorology and Hydrology (Burma)
DRR	Disaster Risk Reduction
ECV	Essential Climate Variables
ECMWF	European Center for Medium range Weather Forecasting
FAO	Food and Agriculture Organization of the United Nations
FOCRAII	Forum on Regional Climate Monitoring-Assessment-Prediction for Asia
GFCS	Global Framework for Climate Services
GFDRR	Global Facility for Diaster Reduction and Recovery
GFS	Global Forecasting System
GTS	Global Telecommunications System
ICIMOD	International Centre for Integrated Mountain Development
iDE	International Development Enterprises
IFRC	International Federation of Red Cross and Red Crescent Societies
IITM	Indian Institute of Tropical Meteorology
INGO	International Non-Governmental Organisation
IPCC	Intergovernmental Panel on Climate Change
IRI	International Research Institute (for Climate and Society)
ISDR	International Strategy for Disaster Reduction
IUCN	International Union for Conservation of Nature
JICA	Japan International Cooperation Agency
JMA	Japan Meteorological Agency
LDCs	Least Developing Countries
LIFT	Livelihoods and Food Security Trust Fund
LRF	Long Range Forecasting
MALOF	Malaria Outlook Forum
M&E	Monitoring and Evaluation

MoES	Ministry of Earth Sciences (India)
MoU	Memorandum of Understanding
NAPA	National Adaptation Programmesof Action
NCAR	National Centre for Atmospheric Research
NCCSP	Nepal Climate Change Support Programme
NCEP	National Centres for Environmental Protection
NCMRWF	National Centre for Medium Range Weather Forecasting
NCOF	National Climate Outlook Forum
NDMA	National Disaster Management Authority (Pakistan)
NERC	Natural Environment Research Council
NGO	Non-Governmental Organisation
NHMS	National Hydrological and Meteorological Services
NWP	Numerical Weather Prediction
PMD	Pakistan Meteorological Department
PPCR	Pilot Program for Climate Resilience
QMS	Quality Management System
RBSN	Regional Basic Synoptic Network
RCC	Regional Climate Centre
RCOFs	Regional Climate Outlook Forums
RECs	Regional Economic Communities
SAARC	South Asian Association for Regional Cooperation
SASCOF	South Asia Climate Outlook Forum
SAWG	South Asia Water Governance programme
SDMC	SAARC Disaster Management Centre
SEI	Stockholm Environment Institute
SHEAR	Science for Humanitarian Emergencies and Resilience programme (DFID)
SMOS	Soil Moisture and Ocean Salinity (mission of the European Space Agency)
SMRC	SAARC Meteorological Research Centre
SPCR	Strategic Programme for Climate Resilience
STSAT	Science and Technology Satellite
SWFDP	The Severe Weather Forecasting Demonstration Project
TRMM	Tropical Rainfall Monitoring Mission
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environmental Programme
UNDP	United Nations Development Programme
UNICEF	United Nations Children's Fund
UNISDR	United Nations International Strategy for Disaster Reduction
UNFCCC	United Nations Framework Convention on Climate Change
USAID	The United States Agency for International Development
UK	United Kingdom of Great Britain and Northern Ireland
VCP	Voluntary Cooperation Programme
VfM	Value for Money
WB	World Bank
WISER	Weather and climate Information and SERvices for Africa (DFID)
WMO	World Meteorological Organization

Exective Summary

Report Summary
This report provides an Options Analysis for a South Asia regional programme on climate services for risk reduction and economic growth. It is the fourth output of a scoping project, which has reviewed evidence on climate services, early warning systems and disaster risk reduction in selected countries: Afghanistan, Pakistan, Bangladesh, India, Nepal and Burma. It considers four options for DFID investment with different emphases on the 'supply' or 'demand' side[i] of climate information provision and use, the choice of sectors, geographical focus and finally the appropriate delivery mechanisms for implementing the programme. The proposed investments range from £5 million to £145 million. The lowest cost options involve small-scale research and innovation projects with targeted support to country offices or existing donor programmes, whereas the larger options include significant capital expenditure on weather observations and investment in national hydrological and meteorological services.

Rationale for investment
South Asian countries are particularly vulnerable to extreme weather events, climate variability and longer-term climatic changes due to high population density, poverty, and lack of resources for adaptation. The proposed programme will deliver improved weather and climate services to inform decision making in agriculture, disaster risk reduction and associated sectors (water and health) to benefit vulnerable groups, particularly women and girls. It takes a demand-led approach, which will transform how countries in the region collect, process and deliver climate information directly to those that need it, enabling them to make effective decisions to avoid economic setbacks and promote economic growth.

Improved weather forecasting can provide better early warnings and therefore support more effective responses, for example evacuation during flood events, and provide essential information to support humanitarian responses to other natural hazards, such as the recent earthquakes and subsequent landslides in Nepal. Seasonal forecasting and climate information can inform decision making on the choice of crops, planting and harvesting times and on longer term investment in improving agricultural productivity and water security. With 60 to 70 percent of women in developing countries involved in agriculture, better forecasting and information can improve their livelihoods by avoiding losses, increasing productivity and improving food security and nutrition. According to the World Meteorological Organization (WMO) women should urgently be provided with equitable access to weather and climate services to improve the productivity on their farms[ii].

Climate information also plays a crucial role in national development planning, allowing governments (and private sector investors) to avail of development opportunities and manage climate risks. For example, climate information is required for agricultural planning (i.e. for crop suitability mapping, assessment of water requirements, and yield estimation). With significant investment in transport, energy and water infrastructure it is important that donors and government agencies have access to information on climate change risks, such as sea level rise and increases in potential flood risk, so that new infrastructure is climate resilient and projects are safeguarded. DFID is already actively involved in climate adaptation and disaster risk reduction in the region, providing support through its Asia Regional Programme and country offices[iii,iv]. Notable programmes involving DFID and their main partners are summarised in this report and described in detail in the Stakeholder Analysis Report and Evidence Review. Major programmes are focused on specific sectors, such as water resources, or on specific types of investment, such as infrastructure for weather observations, modelling and early warning systems (Section 1).

Climate services provide access to a wide range of tailored weather, climate and socio-economic information to support decision making. The cost-benefit ratio and value for money (VfM) of investments in climate services will be greatest when key government decision makers and vulnerable groups take effective action in response to warnings and information on climate risks. The scoping study highlighted that users need relevant and timely information that is presented clearly through appropriate communication channels (radio, mobile phones, agricultural extension services and social networks) but specific needs are not always well known. Therefore an improved understanding of user requirements and decision making processes is critical to any programme in this area, which is why the preferred options outline a demand-led approach that will target investment to those areas that will have the greatest impact. Where the demand for information is not well articulated, further research is proposed to define the gaps and requirements and ensure the major investments in the collection and supply of data by other donors have an impact on key development goals. Option 1 presents clear analysis for this.

Key findings from the scoping study

The key findings from the Evidence Review and Stakeholder Analysis Report provided the main insight for the development of the programme delivery options described below. Notably, the investment options that emerged can be grouped into four main themes, which when combined, would offer a regional programme on climate services for risk reduction and economic growth (Figure 1).

- Enabling market growth in climate services;
- Strengthening global, regional and national networks;
- Research and innovation to co-design climate services and promote scientific decision-making;
- Improving regional cross-border co-operation (see Stakeholder Analysis Table 2).

Together these four areas can be combined to offer a regional programme on climate services for risk reduction and economic growth (Figure 1). Further details on the approach adopted in the scoping study, including criteria for selecting and refining options, are outlined in Section 1.

Executive Summary: Figure 1. **Key investment themes of the proposed programme**

Further details on the approach adopted in the scoping study, including criteria for selecting and refining options, are outlined in Section 1.

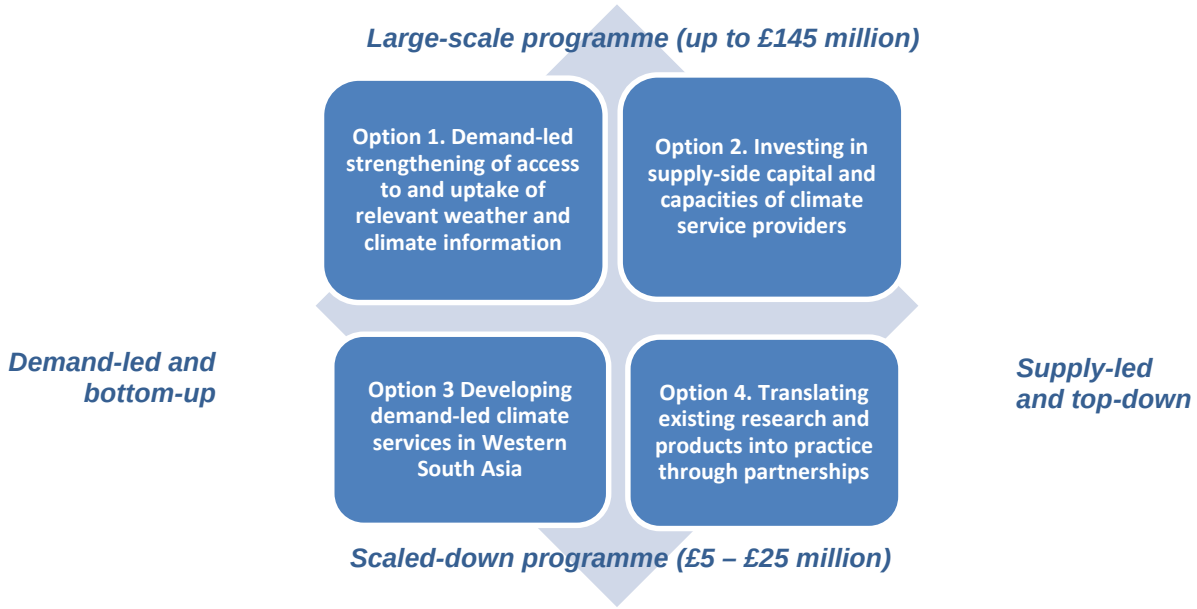
Suggested options for programming

The areas of investment outlined above, and the large number of activities included within them (see the Stakeholder Analysis Report for a comprehensive list), could be arranged into a variety of options. Four of these options are presented in detail in the analysis below:

- Option 1: Demand-led strengthening of access to and uptake of relevant weather and climate information;
- Option 2: Investing in supply-side capital and capacities of climate service providers;
- Option 3: Developing demand-led climate services in Western South Asia;
- Option4: Translating existing research and climate service products into practice through partnerships.

These delivery options were developed by considering the large variety of possible actions presented in the Stakeholder Analysis Report and represent viable opportunities for DFID investment as part of its programming (Figure 2).

***Executive Summary: Figure 2.*Summary of delivery options for the proposed programme**



Theory of change thinking on the projected impacts has been used to develop the options. Option 1 is the preferred option because it best aligns with user needs and DFID's strategy and it creates the strongest link between users and producers of weather and climate information. It will ensure that any major investments will result in the delivery of better climate services (see below) with much stronger Value for Money (VfM). Developing demand-led climate services is a critical gap that requires comprehensive and structured investment in order to create resilient communities able to respond to and recover from disasters and the impacts of climate change. A summary of all the options is provided in Table 1 below. The theory of change for Option 1 is based on the premise that investing in climate services will lead to transformative change and improved resilience to climate change and disasters. Transformative change will occur as a result of vulnerable groups, including women and men, having the information they need to take timely and effective action to either avoid losses and damages during natural disasters or by managing the risks and opportunities presented by climate variability and change, thereby improving their livelihood opportunities and increasing their resilience. This will be achieved through delivery of:

- **Impact**: Resilient economies and livelihoods that cope better with climate shocks and stresses
- **Outcome**: Better weather and climate services used to inform decision-making in selected sectors at regional, national and local levels

- **Outputs** (examples of potential outputs): Improved access to relevant weather and climate services for vulnerable groups, including women and girls; Use of scientifically robust climate information for national planning and infrastructure development; New ways of delivering information on risk; Building capacity of public and private sectors to provide climate services.

Option	Core activities	Areas of investment (Fig. 1)	Delivery mechanism and Partner	Cost	Benefits	Risks
1	**Demand-led strengthening of access to and uptake of relevant weather and climate information**	All, but strong emphasis on A. Markets D. Regional cooperation and C. Research	Private-public/NGO partnerships or/including a demand testing focused organisation Research consortium Government agencies and extension services (National Hydrological and Meteorological Services- NHMS- must be involved but not necessarily leading; also involves regional and national climate outlook forums)	£10 million phase 1 Up to £140 million total	Services targeted for maximum benefit following initial research phase Promotes private sector growth	Medium (Detailed design and stage-gate approach reduces risk; bottom-up and responding to demand; makes use of existing data)
2	**Investing in supply-side capital and capacities of climate service providers**	B. Networks D. Regional cooperation C. Research (partial)	WMO, Asian Development Bank (ADB), World Bank (WB) and Global Facility for Disaster Reduction and Recovery(GFDRR). Regional Climate Centres (India, Korea, Singapore) NHMS (strong involvement and co-development to ensure sustainable implementation)	Up to £145 million	Aligns with other donors' major investments and global initiatives. Coordinated approach	High (Possible slow delivery; top-down; poor capacity to manage supply infrastructure; vulnerable groups may not be reached)
3	**Developing demand-led climate services in Western South Asia**	All (partial)	New or existing research consortium, plus private sector engagement. ADB, NHMS e.g. Pakistan and Afghanistan	Between £5million and £20 million	Targets least developed countries (Afghanistan, Bangladesh, Burma, Nepal) Services targeted for maximum benefit to most vulnerable groups	Low (Can learn from and potentially scale-up successful pilot projects)
4	**Translating existing research and products into practice through partnerships**	B. Networks D. Regional Cooperation C. Research (partial)	DFID country office led working with national government agencies e.g. agro-advisory services or flood forecasting centres. Or existing programme such as CCAFS	Up to £25 million	Coordinated approach (with country strategy) Low management overhead costs	Medium – High (Lack of oversight if implemented by an independent partner)

Table 1 Summary of investment options

Overall conclusions

DFID has scope to make a unique contribution to strengthening climate services across South Asia by investing in a demand-led programme, which then invests strategically in the supply of information to support climate resilient development. There are several key reasons for the UK Government to invest in this area:

- There is a critical gap for demand-led climate services in the South Asia region. There is significant and ongoing investment on the supply-side but most demand-led service developments have been in Africa.
- The combination of UK's development expertise within world leading weather and climate change capabilities including through the UK Met Office, Natural Environment Research Council (NERC), Universities in the UK, and the ability to work in partnership with others, such as regional development banks, makes this an area with a strong case for investment. Various successful demand-led initiatives exist, including for example the Scaling Up Climate Services for Farmers in Africa and South Asia (as part of the CGIAR research program on Climate Change and Food Security (CCAFS)) and the provision of integrated agromet advisory services in India.v
- The outcomes of existing initiatives now need to be evaluated, replicated, tested and scaled-up across DFID's priority countries, with a particular focus on addressing the 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 disaster risk reduction (DRR) and agriculture sectors, as well as in relation to water and health.
- There is a strong need to build the capacity of users and institutions in climate services and improve decision-making across the region.
- DFID is very well placed to provide a regional intervention to improve climate services, which would complement the national scale supply-side work on monitoring and observations led by the World Bank and the Asian Development Bank (ADB). The large investors (e.g. regional banks) are better placed to work directly with governments whereas DFID may work more effectively across partners to ensure that climate services reach the most vulnerable communities, especially women and girls.

This report provides a set of concrete **recommendations** for DFID programming for delivering climate services in the South Asia region:

- **Option 1 is favoured** because it meets all of the selection criteria (Section 6). Stage 1 of the programme can help to design the larger part of the investment to have greater value for money and to be more effectively targeted at women, girls and other vulnerable groups. It would be transformative by ensuring that the much larger regional investments in climate infrastructure result in more effective early warning systems and climate information products. The programme would be rather large and entail some risks but the initial scoping work shows that it can be designed in phases so as to reduce risk and increase impact, and have a greater cost-benefit ratio than other options (i.e. if the programme is designed to respond to demand).
- **Option 2** would entail a large supply-side investment that would require coordination across leading international organisations such as World Bank, ADB, WMO, Japan International Cooperation Agency (JICA) and others, including scientific institutions like the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the National Centre for Atmospheric Research (NCAR). It meets most selection criteria but is less tailored to meet the real needs and demands of vulnerable groups and may potentially duplicate other major donors' investments. DFID could add value by bringing in UK expertise in climate services to help coordinate these programmes and ensure they have greater user focus. The investment by DFID would only be a small proportion of planned 'pipeline' investments by these institutions and more information is needed (for example through Option 1) to ensure DFID investment is appropriately targeted.

- **Option 3** is a small-scale pilot focused on demand-led investment and sub-regional work in Pakistan and Afghanistan, which would ultimately close a gap identified by the DFID team. It meets selection criteria and has a clearer focus on agricultural services, risks of flood and drought, and vulnerable groups, and is likely to achieve a greater impact in these countries. It could also provide useful research and investment support to other donor programmes addressing flood risk management and early warning system development in these two countries.
- **Option 4** offers a scaled-down partnership approach to work with DFID's focus country national governments and other donors. Potentially, it would also provide useful input to CCAFS, and DFID programmes such as the Science for Humanitarian Emergencies and Resilience (SHEAR) and Building Resilience and Adaptation to Climate Extremes and Disasters (BRACED) programmes. The impact of the investment, however, will depend on the success of working with national governments and other donor programmes. It is likely that this option will result in topping-up or extending the funding to existing initiatives.

Option 1 is clearly the best choice for targeting vulnerable communities. It could form the basis of a **CLIMATISE South Asia programme (*CLIMAT*e and Information SErvices for South Asia)** that would have a significant impact on making the region's economies and populations more resilient to climate variability and change. Although it is complementary, it is distinctive different to other DFID weather and climate programmes such as SHEAR (which currently focuses only on landslides in South Asia), WISER (Sub-Sahara Africa only) and BRACED (which currently lacks the important regional collaboration/cross-border dimension). This programme would deliver improved weather and climate services to inform decision making in agriculture, DRR, and associated sectors, to benefit vulnerable groups, especially women and girls. It takes a demand-led approach, which will transform how countries in the region collect, process and deliver information directly to those that need it, enabling them to make timely and effective decisions to avoid economic setbacks and promote economic growth.

Recommendation: DFID should pursue Option 1, focusing on demand-led climate services as an important first step in better understanding the pro-poor dimensions within priority sectors before committing to major investments. It is recommended that an initial phase 1 investment of up to £10 million between 2016 and 2017 is made, and depending on the lessons emerging, a second larger investment phase (up to £140 million including Stage 1) is considered following a stage-gated approach to ensure value for money and investment according to the greatest need.

SECTION 1

Introduction

This report provides an Options Analysis for a South Asia regional programme on climate services for disaster risk reduction and resilient economic growth. It is the fourth output of a scoping project which has reviewed evidence on climate services, early warning systems and disaster risk reduction in selected countries (Bangladesh, India, Afghanistan, Pakistan, Nepal and Burma). This section provides background information, including the main findings of the Evidence Review (Output 2) and Stakeholder Analysis (Output 3). Sections 2-5 discuss each individual option in detail along with their respective outline logical frameworks. Section 6 provides an analysis of options and discussion. Section 7 sets out conclusions and recommendations.

Context

The impacts of weather events were highlighted by the heat waves in Pakistan in June 2015, where mortality was greatest amongst the poorest communities with limited access to resources[vi], and more recently in July and August 2015 by heavy monsoon rains in parts of South Asia, which affected large numbers of people[vii]. With an ever increasing number of poor people living in or forced to move to vulnerable areas, it is highly likely that climate risks will increase in the future (IPCC, 2012). A recent assessment of the costs of climate change in Asia suggests losses of GDP in the range of 2 to 8% by 2050 in the absence of significant adaptation to reduce risks (ADB, 2014).

DFID is already actively involved in climate adaptation and disaster risk reduction in the region, providing support through the Asia Regional Team and country offices programmes(in Afghanistan, Bangladesh, Burma, India, Nepal, Pakistan) (Stakeholder Analysis Report, 2015; Evidence Review, 2015; Wilby, 2009)[viii]. Notable programmes involving DFID include the South Asia Water Governance programme (SAWG)[ix], the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS)[x], the recently launched Climate Services for Resilient Development partnership with the United States Agency for International Development (USAID)[xi] and the DFID Science for Humanitarian Emergencies and Resilience (SHEAR) programme[xii]. Other donors are supporting significant modernisation and capacity building of National Hydrological and Meteorological Services (NHMS), improving risk assessment and disaster response and the resilience of existing and new infrastructure to climate change (Stakeholder Analysis Report, 2015, Section 3 provides a detailed breakdown). There is also a need to strategically address long-term climate and weather emergencies and stress events, such as El Niño, which regularly impact the region.

What are climate services?

Climate Services are defined as *"the dissemination of climate information to the public or a specific user. They involve strong partnerships among providers and 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"* (WMO 2014a).

Climate services provide access to tailored weather, climate change and socio-economic information to support decision-making. Examples are wide ranging, from the provision of short term severe weather warnings that provide vital information for farmers and fishing communities, to seasonal forecasting that can inform decisions on crop choices and climate

change scenarios, which can be used to inform decisions on long term water resources planning. Climate services research and pilot projects highlight the need for more effective networking and communication between those that produce climate information and decision makers. This is recognised in the World Meteorological Organisation's Global Framework for Climate Services (GFCS) (WMO, 2014a). Significant investment is needed on the both the supply of information, e.g. through NHMS (Rogers and Tsirkunov, 2013) and on the user requirements of demand for information (WMO, 2014b). The current strong user focus aims to rectify some previous mistakes where investments were made in observations and equipment but early warnings and risk information was not provided in time, in an understandable format or to the right people to inform effective action.

Scoping study and emerging options

Evidence gathered to support the development of options included literature reviews, in-country workshops and interviews with user groups, suppliers of weather and climate information and 'intermediaries' involved in the processing, brokering or tailoring of climate information for different user groups. Preliminary lists of activities identified from the Evidence Review were prioritised and refined based on interviews and workshops with over 165 stakeholders, as well as discussions with DFID and other donors operating in the region.

The Evidence Review highlighted 6 themes and over 20 activities to improve the provision of weather and climate information. These were broadly in the areas of strengthening the capability of NHMS and other organisations to provide services, improving observation networks, climate research programmes, strengthening the interface between providers, intermediaries and users, supporting existing regional networks and promoting effective use of Information and Communication Technology (ICT) for delivery of timely warnings (Evidence Review, Table 11; Stakeholder Analysis, Table 9). Specific recommendations were also made for addressing current gaps related to meeting the needs of women, girls and other vulnerable groups (Evidence Review, Annex 5).

The Stakeholder Analysis went on to identify 7 major challenges to improving climate services and potential activities to overcome these. Identified challenges included i) lack of capacity to use existing services; ii) lack of tailoring of information for specific users; iii) gaps in data collection and capacity for processing information; iv) lack of a supply/demand interface; v) challenges in communication of information and early warnings; vi) knowledge gaps, and; vii) poor regional cooperation. Again, around 20 activities were identified, refining those originally tabled in the Evidence Review. These were then prioritised and organised into four themes for investment, which form the framework for four alternative options in the proposed programme (Figure 1). The importance of addressing the needs of women, girls and other vulnerable groups was integrated across these themes.

A. **Enabling market growth in climate services** focuses on getting the conditions right to develop an inclusive weather and climate services market, including involvement of regional actors (e.g. SAARC SDMC and SMRC, the WMO),the private sector (e.g. seed producers, insurance providers, credit providers), national agencies (e.g. NHMS, disaster management agencies, agricultural research institutes) and NGOs (Stakeholder Analysis Report, Table 2).It includes specific activities targeting women and girls, such as running science, education and outreach programmes, developing gender sensitive climate services road maps and the establishment of user groups including ensuring the involvement of organisations representing women and vulnerable groups. It is a key component of Options 1 and 3.
B. **Strengthening global, regional and national networks** centres on establishing the right forums and processes to provide effective access to existing weather and climate information down to the local level (Stakeholder Analysis Report, Table 2).It includes activities aimed at strengthening the involvement of women and vulnerable groups in

processes to develop and deliver a suite of standardised climate services products tailored to users' specific needs. It is a requirement across all of the options but has the greatest level of investment through Option 2.

C. **Research and innovation** to co-design climate services and promote scientific decision-making(Stakeholder Analysis Report, Table 2) ensures that services are informed by robust science, adopts a pragmatic approach based on making better use of the data that are already available and also improves the communication of this information. This theme also includes research into access and use of information and effective communication of climate services, especially for women and vulnerable groups. It is a pre-requisite for Options 1 and 3 and is also required for other options.

D. **Improving regional cross-border co-operation** aims to establish better regional dialogues so that information is shared more effectively to facilitate better communication of risks and to develop early warning systems (Stakeholder Analysis Report, Table 2). It proposes activities aimed at improving the participation of women and other vulnerable groups in trans-boundary forums and mechanisms. It responds to well-known geopolitical barriers that have limited the effectiveness of early warning systems, e.g. in the Ganges and Indus river basins.

The **key criteria for prioritisation** of these interventions consider the need to: (i) address gaps in existing services; (ii) support vulnerable groups and provide access to weather and climate information, especially for women; (iii) responds to articulated demand thereby providing evidence to support VfM, cost-benefit analysis, and future business case development;(iv) reduce risks from extreme events, climate variability and change; and (v) promote more resilient economic growth[xiii]. The programme development is at too early a stage to provide a detailed quantitative analysis against these criteria, but activities were checked and scored by the project team (see Appendix 1).

Summary of options

The scoping study framed the discussions around the supply and demand for weather and climate information, but recognised that any successful programme needs to promote effective interface between the two. The options discussed in this report, therefore, focus on where to place the greatest emphasis (and investment), at this point in time and for development of the climate services sector in the region, in order to have an impact on reducing losses following extreme events and building resilient economic growth.

The 20 activities from the Stakeholder Analysis Report were collated into four main options to simplify the analysis and to address a number of key questions related to the costs, benefits and risks of different types of programmes. These included:

i. Should the programme focus on supply or demand-side investments?
ii. How can user requirements be fully integrated into programme design?
iii. Should DFID adopt an ambitious and broad regional programme or a scaled down programme?
iv. Is it more effective to work in selected sub-regions, countries and sectors or on specific climate risks in order to provide more focus to the scaled down options?
v. Finally, should funds be disbursed through a single DFID country office or partner, such as a national government or donor organisation?

Each option works towards an impact of *"resilient economies that can cope with climate shocks*" but the type and scale of investment means that project outcomes and contribution to the overall impact will vary. The Options were introduced in the Executive Summary Table 1. More information on costs is provided in Table 2 below.

Option	Core activities	Cost	Costs of similar programmes	Theme breakdown
1	Demand-led strengthening of access to and uptake of relevant weather and climate information	£10 million phase 1 up to £140 million total	BRACED £140 million CGIAR programme support ~ £120 M over 5 years	A. Markets 25% B. Networks 25% C. Research 20% D. Regional 30%
2	Investing in supply-side capital and capacities of climate service providers	Up to £145 million (over 5-7 years)	Met Office super computer £97M Eastern Europe NHMS modernisation $124 million Annual donor investment in NHMS $200 million	A. Markets 5% B. Networks 30% C. Research 5% D. Regional 60%
3	Developing demand-led climate services in Western South Asia	Between £5million and £20 million	BRACED proposal development stages ~ £1M SHEAR £25M	A. Markets 25% B. Networks 25% C. Research 30% D. Regional 20%
4	Translating existing research and products into practice through partnerships	Up to £25 million	Coordinated approach (with country strategy) Low management overhead	A. Markets 0% B. Networks 70% C. Research 10% D. Regional 20%

Assumptions: For all options, programme management is important and costs are spread across all activities rather than separated; likely to be 15% of overall costs. For Option 1 regional collaboration is the most expensive component due to costs of data infrastructure, regional forums, etc. All themes include some research. Option 2 includes large infrastructure for regional cooperation (capital expenditure) and research and innovation costs are reduced. The supply-side investment is significant at around £20 million per country and coordination with other donors will be essential alongside consideration of future operational costs and sustainability. Lessons learned from previous modernisations will be incorporated (See Rogers and Tsirkunov, 2013). Options 3 and 4 are substantially scaled back in terms of the absolute sums disbursed in each country but are anticipated to have a local to sub-regional impact on protecting economies from setbacks due to floods, droughts and climate change.

Table 2 Summary of options and costing information

SECTION 2

Option 1 Demand-led strengthening of access to and uptake of relevant weather and climate information

Core activities	Cost	Costs of similar programmes	Theme breakdown
Demand-led strengthening of access to and uptake of relevant weather and climate information	£10 million phase 1 Up to £140 million total	BRACED £140 million CGIAR programme support ~ £120 million over 5 years	A. Markets 25% B. Networks 25% C. Research 20% D. Regional 30%

Option 1 involves a demand-led regional programme[xiv] covering South Asia: Afghanistan, Bangladesh, Burma, Nepal, and Pakistan, and partnership with India. There is also an option for potential support to South-East Asia but the initial "test-bed" proposed is South Asia with activities at regional, national and local scale (e.g. regional and national forums and road maps on climate services, pilot projects).

The programme proposal includes activities outlined in the scoping study (Stakeholder Analysis Report, Table 1) and implemented in a specific way to ensure that the demand for services in agriculture, DRR and other sectors is fully understood before larger investment is made. Figure 1 and the text below provide additional detail on the key components proposed for Option 1.

Key programme elements for Option 1
Option 1 has three elements: *(i) demand-led testing of climate services for the agriculture and DRR sectors; (ii) multi-country gap filling supply-side investment, e.g. in observations and weather prediction; and (iii) regional cooperation and information sharing*. These elements provide an opportunity to initially test and understand real needs for climate services among groups who need it most across South Asia, and then provide added value by investing in supply-side needs and regional information through a stage-gated approach once user needs have been articulated. More detail on the outputs and activities under each element is included in the text and in Figure 1below.

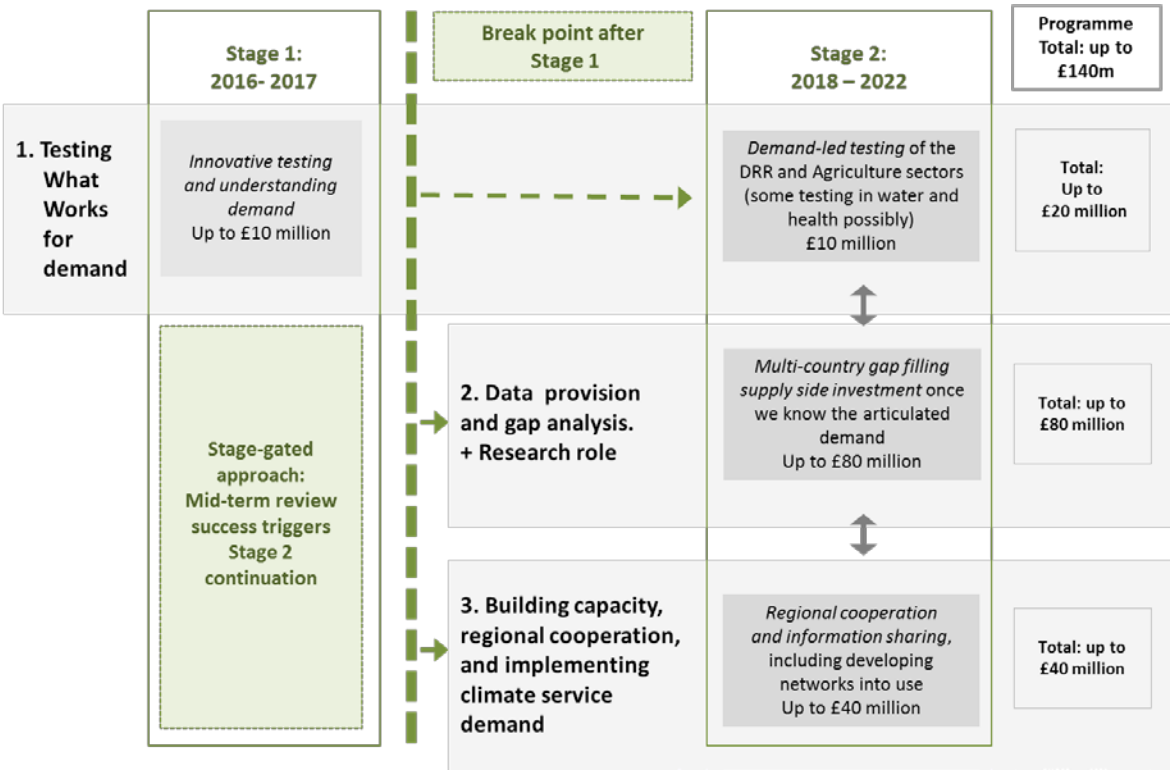
Firstly, **demand-led testing of climate services for the agriculture and DRR sectors**, (with some potential work in water and health) to determine who the user-groups of information are, what their needs are, and how these can best be met. Other sectors, such an infrastructure will also be considered. Outputs and activities include:

- Multiple pilots testing, networking, and cooperation activities as highlighted in the Stakeholder Analysis Report, Table 2. Pilot projects for the co-production of climate information and services, development of tools for transforming data into tailor made information products and training programmes to promote data sharing (essentially understanding theme D "cooperation" and B "networks" first). It also includes scientific inputs (theme C) to ensure that there is a two-way conversation on what services are possible and how these may benefit a range of users, especially the most vulnerable groups, including women and girls. An example of such a pilot is the GFCS Climate Services Adaptation Programme in Africa - Building Resilience in Disaster Risk

Management, Food Security and Health. This pilot is working in the semi-arid Longido and Kiteto Districts of northern Tanzania, which are populated by Maasai communities which depend on livestock for their livelihoods and are extremely vulnerable to climate variability, which affects the onset, duration and intensity of the rainy seasonxv.

- Testing of multiple user activities in themed areas that are organised around specific, spatial scales, user groups and decisions – as outlined in the Stakeholder Analysis Report, Table 3. For example, action research (and market surveys) will determine farmer and fishing communities' understanding of climate variability including monsoon onset, floods and droughtsxvi and their information requirements to inform decisions on timing of labour, irrigation, fertiliser application and harvest times. At a regional scale, user forums with regional climate centres (e.g. the South Asia Climate Outlook Forum - SASCOF), donors, NGOs and the private sector will determine requirements for short term, medium term, seasonal and climate change information for operational planning, financial support, humanitarian aid and long-term adaptation planning (see the Evidence Review, Section 3 on the demand for different time-scales of climate services). Special attention should be paid to understanding the information requirements of women and other vulnerable groups, as well as ensuring their participation in national and regional forums.
- To address a range of climate risks across a geographically diverse region, there could be an overarching network and around 4-8 individual projects (£1 to £2 million per project), although the exact number and themes will emerge through the inception stage. These projects would test and evaluate the use of climate services by end-users and may include projects to support drought and flood forecasting (a gap identified in the SHEAR programme), agricultural risk assessment, and agricultural extension work. They could also include public-private sector services using weather-indexed insurance (e.g. GIZ and AllianzSE, Green Delta Insurance Company in Bangladesh, Agriculture Insurance Company of India Ltd. in India) and heat wave warningsxviiand extreme weather warnings for safety/welfare of farmers and fishing communities. Gender should be incorporated as a cross-cutting consideration within all of the projects funded under this element.

Figure 1 Option 1 diagram showing main project stages, stage gates and costs



Secondly, **multi-country gap filling supply-side investment** once the articulated demand is known (themes A "enabling markets" and C "research and co-design").

- Based on scoping evidence this investment is likely to be focussed on how to make best use of existing global-regional-national data, co-design of new services better tailored to real demand, and investment in the least developed NHMSs (in Afghanistan, Burma and Nepal), and ensuring climate services are accessible to priority users (women and vulnerable groups). Supply-side investments will include support to improve data rescue and digitisation of hard copy climate records, tools for processing station and gridded data and creation of new agro-meteorological and weather and climate indicator data sets, ICT hardware and software for processing Numerical Weather Prediction (NWP) and climate data, a climate change impacts research programme and training. Where there are clear gaps in the observation networks (see Evidence Review, Section 2.4) further support may include observations equipment and infrastructure. Where other gaps are identified in the delivery of information it may include improved communications (e.g. telecommunications, radio programmes, mobile phone technology). Again, a specific focus on ensuring the 'pull through' of information to priority users and vulnerable groups should help shape investments under this element.

Thirdly, **regional cooperation and information sharing**, including engagement at a government and specialist level to gather support for greater cooperation in climate services and developing "networks into use" (Theme D, cooperation). Effective networks will include WMO regional climate centres, river basin commissions, agricultural research institutions and networks (CGIAR) and user groups (as identified in stage 1), and involve actions that help to ensure the engagement and active participation of women and vulnerable groups in these spaces. The information sharing element will also include work on raising the awareness of the benefits of Early Warning Systems and communication of weather and climate risks down to the community level.

The **role of research and testing** in this option would be to help understand the demand needs over an inception period (up to a year in length), which will involve private sector organisations (weather risk companies, agri-technology and consultancies) and researchers piloting demand testing, including last mile delivery and market creation mechanisms. In Stage 2 there is likely to be a requirement for both fundamental and applied climate and adaptation research including: (i)a Climate Science Research Partnership aimed at improving our understanding of the drivers of climate in South Asia and building on existing UK-India partnerships; (ii) further research on tailoring information for DRR, agriculture and infrastructure projects; and (iii) research on decision making under uncertainty so that users are aware of methods from basic risk assessment to robust decision making and real options analysis.

Delivery choices and stage-gated approach

The delivery mechanism for this option during Stage 1 could be a single research consortium or a competitively procured programme with projects, including some market testing organisations (such as MORI). The starting point for this testing work are the user groups identified in the Stakeholder Analysis Report, including farmers and fisherman, agro-advisories and DRR and policy professionals. Methods will vary from action research and ethnography to simpler surveys of larger numbers of users. A programme manager or delivery partner could tender research and innovation projects in a similar way to Innovate UK's Newton Fund, or GFDRR and DFID's Challenge Fund. A stage-gated approach, which could undertake a mid-term review after stage 1 to decide on progression to stage 2, would enable DFID to analyse evaluation results and decide on the delivery and procurement possibilities for a second phase. If it was felt other partners or national governments were best placed to act in this space following initial DFID investment, the programme could be completed after phase 1 and 2.

Delivery choices for this option are complex for two main reasons. First, National Met Services (NHMS) will not be the right place to start in Stage 1 because as a demand-led initiative it needs to begin working with the stakeholders making decisions using weather and climate information (e.g. national disaster management agencies, agro-advisors, farming communities). However, NHMS must be informed and involved in some way (any programme must operate in accordance with WMO and national government mandates, which determine who can provide early warnings and also require sources of free/affordable data from global/regional/national meteorological community). Secondly in Stage 2, which includes supply-side investment, World Bank, GFDRR and ADB coordination will be required and WMO and NHMS will have an essential role alongside intermediary organisations, such as flood forecasting centres and agro-advisories.

While further development of delivery choices needs to be undertaken, Table 3 below suggests a breakdown of spend across stage 1 and 2 and the three programme mechanisms proposed. These cover a range of the themes suggested by the Stakeholder Analysis and an indication of the breakdown of costs across mechanisms.

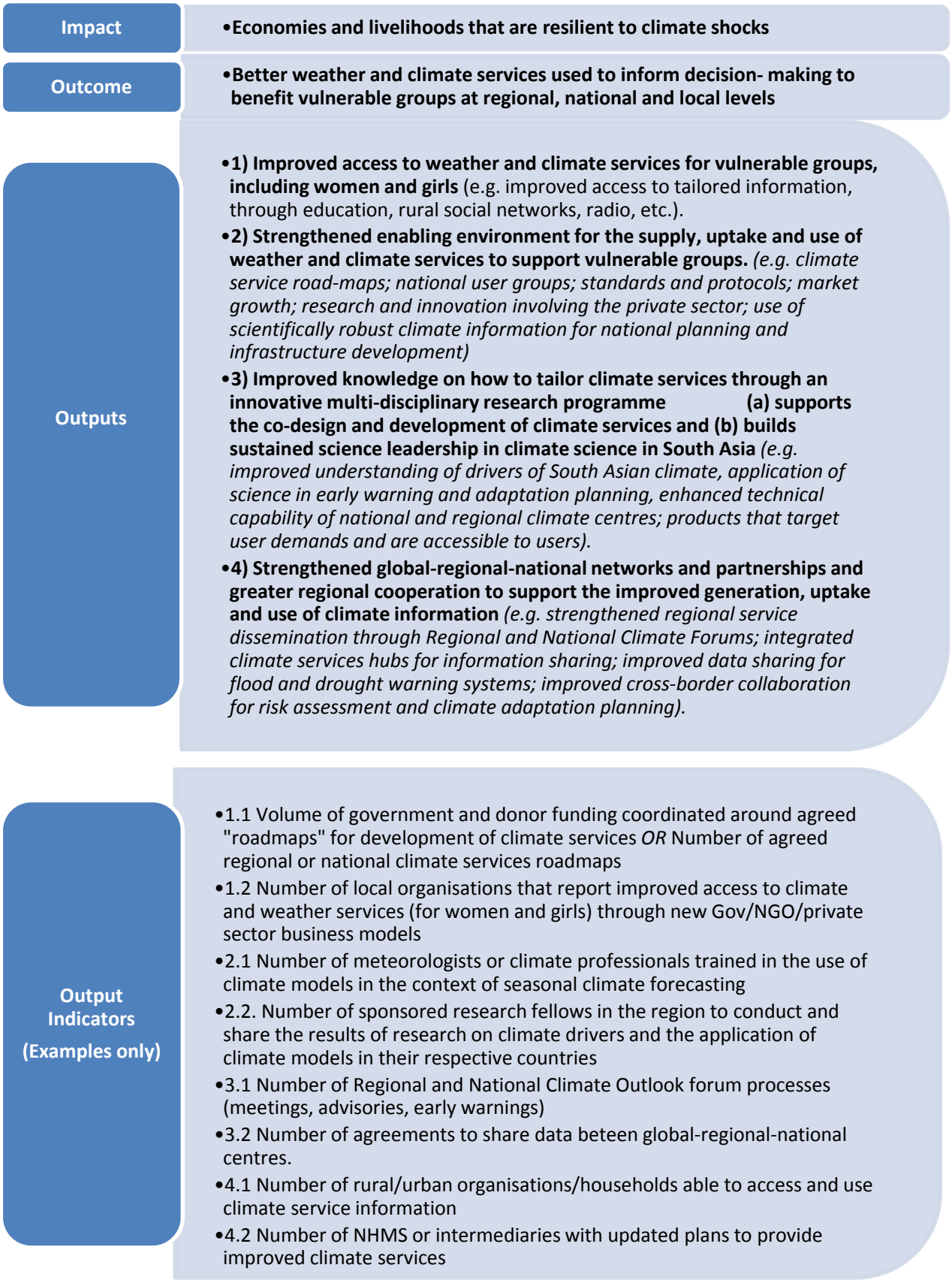
Option 1 programme mechanisms	**Stage 1 2016-2017**	**Stage 2 2018-2022**	***Themes addressed***
Mechanism 1: Testing demand and what works	£10 million	£10 million	A. Markets C. Research
Mechanism 2: Multi-country gap filling supply-side investment		£80 million	A. Markets B. Networks
Mechanism 3: Regional cooperation and information sharing		£40 million	D. Regional
Totals *all figures are up to a maximum spend	*Up to £10 million*	*Up to £140million*	

Table 3 Summary of costs by stage and activity

Theory of change and suggested outputs

Theory of change thinking on the projected impacts has been used to structure the development of the options presented in this report. For this option, a stronger enabling environment, supported by research and innovation and better access to information will lead to improvements in weather and climate services, which would contribute to more resilient economies and livelihoods that can cope with climate shocks. This assumes an effective two-way discussion between scientists and users so that user expectations are managed and decision making methods incorporate the uncertainties in seasonal forecasting and climate change information. This is set out in Figure 2 below and in the attached Excel worksheet (Appendix 2).

Figure 2 Outline logical framework for Option 1



SECTION 3

Option 2 Investing in supply-side capital and capacities of climate service providers

Core activities	Cost	Costs of similar programmes	Theme breakdown	Assumptions
Investing in supply-side capital and capacities of climate service providers	Up to £145 million (over 5 years)	Met Office super computer £97M Eastern Europe NHMS modernisation $124 million. Annual donor investment in NHMS $200 million	A. Markets 5% B. Networks 30% C. Research 15% D. Regional 60%	Include large infrastructure for regional cooperation (capex) Research and innovation costs reduced Management is spread across themes Best practice implemented

Key programme elements for Option 2
Option 2 presents a large-scale supply-side investment for regional climate services across the South Asia region. Supply-side investment includes improvements to observation networks to monitor Essential Climate Variables (ECVs) using weather stations, upper air observations, marine observations and satellite data. 'Climate service providers' in this context includes intermediaries and boundary organisations as well as NHMS (such as national disaster management agencies and private sector providers – see Box 2 in Stakeholder Analysis Report). Option 2 suggests a regional programme covering South Asia: Afghanistan, Bangladesh, Burma, India, Nepal, and Pakistan. Consultation with DFID indicated that the Philippines and Indonesia could also be included under this option.

The key elements (activities and outputs) of the programme would be:

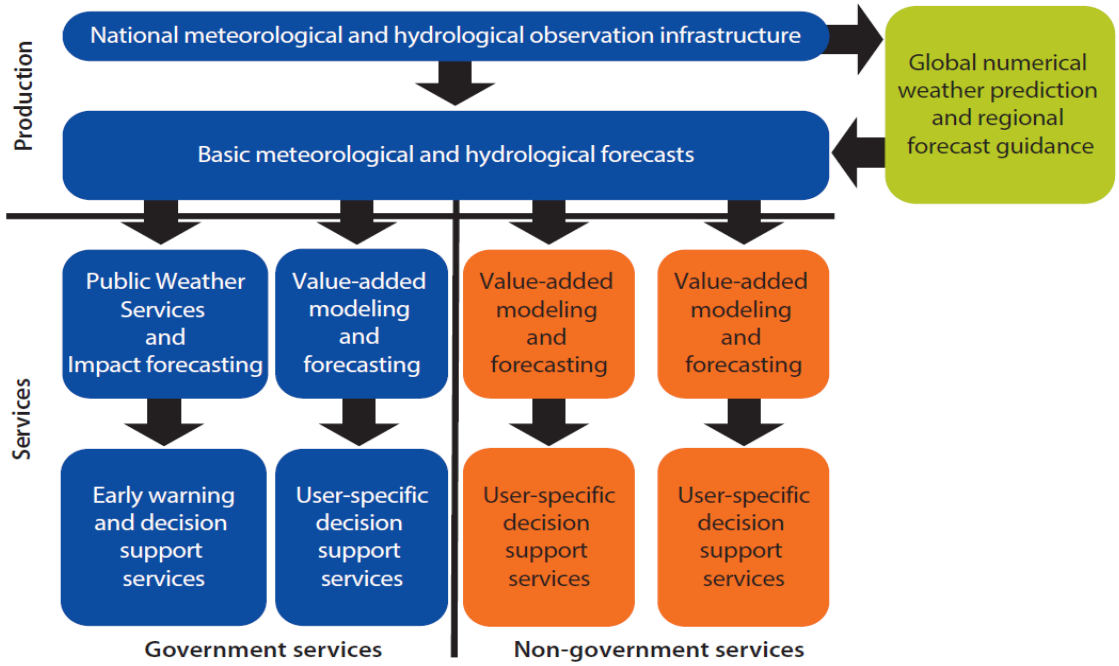
- **Research and innovation** projects that would make best use of existing data to develop sector information services. Data sets would include satellite information such as European Space Agency's Soil Moisture and Ocean Salinity (SMOS) mission as part of the Living Planet Programme, Tropical Rainfall Monitoring Mission (TRMM) rainfall estimates[xviii], climate model reanalysis data[xix] and more fundamental research on weather processes affecting climate variability and change (Evidence Review, Table 5 and Stakeholder Analysis, Table 2).
- **Capital investments in infrastructure** for improving weather observing capability, such as surface observatories, automatic weather stations (AWS), upper air observations - filling gaps in the WMO defined Regional Basic Synoptic Network (RBSN), radars, ship and buoy based marine observing stations, modelling (computation facilities including high end computers, servers) and monitoring tools (data archiving, management tools and software), particularly where the current networks are poor in Afghanistan, Burma and Nepal (see Evidence Review, Table 3 and Annex 2). Observation requirements extend to hydrological measurements and processing and data management tools. Any capital investment requires management support for implementation and a sustainable plan for supporting operational and maintenance costs.
- **A regional approach** – investment into a large regional body (e.g. WMO and its associated regional centres, India IMD Pune that hosts the South Asia Regional

Climate Outlook Forum-SASCOF and/or collaboration with ADB as a hub for climate change information provision), Red Cross Climate Centre and scientific partners (e.g. NERC, Ministry of Earth Science in India, UK Met Office) to provide upstream activities, such as scoping work and delivery of data sets.

- **Selected research and consultation** activities in parallel and completion of climate service products towards the end of the project. Research collaboration to build on existing UK-India and UK-Korea or UK-Singapore relationships for seasonal forecasting and climate change modelling and operate with established groups such as SASCOF and the Climate Outlook Forum for the ASEAN (Association of South East Asian Nations) region - ASEANCOF. The delivery mode is more top-down and similar to the kind of process used to develop national climate change projections. A range of regional and national information products as well as access to data streams for third parties would be included as outputs.
- Up to £145 million: The budget could comprise of both grant funding (up to £45 million) and capital expenditure of up to £100 million. Capital expenditure could be used in partnership with appropriate organisations to build, for example, the physical asset base for weather observations in the region (see Evidence Review, Table 5 and Annex 2).

A strong supply-side investment could provide a sustained programme across South Asia to enable the delivery of improved weather predictions and climate resilient development, and contribute to more resilient infrastructure projects, when climate change is incorporated into project design (Evidence Review). It would need to manage the risks associated with such a programme and learn lessons from recent reviews (e.g. the World Bank review completed by Rogers and Tsirkunov, 2013).A supply-side investment would focus on WMO Global and Regional Climate Centres (e.g. UK, India, Korea, and Singapore), NHMS and other information providers, such as Ministries of Agriculture and Water Resources. It can enable them to deliver more tailored information for public, NGO and private sector intermediaries, and could focus, in particular, on meeting the needs of women and vulnerable groups. It would invest in gaps in observation infrastructure, it would aim to move NHMS from a position of providing basic forecast information to more tailored services to the public sector (including value-added services developed with others such as disaster management agencies), and make information available to others for non-government services (Figure 3). Without the demand orientated focus in Option 1, the assumption is that the private sector, universities and NGOs may develop further services ***if basic weather forecast and climate modelling data are made available for commercial use*** (orange boxes in Figure 3).

Figure 3 Provision of different types of services from government and private sector



Note: Users are governments, households, and businesses.

(Source: Rogers and Tsirkunov, 2013)

The Evidence Review set out the level of capability (assessed in 2011) of each of the national meteorological services and the WMO objectives of increasing this capability by at least one level, for example from provision of "basic" to "essential" services (see Evidence Review). Investments in modernising NMHSs in developed countries typically have cost-benefit ratios between 1:2 and 1:6, with higher values of 1:10 reported in Central Asian countries. Investments in developing countries are regarded as higher value investments but there is lack of evidence in this area and the highest figures reported of 1:100-1:400 are based on many assumptions regarding the timeliness and effectiveness of warnings as well as responses to reduce loss and damage (e.g. see Pappenberger et al., 2015).

The benefit of a regional approach is that more advanced data provision and processing tasks can be done at the more advanced global and regional centres of excellence (e.g. UK Met Office, the European Center for Medium range Weather Forecasting-ECMWF and Indian Meteorological Department, National Centre for Medium Range Weather Forecasting-NCMRWF, Indian Institute of Tropical Meteorology-IITM), from which information can cascade down to national services. Investment in one global and regional centre, and communications networks, can therefore provide significant benefits for several countries, without the need for each nation to have the most advanced numerical weather prediction or climate models and associated super-computing infrastructure. (Individual countries may still aspire to self-sufficiency and significantly improved capability, particularly for climate services for defence and aviation, but this option is focused on cooperation for humanitarian and development purposes).

There is also a strong rationale for regional programmes with respect to (i) down-scaled climate change projections, as the domains of down-scaling are inherently regional (supranational) as determined by important physiographic features (e.g. Indian Ocean, Tibetan Plateau) and regional circulation patterns (e.g. the Southwest Monsoon). (ii) Similarly for forecasting, the WMO Severe Weather Forecasting Demonstration Project (SWFDP) has shown the effectiveness of a "cascading forecast process" (global to regional to national) involving regional climate centres and NHMS[xx].

Delivery options and potential costs

Several delivery options are possible in collaboration with existing initiatives from regional donors (Stakeholder Analysis Report, Table 7; Wilby, 2009).Table 4 sets out one possible approach with a similar stage-gated approach to Option 1 but focuses on working with suppliers and the research community. Mechanism 2 is general modernisation of the NHMS, which can be achieved with WMO collaboration and differs from Option 1, which focuses on specific demand–led services.

Option 2 programme mechanisms	**Stage 1 2016-2017**	**Stage 2 2018-2022**	***Themes addressed***	***Delivery Mechanism***
Mechanism 1: A Research and Innovation Programme: What is possible with existing data sets?	£10 million	£5 million	A. Markets C. Research	Innovate UK, European Space Agency or UK Space Catapult GFDRR/DFID Challenge Fund
Mechanism 2: Improvement of national services: weather observations, monitoring, processing and delivery(Nepal, Afghanistan, Burma, then Pakistan and Bangladesh)		£100 million (£20 million per country)	C. Networks D. Regional	WMO, UK Met Office, Voluntary Cooperation Programme, NHMS
Mechanism 3: Regional cooperation and information sharing, regional service delivery		£20 million	D. Regional	India IDM SASCOF ASEANCOF, Forum on Regional Climate Monitoring-Assessment-Prediction for Asia (FOCRAII), ADB (CSIRO, Met Office)
Mechanism 4: Research programmes on seasonal forecasting and climate change	£2 million	£8 million	B. Networks C. Research D. Regional	Existing UK-India and other S Asia research partnerships (NERC, MoES)
Totals *all figures are up to a maximum spend	*Up to £12 m in Stage 1*	*Up to £145 million*		

Table 4 Summary of costs by stage and activity

Theory of change and suggested activities

For this option, improvements in the processing of existing data, modernisation of NHMS and greater regional collaboration and research would lead to better weather and climate services and regional cooperation. This is set out in Figure 4 below and in the draft logical framework (Appendix 2). Note that unique aspects of this option compared to Option 1 are in black text.

Figure 4 Outline logical framework for Option 2 (text in grey highlights some overlap with Options 1 and 3)

Impact	•Economies that are resilient to climate shocks
Outcome	•**Better weather and climate information owing to improved observations, data processing and delivery through global-regional-national collaboration**
Outputs	•**1) Improved data at historical, present and future timescales and better production systems support the generation of improved weather and climate information and services** *(e.g. including remote sensing products, data rescue, gridded data products and climate change model output portals)* •**2) Improved meteorological (including upper atmosphere) and hydrological monitoring to improve networks and fill gaps in regional and global data sets** (e.g. improved network design inc. assessment of capacity/opex/sustainability) •**3) Innovative multi-disciplinary research programme (a) supports improved data sets and *(b) builds sustained science leadership in climate science in South Asia*** *(e.g. improved understanding of drivers of South Asian climate, enhanced technical capability of national and regional climate centres)* •**4) Strengthened global-regional-national networks and partnerships and greater regional cooperation to support the improved generation, uptake and use of climate information** *(e.g. strengthenned regional climate service dissemination through Regional and National Climate Forums; integrated climate services hubs for information sharing; improved data sharing for flood and drought warning systems; improved cross-border collaboration for risk assessment and climate adaptation planning)*
Output Indicators (Examples only)	•1.1 Number of quality assured joint river basin or gridded data sets available for research and government services •1.2 Data sets including live data feeds made available to third party developers of climate services •2.1 Number of NHMS with updated modernisation plans in coordination with other donors •2.2. Number of cross-border data sharing agreements for risk assessment or early warning systems •3.1 Number of meteorologists or climate professionals trained on the use of climate models in the context of seasonal climate forecasting; •3.2. Number of sponsored research fellows in the region to conduct and share the results of research on climate drivers and the application of climate models in their respective countries. •4.1 Number of Regional and National Climate Outlook forum processes (meetings, advisories, early warnings) •4.2 Number of agreements to share data between global-regional-national centres

SECTION 4

Option 3 Developing demand-led climate services in Western South Asia

Core activities	Cost	Costs of similar programmes	Theme breakdown	Assumptions
Developing demand-led climate services in Western South Asia	Between £5million and £20 million	BRACED proposal development stages SHEAR £25M	A. Markets 25% B. Networks 25% C. Research 30% D. Regional 20%	Significant user interfacing (networks) and research Limited market growth work Management is spread across themes

Key programme elements for Option 3

Option 3 presents a sub-regional approach focusing on DFID target countries in the western part of South Asia, Afghanistan and Pakistan. The Evidence Review placed a similar focus on Burma, Nepal and Bangladesh. All of these countries only have "basic" or "essential" levels of weather and climate service provision. However, DFID and other donor activity in Burma, Nepal and Bangladesh (Stakeholder Analysis, Table 7) is regarded as stronger than for Afghanistan and Pakistan[xxi], and therefore these countries provide a focus for a scaled down and research focused programme. A focus on Western South Asia is therefore suggested initially, but could be expanded to DFID country offices in Burma and Nepal if required.

Afghanistan requires urgent and substantial investments in their NHMS and climate services. The UK Met Office, in partnership with International Security and Assistance Force (ISAF) and DFID (Met Office 2012), has drawn up a comprehensive ten-year capacity development programme for the Afghan Meteorological Authority (AMA) (Evidence Review, Table 2). Further work to refine this and focus on climate services provision and cross-border issues with Pakistan (and neighbouring countries such as Tajikistan) is timely. The Pakistan Meteorological Department (PMD) (Cabinet Secretariat, Aviation Division) is more advanced and provides flood and drought early warning as well as maintaining an observation network (Evidence Review, Table 2).Workshops in both countries identified multiple gaps in climate services and the need for improvement in observations, modelling, communication and delivery of warnings on all timescales (Stakeholder Analysis Report, Annex 8 and Annex 9).

Afghanistan and Pakistan share a number of environmental challenges related to floods, droughts, climate change, water, food and energy security, and they also share transboundary river basins (Kabul River provides around a quarter of Afghanistan's water resources for around half of its urban population). The activities below represent investments between £5 million and £20million to deliver provision of climate services for the sub-region, which are research focused and demand-led, but also involve building the capacity of the AMA and PMD. This option would follow a similar logic to Option 1 with some initial scoping and demand testing, followed by research projects and pilot services delivered by AMA and PMD in collaboration with universities and NGOs. Its ambition would be limited to pilot projects that build research and service capacity and provide improved information to target communities, rather than tackling bigger geo-political challenges such as water sharing in transboundary basins (Figure 1, Box 1 and 2).Key elements of this option are as follows:

Firstly, conduct further **research to understand the demand for specific services and to test information provision:**

- Research, pilot testing and networking activities that link NHMS, the research community and users of climate information within each country. This could proceed through National Climate Outlook Forums and sector-focused groups working on flood risk management, drought risk management and agricultural or health extension work. Special attention should be paid to meeting the needs of women and vulnerable groups through involving them in production and interface spaces and processes.
- Testing will proceed in themed areas that are organised around specific spatial scales, user groups and decisions. For example, projects could provide research to (i) support Pakistan's Flood Forecasting Centre and National Disaster Management Authority for delivery of timely warnings to a local scale and to develop a new Flash Flood Warning Centre in Kabul; (ii) provide agricultural risk assessment, agricultural extension work and seasonal forecasting to manage food security; and (iii) tailored forecasts to provide health advisories related to urban heat waves and air quality, and also more information for rural areas (which is perceived as ignored, see Stakeholder Analysis Report, Annex 8).In North East Afghanistan there is an urgent need to pilot landslide risk assessment and early warning (Stakeholder Analysis Report, Annex 9). Clear gaps were identified in the user workshops, which can inform the Terms of Reference for these activities. In all instances, the uptake and use of these new tools by women (professionals and last mile users), as well as the impacts of tailored products on vulnerable groups, should be integrated into activity design and evaluation in order to provide lessons for the wider region.

Secondly, **some supply-side investment:**

- To be aligned with the modernisation plans of each NHMS, which would be refined in response to these research projects. Supply-side investments may include substantial capital investments in observational and communication networks – filling RBSN data gaps, installation of automatic weather stations, radar stations, basic telecommunication facility for exchange of data within and outside of country, reception and processing of remote sensing data, data rescue and digitisation of hard copy climate records, quality control, software tools for processing station data and various types of gridded data sets from global and regional centres.
- For the development of new data sets, which can be used for research and developing services including historical reanalysis data sets for meteorological and climate profiling, (for example generated by ECMWF, National Centres for Environmental Protection (NCEP), and various other global centres), processing of real time gridded forecast data for operational forecasting in short, medium and long range (for example NCEP-Global Forecasting System (GFS) & the Coupled Forecast System model version 2 (CFSv2), and creation of new agro-meteorological and climate indicator data sets.
- To provide support to Flood Forecasting Centres, training in delivery and communication of warnings, radio and TV studio facilities, etc. The stakeholder workshops identified the demand for capacity building and training for AMA staff in a range of activities from writing of research proposals and business cases to improved weather prediction models. The potential for stronger bilateral links between PMD and AMA were also evident (Stakeholder Analysis Report, Annex 9).
- To involve other key agencies in the supply chain, such as the National Disaster Management Authority (NDMA) in Pakistan and the Afghanistan National Disaster Management Authority (ANDMA), and more local organisations in the implementation of successful pilots from stage 1. This could, for example, include seasonal advisories on drought and river flows, landslide warning services and climate risk assessments for specific crops.

- To include elements of short, medium and long term warning systems, and climate change risks and adaptation. The Pakistan stakeholder workshop indicated a high demand for weather and climate information but also training and education on how forecasts and risk information can save lives and reduce damage from floods and droughts. A series of television and radio documentaries, a communications plan in national and local languages, as well the need for awareness-raising through school curriculum were highlighted (Stakeholder Analysis Report, 2015).

Although DFID and the scoping study team explored different ways to focus this programme in order to ensure an impact, including focusing on specific cross-border areas, forecasting timescales and potential elements of a research programme (during discussions on August 3rd 2015), basic supply infrastructure improvements in Afghanistan are urgently needed before services can be improved. One possible focus area is the transboundary Kabul River, which is a key basin for both water resources and flood risk management. This will require collaboration with other ongoing World Bank and USAID projects. DFID could play a niche role in these programmes by (i) providing research and pilot testing at a scale that is not possible for capital investment NHMS projects or ongoing infrastructure projects[xxii]and (ii) working more closely with non-government users (e.g. NGOs) keeping in mind that the World Bank works with national government clients.

Delivery options and potential costs

Table 5 outlines the costs of each stage and activity, drawing partly from Option 1 and partly from Option 2, focused on working with suppliers and the research community. Mechanism 1 is crucial to this option with a significant proportion of the total budget; the overall research spend is much less compared to Options 1 and 2 (~£15-£20 M) but is focused mostly in two countries. Mechanism 2 is general modernisation of the NHMS, similar to Option 2, which can be achieved through collaboration with WMO and other organizations. The indicative spend per country is £6 million, which is less than Option 2 (~£20 million).

Option 1 programme mechanisms	**Stage 1 2016/17**	**Stage 2 2018-2022**	***Themes addressing***	***Delivery Mechanism***
Mechanism 1: Research and pilot testing programme	£1 million	£7 million	C. Research	Existing UK-India and other South Asia research partnerships(NERC, Ministry of Earth Sciences (MoES) India) ADB, International Non-Governmental Organisations (INGOs), UNEP, World Bank
Mechanism 2: Gap filling supply-side investment		£12 million	B. Networks C. Research	WMO, World Bank, NHMS (PMD, NDMA, AMA), UK Met Office, Voluntary Cooperation Programme (VCP), USAID
Mechanism 3: Regional and national networks and information sharing		£5 million	D.Regional B. Networks	WMO ADB, United Nations Economic Commission for Europe (UNECE)
Totals *all figures are up to a maximum spend	*Up to £1 million in Stage 1*	*Up to £25 million*		

Table 5 Summary of costs by stage and activity

Theory of change and suggested activities

For this option, research and demand testing work will identify what improvements are needed to enhance services and improve access to information for selected pilots, which would ultimately contribute to making communities more resilient to climate shocks. Urgent activities to support Afghanistan's AMA could be fast-tracked, as is set out in Figure 5 below and in the attached Excel worksheet (Appendix 2). The logic is similar to Option 1 but with ambitions/impact that are scaled back, commensurate with the reduced funding.

Figure 5 Outline of logical framework for Option 3 (text in grey highlights some overlap with Options 1 and 2)

Impact	•**Communities that are resilient communities to climate shocks**
Outcome	•**Better weather and climate services to inform decision making in selected sectors at national and local levels**
Outputs	•**1) Improved basic meteorological infrastructure in Afghanistan and regional improvements in monitoring to fill gaps in meteorological and hydrological data sets** (e.g. establish infrastructure for flood and landslide early warning systems and improve coordination amongst donor initiatives) •**2) Improved capacity for the generation, uptake and use of weather and climate services to support development** *(e.g. climate service road-maps; sector user groups; research and innovation in flood and drought forecasting; use of scientifically robust climate information for national planning and infrastructure development)* •**3) Innovative multi-disciplinary research projects support the co-design and development of climate services** *(e.g. research support similar to Option 1 but scaled back to selected projects)* •**4) Strengthened global-regional-national networks and partnerships and greater regional cooperation to support the improved generation, uptake and use of climate information** *(e.g. strengthened regional service dissemination through Regional and National Climate Forums; improved cross-border collaboration for risk assessment and climate adaptation planning, improved collaboration between PMD and AMA, real time exchange of river flow data between Afghanistan and Pakistan; build a mutually agreed climate and hydrological knowledge base on the Kabul River basin* •**5) Improved access to weather and climate services for vulnerable groups, including women and girls** (e.g. improved access to tailored information, through education, rural social networks, radio, etc.)
Output Indicators (Examples only)	•1.1 Number of stations installed and operational to fill gaps in RBSN •1.2 Number of AWS, radar or hydrological stations installed and operational to support climate service development •2.1 Volume of government and donor funding coordinated around agreed roadmaps for development of climate services *OR* Number of agreed regional or national climate services roadmaps •2.2 Number of local organisations that report improved access to climate and weather services (for women and girls) through new Gov/NGO/private sector business models •3.1 Number of meteorologists or climate professionals trained on the use of climate models in the context of seasonal forecasting •4.1 Number of National Climate Outlook forums or sector climate service group processes (meetings, advisories, early warnings) •4.2 Number of bilateral agreements or working groups to share data between Afghanistan, Pakistan and neighbouring countries •5.1 Number of rural/urban organisations/households able to access and use climate service information •5.2 Number of new services offered by NHMS or intermediaries

SECTION 5

Option 4 Translating existing research and products into practice through partnerships

Core activities	Cost	Costs of similar programmes	Theme breakdown	Assumptions
Translating existing research and products into practice through partnerships	Up to £25 million	Coordinated approach (with country strategy) Low management overhead costs	A. Markets 0% B. Networks 70% C. Research 10% D. Regional 20%	Concerned with national climate services networks/outlook forums/forecasting centres. Some research and Knowledge Management and regional collaboration e.g. for transboundary flood forecasting

Key programme elements for Option 4
Option 4 considers investment in a partner organisation or delegation of the programme to several DFID country offices. This option suggests that up to £25 million could be invested in countries where the need for upgrading climate services is the greatest (ie. in Afghanistan, Burma, and Nepal).

A country-focused programme would concentrate on the demand-side and could work through promoting national climate outlook forums or working with groups like CCAFS and the International Centre for Integrated Mountain Development (ICIMOD) in the agriculture and DRR sectors. Support could be provided for national capacity building and smaller capital investments in monitoring systems. At a country-level Afghanistan, Burma and Nepal are in need of substantial and sustained support to improve basic NHMS. The possibilities for partnering in these countries are outlined below.

Partnership options
Listed below are a number of key partnerships options for DFID in target countries in South Asia. These are relevant for all options but are particularly true for Option 4, which proposes direct investment in another organisation or programme. Partnerships with other donors were explored and additional information can be found in the Stakeholder Analysis Report, Section 3. Table 6 provides a shorter description of existing programmes and feasibility of partnering. It is not possible to provide an outline logical framework for this option as the outputs will vary according to which country and which partners are selected, however, potential advantages include extending existing projects that have already demonstrated an impact and potentially lower management overhead costs.

There are also several existing DFID programmes that have potential overlap with Option 4. For this reason it is proposed that any development of Option 4 would involve an initial assessment of existing programmes to enable learning and value for money assessment. The more feasible partnership options involve: the possibility of extending current BRACED projects in Burma, Nepal and Pakistan; investment in DFID country programmes in Bangladesh, Burma, Nepal and Pakistan; further investment in existing programmes (e.g. CCAFS); working with a major donor, such as ADB, or organisation, such as WMO. A mix of these options may be possible with an investment of £25 million. Although not considered under partnership options below, the project could also be contracted to a UK delivery partner.

Partnership options	Feasibility rating	Comments
Partnering with DFID country-led programmes **Afghanistan** In Afghanistan the DFID-funded £29 million Comprehensive Agriculture and Rural Development Facility Phase II aims to increase agricultural growth in targeted provinces	Medium	The UK Met Office set out the capacity building requirements for the Afghanistan NHMS (see Evidence Review). Additional funding of climate services for agriculture could support this programme. Providing research support is problematic for security/duty of care reasons
Bangladesh The DFID-funded £17 million Climate Change Programme focused on climate change adaptation and risk reduction measures to protect and improve the lives and livelihoods of 15 million poor and vulnerable people by December 2017	High	The USAID/DFID/Google partnership will be piloted in Bangladesh. Large numbers of programmes ongoing in country so alignment with other donor activities essential (see Stakeholder Analysis Report, Table 7)
Burma The delta region will remain a geographical focus for DFID Burma, the United Nations Children's Fund (UNICEF) and UNDP could be the most important UN delivery partners in the country. There is potential to build upon the Livelihoods and Food Security Trust Fund (LIFT) for Burma, the purpose of which is to sustainably increase food availability and income of 2 million target beneficiaries, which should be completed by December 2015	High	Focus on weather and climate impacts on food production in the Bay of Bengal (i.e. through Severe Weather Forecasting Demonstration Project-SWFDP). Floods and water security also key issues in the delta region. The UK Met Office is liaising with Finnish and Norwegian Met Services to provide some support to the Department of Meteorology and Hydrology (DMH). Water resources work is being led by Dutch programmes
Nepal The £12 million Nepal Climate Change Support Programme (NCCSP) aims to develop, cost, budget and implement adaptation measures at the local level aimed at mainstreaming climate change in key development sectors (i.e. agriculture, forestry, water and energy), including through public private partnerships, by December 2016	Medium	Focus will be on post-earthquake activities. There is a lot of ongoing donor activity (See Stakeholder Analysis Report, Table 7)
DFID-funded BRACED projects DFID-funded BRACED projects commenced on 1 October, 2014.There are three relevant ongoing projects that could be built upon, led by the following organisations: • Plan UK in Burma who are building the resilience of 1.7 million people to climate extremes, protecting livelihoods, improving institutional coordination, and influencing national policy • RAIN Foundation in Nepal and Pakistan who are working on catchment perspective water harvesting at community level to enable long term resilient livelihood systems	High	BRACED is a bottom-up programme. Originally more top-down activities were promoted but it is unclear how this has progressed. Each project has a climate resilience focus and could be extended to make better use of climate services.

Partnership options	Feasibility rating	Comments
• International Development Enterprises (iDE UK) in Nepal who are developing climate resilient livelihoods for local communities through public-private partnership for 500,000 poor people in the western part of the country		
DFID-funded SHEAR projects In June 2016 at least one £2 million research project on hydrological controls on landslide risk (as part of a multi-hazard risk assessment and toward warning system) will commence in South Asia. This will include the use of climate services in forecasting landslides	Medium	SHEAR is more a research-focused programme so an investment here could help bring services into use. High potential, however, for overlap. To avoid overlap, the CLIMATISE Programme might avoid addressing landslides in the same countries
World Bank Trust Funds Within the region there is one relevant World Bank Trust Fund, the Afghanistan Reconstruction Trust Fund (ARTF), established in 2010.This covers, amongst other areas, infrastructure, rural development, and agriculture and has a three-year rolling allocation plan which evolves over time in response to emerging needs, government capacity and actual paid-in contributions. The World Bank has a policy of not permitting ear-marking of donor funds for particular activities in these funds, however, donors can express preferences for projects/programmes for a portion of their overall contribution and can monitor expenditure through World Bank systems	Low	Too far removed from climate resilient economies objectives. Unlikely to have desired impact
Asian Development Bank Nepal and Bangladesh are both pilot countries of the $1.2 billion Pilot Program for Climate Resilience (PPCR) which is the Strategic Climate Fund (SCF) funding window of the $8.1 billion Climate Investment Funds (CIF) framework. Although the CIF are World Bank funds, ADB is one of the implementing partners administering the funds and overseeing project implementation along with the respective Government ministries. 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. 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 other information on water resources. Co-funder Climate Research and Information Services in South Asia (CRISSA).ADB is also a partner in the newly established Climate Services for Resilient Development (CSRD) initiative, organized by USAID (see below). ADB is a key partner of many governments in the region and has established MoUs with numerous agencies working on climate science, such as the Hadley Centre, the Stockholm Environment Institute (SEI) and UN agencies.	Medium to High	Lots of opportunities for collaboration and various existing mechanisms to potentially fund ADB programmes (untested). For example, the potential for channelling funds from second parties (e.g. DFID) through the Climate Change Fund exists in principle but has not been utilized to date. The advantages to such an arrangement would include low overhead costs, high leverage and well-established fiduciary standards.

Partnership options	Feasibility rating	Comments
CCAFS, CGIAR Flagship work on climate services to focus on India, Nepal and Bangladesh. The CCAFS-South Asia project Improving Index Insurance in Maharashtra is working with industry and government to develop improved index insurance products that increase satisfaction of farmers and economic viability.	High	DFID is already funding the programme so duplication should be avoided. CGIAR is an excellent partner for agricultural research and they appear to be having a significant impact in this area. Spearheading work on gender. Significant potential for replication, testing and scaling-up achievements to date. Also has a developed research agenda with lots of complementarities in the areas of social science and market-related research.
Global Facility for Disaster Risk Reduction 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.	Medium	Opportunity to collaborate on climate change research and risk assessment methods within GFDRR programmes.
JICA (Japan) Example activities include establishment of End to End Early Warning System for Natural Disaster in Burma and Development of Storm Forecasting Project with Science and Technology Satellite/ Storm Surge/ Forecasting Tools (in partnership with the Japan Meteorological Agency) 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 Centre and Strengthening of Early Warning and Dissemination Network and Installation of Weather Surveillance Rader at Karachi)	Medium to Low	Heavy supply-side and bilateral engagement may not fit well with DFID objectives
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. The UNDP developed multi-hazard risk assessments in 4 states in Burma in 2011. Strengthening Climate Information and Early Warning Systems for Climate Resilient Development in Pakistan, Nepal, Bangladesh, Bhutan and Burma. Supporting the development of early warning systems to help communities respond to both short-term/rapid onset climatic hazards as well as long-term/slow onset impacts.	Medium	There is 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 space for discussions around science and technology outside the traditional academic context
USAID USAID funds and partners in the Climate Services Partnership (CSP), Scaling Up Climate Services for Farmers in Africa and South Asia (CGIARCCAFS) and SERVIR-Himalaya initiatives, amongst others. USAID has also developed, in partnership with the WMO, a methodology for estimating the economic	Medium	The South Asia Regional Hydromet Program seeks to strengthen disaster preparedness and climate resilience

Partnership options	Feasibility rating	Comments
value of climate services to farmers and other users of climate data (see WMO below)		A priority for collaboration should be carrying out economic analysis of climate services with USAID (and WMO, based on the book *Valuing Weather and Climate (WMO 2015b)*) in order to demonstrate the value added by climate services
World Bank 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. Focus countries are Afghanistan, Bangladesh, Bhutan, India, Nepal, and Pakistan	Medium	Potential for DFID to provide research services and work closely with user groups
WMO The WMO Regional Programme for Asia 2012-2015 has focused, amongst others, 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	High	Natural partner for climate services work. Secondment of UK Met Office staff possible to assist in management of programmes. A priority for collaboration should be carrying out economic analysis of climate services with WMO (and USAID, based on the 2015 book, *Valuing Weather and Climate*) in order to demonstrate the value added by climate services.

Table 6 Commentary on potential partnering options (based on Stakeholder Analysis Report, Section 3, and DFID's own country programmes and ongoing research and evidence programmes)

SECTION 6

Analysis and Discussion

The scoping study has been guided by the need to improve weather and climate services in South Asia, making information accessible to vulnerable communities and aiming *resilient economies that can cope with climate shocks*. Effective Early Warning Systems and provision of information on climate risks enable businesses and communities to take action to reduce loss and damage and avoid setbacks that can limit economic growth.

A stronger enabling environment for use and uptake of information coming from climate services needs to be supported by research and innovation, scientific inputs and better access to information to support wider institutional changes. DFID has the potential to deliver significant impact working with its local, national and global partners in combination with the UK's world-leading weather and climate change expertise. This can be delivered through either a regional or sub-regional arrangement involving DFID target countries. Four options have been presented, each having different emphases on the supply and demand-side of climate services, requiring different levels of investment. The spectrum of options ranges from a £5-20 million research-based programme to a £140-145 million investment with significant capital expenditure on equipment. This section presents some analysis and discussion on what is the best option for DFID in the context of other ongoing programmes (Section 5) and the costs, benefits and risks of each option.

In Section 1 several criteria were introduced to evaluate the benefits of different potential activities and the same criteria are considered in Table 7 to assess the four options. The criteria were:

i. The need to address gaps in existing services;
ii. To build resilience of vulnerable groups and provide access to services, especially for women;
iii. To help to articulate the demand thereby providing evidence to support VfM, and cost-benefit analysis, and future business case development;
iv. Reduce risks from extreme events, climate variability and change;
v. Promote resilient economic growth through improved Early Warning Systems and targeted services in the agriculture and infrastructure sectors. Each criteria was scored by the research team and an initial view on cost:benefit ratio provided based on studies of the return of investing in NHMS (e.g. Pappenberger et al., 2015; Rogers and Tsirkunov, 2013).

Option 1 **Demand-led development and testing of weather and climate services** meets all the criteria and is the strongest in terms of delivering pro-poor transformational change and collecting evidence on demand for climate services, which can then be used to target supply-side investment to meet DFID objectives (criteria iii).Although there are some risks associated with this option, it has been designed in a phased way to reduce risk and increase impact. Other features of this option, which support the analysis in Table 7 include opportunities for:

- Demand-led testing of climate services in agriculture and DRR, which are both key sectors for targeting vulnerable groups
- Design of a supply-side investment that will address identified gaps across a range of countries in South Asia, including significant capital expenditure and capacity building

- Strengthening the enabling environment for the generation, uptake and use of weather and climate services to support development, leading to livelihoods and economies that are resilient to climate shocks
- Supporting global – regional – national networks and research cooperation for climate information generation and sharing, involving public and private sectors
- Translating regional investments in climate infrastructure into effective cross-border early warning systems that would benefit multiple countries, and climate information products that would improve the use of scientifically robust climate information for national planning and infrastructure development
- Building sustained science leadership in climate science in South Asia through innovative multi-disciplinary research programmes and paving the way for enhancement of technical capability of national and regional climate centres
- Improving access to weather and climate information for vulnerable groups, including women and girls, designed to meet their specific needs.

Overall Option 1 could be transformative to selected countries and the region if it is effectively coordinated with other ongoing donor activities, as it would fill an existing gap. Furthermore, the research in year 1 could strongly influence the pull-through of services to meet the needs of vulnerable groups.

Table 7. Qualitative assessment of options against selection criteria

Options and activities		**Criteria** [1]						
Option	*Core activities*	*Addresses gaps* [i]	*Support vulnerable* [ii]	*Enables demand articulation* [iii]	*Reduces risks* [iv]	*Promotes economic growth* [v]	*Cost*	*Comments*
Option 1	Demand-led co-development and testing of weather and climate services	✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓	Up to £140 million	Demand-led approach helps to identify gaps and support vulnerable groups. Significant supply-side investment to develop NHMS. Possibility for (public private partnerships) PPP mode through involvement of private sector organisations and researchers. *Medium Risk: High Return*
Option 2	Large-scale supply investments for regional climate services	✓ ✓ ✓	✓	✓	✓ ✓	✓ ✓	Up to £145 million	Involves doing very similar work to other major donors and therefore a risk of duplicating efforts. Enhances the capacity of NHMS to provide tailored services to the public, NGO and private sector intermediaries. A more general investment that may not target women and girls. *High Risk: Medium Return*
Option 3	Demonstrating the value of climate services in Western South Asia	✓ ✓	✓ ✓	✓ ✓	✓ ✓	✓	Up to £20 million	Lower investment with less risk. Only sub-regional impacts. Testing in themed areas organised around specific, spatial scales, user groups and decisions. Conducting research in Afghanistan may be difficult. *Medium Risk: Medium Return*
Option 4	Translating existing research and products into practice through partnerships	✓	✓	✓	✓	✓	Up to £25 million	Sub-regional low risk investment. Uncertain impact depending on choice of partner. Potential to lose focus on climate service objectives. *Low Risk: Low Return*

[1] Criteria for prioritisation of interventions - need to: (i) address gaps in existing services; (ii) support vulnerable groups and provide access to services, especially for women; (iii) articulate the demand thereby providing evidence to support VfM, cost-benefit analysis, and future business case development; (iv) reduce risks from extreme events, climate variability and change; and (v) promote economic growth. Note: ✓ Partially meets criteria or only subject to key assumptions, ✓✓Meets criteria, ✓✓✓ Directly addresses criteria or exceeds other options.£: Relative costs with each symbol representing £25 million plus.

Option 2 **Large-scale supply investments for regional climate services** meets some criteria but assumes that needs are already well understood and that others will pick up improvements in the supply-side to develop effective early warning systems and other services. This option is, therefore, regarded as higher risk and has slightly poorer VfM than Option 1 as it is currently unclear how best to target the investment. Option 2 does have several positive elements**,** namely:

- It is a supply-led programme for climate infrastructure development on a truly regional scale, which is currently lacking, and therefore could provide a sustained programme to enable delivering improved weather predictions and climate resilience across South Asia.
- It will provide better weather and climate information owing to improved observation, data processing and delivery through global-regional-national collaboration.
- By working closely with NHMS, which are mandated organisations for providing weather and climate information, it will enhance their capability from a position of providing basic or 'essential' forecast information to more tailored services to the public sector (including value-added services that can be developed with others, such as disaster management agencies) and making information available to others for non-government services (NGO and private sector intermediaries).
- Investment in one global and one or two regional centres and communications networks can provide significant benefits for several countries, without the need for each nation to have the most advanced numerical weather prediction or climate models and associated super-computing infrastructure. It is recognised that countries do have security, geo-political and resource interests that act as barriers to data sharing. In such cases outputs from global and regional centres have additional value, and fill an important gap for humanitarian work in the DRR sector.
- DFID and other UK expertise in climate services may help to coordinate these programmes and ensure they have greater user focus, bringing in a gender dimension where this is currently weak or absent.
- It strengthens research collaboration to build on existing UK-India and UK-Korea or UK-Singapore relationships for seasonal forecasting and climate change modelling and operates with established groups such as SASCOF and ASEANCOF.

Overall Option 2 could have significant impact if aligned and coordinated with other donor investments; however, it is regarded as higher risk. The investment offered by DFID is only a small proportion of 'pipeline' investments and without pull-through to meet demand it may not lead to better services for vulnerable groups for which it is intended.

Option 3 **Demonstrating the value of climate services in Western South Asia** isa scaled back option. It still meets the first three criteria but only partially meets the final two on risk reduction and economic growth. Positive aspects of this option include:

- A focus on two less developed contiguous countries (Afghanistan and Pakistan) in the region to build the capacity of the NMHS; the targeting of a sub-region makes the programme easier to manage and is likely to have a successful impact.
- Option 3 offers a smaller scale investment with medium risk and will help solve the environmental challenges related to floods, droughts, climate change, water, food and

energy security and also transboundary river basin issues for key basins in Afghanistan/Pakistan.

- The investment could potentially achieve high impact as it focuses on agricultural services and flood and drought risks in a highly vulnerable sub-region.
- It will strengthen National Climate Outlook Forums and sector focused groups working on flood risk management, drought risk management and agricultural or health extension work by creating linkage between NHMS, the research community and users of climate information at country level. However, any network activity and meetings in Afghanistan would be high cost due to DFID's duty of care for contractors working on the project.

Option 4 **Translating existing research and products into practice through partnerships** is more difficult to assess without additional specific details and discussions with potential partners. It is a smaller scale programme focused on the demand-side for building the national capacity in improving monitoring systems. Management costs may be reduced but the investment may be difficult to monitor when it is a very small part of a much larger programme.

The baseline situation for climate services in South Asia varies considerably between countries. The scoping work identified that there is a large programme of work needed in this area and evidence from other studies shows that such investments can provide value for money and reduce risks for vulnerable groups (Rogers and Tsirkunov, 2013). Issues identified in the scoping study included:

- a poor weather service in Afghanistan, Nepal and Burma due to severe deficiencies in the basic/essential meteorological and hydrological infrastructure;
- a complex geopolitical environment resulting in barriers to sharing information on water resources, river flows and hazardous weather;
- a lack of understanding of the benefits of weather and climate services amongst users and hence lack of demand for these services, and deficiencies in providing tailored information for specific users.

Major investments, such as those outlined in Option 1 and Option 2are needed to address these challenges.

Option 1 and Option 2 share some common activities and both include significant investment in NHMS and regional cooperation in weather and climate services (Tables 3 and 4). The difference is that Option 1 aims to target investment on user requirements in agriculture and DRR, which provides an opportunity to focus on these specific services. Programme design during the inception phases can ensure that projects meet DFID's objectives of providing access to services, and improving the livelihoods of women and girls. The targeting of investment on specific gaps is also likely to result in projects in specific sub-regions with significant weather and climate risks, as well as on economically productive sectors, offering greater value for money than general investment in the supply-side. The trade-off of investing more in research and innovation and co-creation activities is that marginally less investment may be made in NHMS (Option 1 £80 million focused on specific countries and sectors, Option 2 £100 million).

The role of women and girls

Given that in South Asia women often constitute the majority of the work force in the agriculture, water resource management and forestry sectors, and are often the main providers of food for their families, climate services must be designed with women's needs, priorities, experience, livelihood activities and knowledge in mind. This not only improves their lives but also the lives of their families and the wider community (Kapoor 2011). Yet at present, climate services and information are mostly "gender blind" and thus are unable to

respond to the specific and differential needs of women and vulnerable groups. By engaging women, girls and other vulnerable groups directly in the design of climate services, the proposed interventions will improve understanding about what kind of climate services these groups require and how this information can be best communicated so that it may be used effectively for critical decision-making purposes (Agrawal et al. 2014).Some small-scale initiatives have already been carried out along this vein (e.g. CGIAR CCAFS), and the proposed intervention options include activities to replicate, test and scale-up these measures. In addition, activities have been recommended that would strengthen the enabling environment, such as promoting the mainstreaming of gender considerations across climate services programming – including the development of specific M&E indicators - and running training and conferences to specifically address these issues. It will be important for DFID to monitor and measure the impacts of these proposed interventions on the well-being and livelihoods of women and other marginalised groups.

The rationale for investing in climate services for agriculture and DRR is clear. Investment in agricultural climate services provides useful information to increase sustainable production and manage risks thereby promoting economic growth, supporting national food security and improving the livelihoods of the poorest communities. Reducing damage and losses from natural disasters also helps the poorest communities build resilience and provides support that cannot be provided by national governments in Least Developed Countries (LDCs) or by the private sector (insurance). Such climate services include analysis and information products that support weather index based insurance (Evidence Review) and information on climate risks to improve disaster risk assessment and prevention.

Currently there are a number of barriers to improving climate services, such as the lack of funding and capability of NHMS, the variability of NHMS capability across the region and the very low levels of development in the market for weather and climate services. Poor market development exists because users are unaware of the potential benefits and suppliers are unable to present a clear value proposition to national governments.

SECTION 7

Recommendations and Conclusions

The Evidence Review and Stakeholder Analysis Report delivered a four-theme framework for development of climate services:

(a) Enabling market growth to develop a weather and climate services market, including involvement of the private sector and NGOs;
(b) Strengthening global, regional and national networks to enable access to weather and climate information down to the local level;
(c) Research and innovation to co-design services and promote scientific leadership so as to ensure that services are robust and science based;
(d) Improving regional cross-border co-operation to ensure more effective sharing of information.

Grouping of activities identified in the scoping study into four main options was influenced by considerations on which interventions could offer cost-effective support to the most vulnerable, where to place the greatest emphasis (and investment) in order to achieve the highest impact on economic growth, and how to reduce losses following extreme events. The aim of developing four options (from the 20 or more activities identified) was to simplify the analysis and to address a small number of key questions related to the costs, benefits and risks of different types of programmes. The other important consideration in formulating the options was the alignment with ongoing regional programmes in similar areas funded by several donors, including DFID itself (see Section 3 of the Stakeholder Analysis Report).

Each of the four options proposed encompass the four Stakeholder Analysis Report themes, albeit to varying degrees. It may be that further refinement of Option 1 to include the best of Option 2 or 3 would enhance its overall impact - for example, a truly regional and demand-led programme across South Asia with an initial case study on the transboundary Kabul River Basin (or alternative cross-border environmental challenges) in Afghanistan and Pakistan. This refinement would take place as part of the next stage of programme design or project inception phase.

Regional cooperation and information sharing remain critical issues within South Asia where improved data sharing and cross-border collaboration could have great potential in making significant impacts on disaster preparedness and response, particularly on people's lives and livelihoods. Various sub-regional initiatives are already providing useful lessons that could be replicated and scaled-up. Numerous recent, ongoing 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 (NHMS).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. Option 1 is distinct from other DFID programmes such as SHEAR (currently focusing on landslides only in South Asia), WISER (Sub-Sahara Africa only) and BRACED (which lacks the important regional collaboration and cross-border dimension).

User requirements in the South Asia Region

The Stakeholder Analysis identified user needs for weather and climate information (Stakeholder Analysis Report, Table 3 and Annex 13) and gaps in information provision. This demonstrates a significant un-met demand in agriculture, disaster risk reduction and other sectors for weather and climate information. For example, farmers require local agro-meteorological information, advice and early warnings of severe weather as this affects decisions on fertiliser application, planting and harvesting. Disaster risk managers need timely information about extreme weather in order to implement effective early warnings, manage risks and avoid damages. Consultations completed as part of the Stakeholder Analysis shows that there is a clear demand for more investment in the area of climate services.

DFID's strategic policies

DFID's strategic priorities are changing in response to new sustainable development goals in *'Transforming our World: the 2030 Agenda for Sustainable Development'* that were agreed in August 2015[1]. These emphasize economic, social and environmental goals (the five 'Ps' – people, planet, prosperity, peace and partnership), apply universally to all countries and broadly align with emerging UK Government priorities to support immunisation, education, nutrition, water and sanitation, humanitarian relief, and health. DFID's bilateral targets have previously aimed to increase the numbers or people able to cope with the effects of climate change[xxiii] and this is likely to continue.

DFID's approach to climate services is directed towards providing a step change in the use and application of climate information to support poverty reduction and promote socio-economic development, with a particular focus on protecting poor and vulnerable communities, especially women and girls. DFID's emerging humanitarian policy, Regional Inclusive Growth Diagnostic work, and strategic policy review analysis all support the increased use of climate information across the South Asia region.

DFID has made tackling poverty and equitable pro-poor growth the cornerstone of its organizational policy. In both policy and practice, DFID upholds the principles of aligning its support with the policies and plans of the countries it is assisting, and of trying to encourage all donors to harmonize their actions to reduce transaction costs for developing country governments. DFID has also been a strong advocate for multi-lateral organizations (such as the United Nations, the European Commission and various regional bodies), and of public-private partnerships. Climate change has also emerged as a central priority in DFID's new strategic objectives, and DFID can play an important role working with other UK and international partners to leverage world-class expertise to support developing countries in tackling climate change and contributing to a low carbon global economy. Areas of engagement cover four new priority themes: improving accessibility of climate science, scenarios, and impacts and vulnerabilities at regional, sub-regional, and national level.

DFID is best placed to act

The UK has strengths in research, policy-making and innovation, as well as an effective NGO sector, and is well placed to provide leadership in the area of weather and climate services. In particular DFID has the opportunity to make a unique contribution to a demand-led programme on climate services, underpinned by high quality research, action and innovation and to promote stronger regional networks and partnerships on climate services. Other donors are focusing on the supply-side and are largely focused on providing equipment for new hydro-meteorological observation networks and the development of Early Warning Systems. Without sufficient work on understanding the user requirements, building capability to use and

[1] For more information see https://sustainabledevelopment.un.org/post2015/transformingourworld

interpret data, the communication of timely warnings and incentivizing the right response among decision makers to climate information, the value of supply-side investments will be limited. Essentially it is the whole system that must function not just one part of it; from the supply of information through to its interpretation, timely communication of appropriate response. DFID involvement can help provide the knowledge and understanding of how best to complement other donor activity and ensure that supply-side investments have a more positive impact on the most vulnerable communities. The World Bank and Asian Development Bank work with national government clients and DFID are able to work more independently to promote, develop and improve cross-border early warning systems and climate services. Also DFID could underpin provision of useful regional weather and climate information, such as impacts forecasts and regional climate change information, to ADB and others working with national governments.

The proposed option will involve working in partnership with global, regional, national and local partners. The delivery mechanism for Stage 1 could be a single research and development consortium and/or a programme manager/delivery partner that would tender research and innovation projects. Choices on the delivery mechanism should consider value for money (including low management overhead costs), technical and management capability and potential for downstream involvement of both private sector innovators in climate services and NGOs for the co-creation and delivery of services to target communities, and those most vulnerable within them. Working in collaboration with NHMS and WMO in some form will also be essential to ensure buy-in and alignment with other activities and mandates. In Stage 2, which includes supply-side investment, World Bank, GFDRR and ADB coordination will be required and WMO and NHMS will have an essential role alongside intermediary organisations, such as flood forecasting centres and agro-advisories.

Final Recommendation

Option 1 is the preferred option based on the analysis of findings in the Evidence Review and Stakeholder Analysis Report. It promotes a demand-led programme and lays strong emphasis on market development and research (Section 2 of this Report).A key feature of Option 1 is that this is proposed to be implemented through a stage-gated approach which will ensure that the precise nature of demand for climate services in agriculture, DRR and other sectors is fully understood (Stage 1) before larger investment in climate service infrastructure is made. This way it has the potential to deliver more effective early warning systems and climate information products more efficiently, with greater uptake potential, and thus with greater impact on reducing the exposure of vulnerable groups to climate risks and thus better VfM overall. The outcomes of activities undertaken in this option largely address the DFID strategic policies outlined above.

REFERENCES

Agrawal, S. Davis, A. and Tall, A. 2014.Does climate information matter? An innovative tool to measure the value of climate services for farmers. News blog on the CCAFS/CGIAR website,Accessed April 2015.

Asian Development Bank, 2014. Assessing the Costs of Climate Change and Adaptation in South Asia. Available at: http://adb.org/sites/default/files/pub/2014/assessing-costs-climate-change-and-adaptation-south-asia.pdf

CCAFS. 2013. Climate services for smallholder farmers: helping farmers cope with risk. CCAFS, Frederiksberg, Denmark.

Clements, R.; Lumbroso, D.; Prasad, K.; Vellingiri, G.; Viswanathan, R.; Wade, S.; Joshi, M.; Hanif, M.; Dugar, S.; Dashora, L. 2015. Stakeholder analysis: options analysis for a regional climate change programme to deliver more effective climate services, early warning and disaster risk reduction. Evidence on Demand, UK (2015) x + 145 pp. Available at http://dx.doi.org/10.12774/eod_cr.august2015.clementsretal

European Commission. 2015. A European research and innovation Roadmap for Climate Services. European Commission, Brussels. http://www.ec.europa.eu/newsroom/horizon2020/document.cfm?doc_id=10198

Gautam, D.K.,2011. Web-based real time data acquisition system for flood early warning. National stakeholders workshop on weather forecasting and flood early warning system in Nepal, 8 April 2011, Kathmandu, Nepal.

Haq, R and Nibanupudi, H. K. 2013. South Asia: The need to enhance cross border risk communication. Journal of Risk and Crisis Communication. Available at http://www.journalriskcrisis.com/south-asia-the-need-to-enhance-cross-border-risk-communication/

International Bank for Reconstruction and Development / International Development Association of The World Bank. 2013. South Asia Water Initiative 2009-2013. Final Report. The World Bank. Washington, DC.

Integrated Regional Information Networks (IRIN). 2007. Bangladesh: Megaphones save thousands. Available athttp://www.irinnews.org/report/75470/

Jha, A. and Bisht, H. 2012. Addressing the information and knowledge needs of farmers to enable climate change adaptation-A study of Bundelkhand region in Central India. Development Alternatives. New Delhi, India.

Kapoor, A. 2011. Engendering the Climate for Change: Policies and Practices for Gender-Just Adaptation.Alternative Futures. New Delhi, India.
Available at http://www.seachangecop.org/node/187

Khadka, N.S. 2013. South Asia disunity 'hampers flood warnings', 19 July 2013, Available at: http://www.bbc.co.uk/news/science-environment-23358255 [Accessed on 31 March 2015].

Lumbroso, D., Rance, J., Pearce, G. and Wade, S. 2014. Science for Humanitarian Emergencies and Resilience (SHEAR) scoping study: Final report, Evidence on Demand, March 2014.

Paul, K.M. 2009. Why relatively fewer people died? The case of Bangladesh's Cyclone Sidr, Natural Hazards, August 2009. Volume 50, Issue 2, pp. 289-304.

Pappenberger,F.,Cloke, H.L.,Parker, D.J., Wetterhall,F.,Richardson, D.S.,& Thielen, J. 2015. The monetary benefit of early flood warnings in Europe. Environmental Science& Policy51, pp.278–291. Available at http://www.sciencedirect.com/science/article/pii/S1462901115000891

Rogers, David P., and Vladimir V. Tsirkunov. 2013. Weather and Climate Resilience: Effective Preparedness through National Meteorological and Hydrological Services. Directions in Development- Environment and Sustainable Development. World Bank.

Washington, DC. Available at https://openknowledge.worldbank.org/bitstream/handle/10986/15932/81113.pdf?sequence=1

Shukla, J., et al. 2010. Toward a new generation of world climate research and computing facilities. Bulletin of the American Meteorological Society, 91, pp.1407-1412.

Singh, R. 2012. Real time flood forecasting - Indian experiences. Available at: http://gwadi.org/sites/gwadi.org/files/Singh_L11.pdf [Accessed 31 March 2015]

Sivakumar M. V. K., Das H. P., Brunini O. 2005. Impacts of present and future climate variability and change on agriculture and forestry in the arid and semi-arid tropics. Climate Change, 70, pp. 31–72.

Tall, A., Hansen, J., Jay, A., Campbell, B., Kinyangi, J., Aggarwal, PK. and Zougmoré, R. 2014.Scaling up climate services for farmers: Mission Possible.Learning from good practice in Africa and South Asia. CCAFS Report No. 13. CCFAS, Copenhagen. Available at https://cgspace.cgiar.org/bitstream/handle/10568/42445/CCAFS%20Report%2013%20web.pdf

UNDP. 2014. Early Warning: Saving Lives in India. Available at http://www.in.undp.org/content/india/en/home/ourwork/crisispreventionandrecovery/early-warning--saving-lives-in-india.html

Vellingiri, G.; Prasad, K.; Wade, S.; Lumbroso, D.; Oakley, T.; Viswanathan, K.R.; Dugar, S.; Dashora, L.; Sogani, R.; Joshi, M.; Fakhruddin, S.H.M.; Hanif, M.; Clements, R. Evidence review: options analysis for a regional climate change programme to deliver more effective climate services, early warning and disaster risk reduction. Evidence on Demand, UK (2015) Available athttp://dx.doi.org/10.12774/eod_cr.june2015.vellingirigetal

Wilby, R.L. 2009. Climate for development in South Asia (ClimDev-SAsia): An inventory of cooperative programmes and sources of climate risk information to support robust adaptation. Report on behalf of the UK Department for International Development, 70pp. Available at http://www.google.ca/url?q=http://ipcc-g2.gov/njlite_download.php%3Fid%3D7293&sa=U&ved=0CBMQFjAAahUKEwjA3Zm3_qnIAhVCkx4KHV90A4Y&usg=AFQjCNFwxcCIaMYs_snH_0LlZK3e6SXKeA

WMO.2014a.Climate Services Introduction. Available at: http://www.wmo.int/pages/themes/climate/climate_services.php[Accessed 15 August 2015].

WMO, 2014b. Implementation plan of the Global Framework for Climate Services.Meeting on the Implementation and Coordination of the GFCS. Geneva 29thSeptember to 1st October 2014. The implementation Plan, along with its Annexes and the User Interface Platform exemplars can be downloaded at http://www.gfcs-climate.org/implementation-plan

WMO, 2015.Empowering Women Strengthens Climate Response: WMO, Related material based on Conference on Gender Dimensions of Weather and Climate Services. WMO, Geneva. between 5-7 November 2014 . Outcomes and documents available at http://www.wmo.int/gender/content/conference-gender-dimensions-weather-and-climate-services-0

WMO, 2015b. Valuing Weather and Climate: Economic Assessment of Meteorological and Hydrological Services. Available at http://www.wmo.int/gfcs/sites/default/files/wmo_1153_en.pdf

World Bank.2014. Ganges strategic basin assessment: A discussion of regional opportunities and risks. Report No. 67668-SAS, World Bank, Washington, DC. Available at https://www.southasiawaterinitiative.org/sites/sawi/files/Ganges%20Strategic%20Basin%20Assessment_A%20Discussion%20of%20Regional%20Opportunities%20and%20Risks.pdf

World Metrological Organisation WMO (2013).Early warning systems saves millions of lives. A WMO factsheet. Available at: http://www.wmo.int/pages/prog/drr/events/GPDRR-IV/Documents/FactSheets/FS_nhews.pdf. [Accessed 21 November 2013].

Appendix 1 Analysis of programme activities from the Stakeholder Analysis Report

Potential Intervention Activities (Based on Table 1 in SA Report) Scored versus criteria (3=high, 1=low)	Supply or Demand side?	A user defined need/gap?	Targets vulnerable groups?	Helps to articulate demand (VfM)	Reduces risks?	Promotes economic growth?	Score	Priority Ranking (Table 2)	Figure1 Investment Area	Option 1	Option 2	Option 3	Option 4
Promote the development of a clear roadmap for climate services in South Asia tailored to the GFCS Frameworkand oriented to meet demand for information in the region	Both	3	2	3	1	2	11	1	A				
Strengthen the capability of NMHS and intermediaries to utilise available climate products from GPCs and (Regional Climate Centres) RCCs for end-user interests	S	2	2	2	2	2	10	1	B				
Promote the development of standard climate services toolkits together with accompanying training modules designed to support the generation and use of climate information andproducts that meet user needs, especially women and vulnerable groups	S	3	3	2	2	1	10	1	B				
Support National Climate Outlook Forums and similar platforms to strengthen their presence and capacity and improve two-way communication between NMHS, intermediaries and end-users in priority sectors	Both	3	2	3	2	1	11	1	B				
Increase and improve the interaction between producers, intermediaries and users of climate information with the aim of making information more relevant and useful for different sectors and types of users	Both	3	2	3	3	2	13	1	B				

Potential Intervention Activities (Based on Table 1 in SA Report) Scored versus criteria (3=high, 1=low)	Supply or Demand side?	A user defined need/gap?	Targets vulnerable groups?	Helps to articulate demand (VfM)	Reduces risks?	Promotes economic growth?	Score	Priority Ranking (Table 2)	Figure1 Investment Area	Option 1	Option 2	Option 3	Option 4
Strengthen inter-country communication systemsand dissemination of climate information and services to priority users, such as monsoon forum groups and the agriculture and health sectors	S	3	2	2	3	1	11	1	A and D				
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	S	3	2	2	2	1	10	1	D				
Support capacity building amongst priority user groups to translate and interpret risk assessments into clear recommendations or plans of action	D	3	3	1	3	1	11	1	A and 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	S	2	2	1	2	1	8	2	C				
Raise the capability of least developed NMHS (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	S	3	2	1	2	1	9	2	None				
Support research to better understand Regional Climate Model (RCM) limitations when representing South Asia's complex topography at high resolution	S	1	1	1	1	1	5	2	C				
Establish regional networks between farmers' associations, DRR practitioners and water user groups to enhance the exchange and use of climate knowledge products and services	D	1	3	3	2	2	11	2	None				

Potential Intervention Activities (Based on Table 1 in SA Report) Scored versus criteria (3=high, 1=low)	Supply or Demand side?	A user defined need/gap?	Targets vulnerable groups?	Helps to articulate demand (VfM)	Reduces risks?	Promotes economic growth?	Score	Priority Ranking (Table 2)	Figure1 Investment Area	Option 1	Option 2	Option 3	Option 4
Support the establishment of regional advisory teamscomprising subject matter specialists in priority sectors and NMHS to help improve the relevance of climate information and services to priority sector decision making needs	D	2	2	2	2	2	10	2	None				
Support collaboration and knowledge transfer between the regional Coordinated Regional Climate Downscaling Experiment (CORDEX) and stakeholders in each country to improve climate services	Both	2	1	2	1	1	7	2	CORDEX named as potential partner under 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	S	1	1	1	1	1	5	3	C				
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 risk insurance products for low income sectors.	S	1	3	2	3	2	11	3	None				
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	D	2	1	1	1	1	6	3	None				
Support scaling up of successful experiences where ICT tools have been used for more effective and efficient dissemination of climate information to end-users	D	2	2	2	2	1	9	3	B				

Appendix 2 Logical Framework for Option 1

Initial Draft based on Output 4 "Options Analysis: Options Analysis for a Regional Climate Change Programme to Deliver More Effective Climate Services, Early Warning and Disaster Risk Reduction"

DRAFT: 28th September 2015

PROJECT TITLE	CLIMATISE SOUTH ASIA: Climate Information					
IMPACT	**Impact Indicator 1**		**Baseline**	**Milestone 1**	**Milestone 2**	**Target (date)**
		Planned				
Resilient economies and livelihoods that cope with climate shocks	Value of socio-economic benefits and reduced losses (e.g. number of lives saved, improved agricultural productivity and property value protected)	**Achieved**	National and sub-national GDP figures dissaggrated by sector.			to be confirmed during Inception Stage
			Specific qualitative and			
	Impact Indicator 2		**Baseline**	**Milestone 1**	**Milestone 2**	**Target (date)**
	Number of people with improved resilience (ICF KPI 4)	**Planned**				16,000,000
		Achieved				
			Source			
			ICF Monitoring and			

OUTCOME	Outcome Indicator 1		Baseline	Milestone 1	Milestone 2	Target (date)	Assumptions
Better weather and climate services used to inform decision making to benefit vulnerable groups at regional, national and local levels.	Number of projects and programmes where integrated regional approach promoted by CLIMATISE is adopted for development of climate services	**Planned**	1			6 (2022)	Improved climate information translates into better decisions and greater resilience to climate variability and change
		Achieved	Very few (MRC, ICIMOD); Regional survey needed as part of incpetion phase			To be confirmed in Inception Stage (Yr1)	
			Source				
			Specific programme studies				
	Outcome Indicator 2		**Baseline**	**Milestone 1**	**Milestone 2**	**Target (date)**	All the requirements for an effective climate service are effectively supported and coordinated. Assume 10 organisatiions using the outputs ofthe project. Assumes open access or affordable access to required services
	Number of organisations and institutions reporting 'improved' or 'considerably improved' use of weather and climate information to inform their decision making	**Planned**	0			60	
		Achieved	Baseline is low outside of successful pilot studies. National surveys needed.			To be confirmed in Inception Stage (Yr1)	
			Source				
			Specific Programme Studies (self reporting and/or external assessment)				
	Outcome Indicator 3		**Baseline**	**Milestone 1**	**Milestone 2**	**Target (date)**	Assume that around 3 Government organisations are involved in each project, e.g. Ministry of Ag, Extension Service, Research Centes or Min of Water, Finance and Health
	Number of government departments/ ministries/ institutions reporting 'improved' or 'considerably improved' understanding of weather and climate issues and links to development related to their sectors	**Planned**	0			18	
		Achieved	National surveys needed.				
			Source				
			Specific Programme Studies (self reporting and/or external assessment)				
	Outcome Indicator 4		**Baseline**	**Milestone 1**	**Milestone 2**	**Target (date)**	
	Number of households reporting using of improved climate services for decision making that improves their livelihoods	**Planned**	0			1,000,000	Assumed to be 25% of number of people (cell G11) with improved access to services and a household size of 4.
		Achieved	Household surveys needed on use of agricultural or flood advisories				Climate services likley to be delivered by Ag. Advisories, social support groups, NGOs, faith groups etc..rather than direct from NHMS at this level
			Source				
			Specific Programme studies (self reporting and/or external assessment)				

OUTPUT 1	Output Indicator 1.1		Baseline	Milestone 1	Milestone 2	Target (date)	Assumptions
Improved access to weather and climate services for vulnerable groups, including women and girls (e.g. improved access to tailored information, through education, rural social networks, radio etc.....)	Number of new or improved tailored information services targeted at women and girls in agriculture, DRR or health sectors	**Planned**	Very few			15	Very few targeted services currently. Assumed 3 services developed in 5 pilot areas.
		Achieved	Further scoping needed during inception phase				
		Source					
		Reporting/stakeholder feedback, dissagregated by gender.					
	Output Indicator 1.2		**Baseline**	**Milestone 1**	**Milestone 2**	**Target (date)**	
	Number of households able to access new and/or improved climate services through a range of intermediaries and communication channels [must be l;inked to outcome indicators above = assumes houdehold size of 4]	**Planned**	0			3	
		Achieved					Improved access to and co-production of climate information leads to increased uptake and use
		Source					
		Reporting/stakeholder feedback, dissagregated by gender					
	Output Indicator 1.3		**Baseline**	**Milestone 1**	**Milestone 2**	**Target (date)**	
	Number of organisations and institutions reporting improved access to new and improved climate services through a range of channels [disaggregated by type and size of organisation and reach]	**Planned**	0			5 *or 15*	
		Achieved					
		Source					
IMPACT WEIGHTING (%)	**Output Indicator 1.4**		**Baseline**	**Milestone 1**	**Milestone 2**	**Target (date)**	
15%	Number of local organisations (including women and girls) that report improved access to climate and weather services through new Gov/NGO/private sector business models	**Planned**	0			50	
		Achieved					An average on 10 in each country, although this could be more ambitious than this
		Source					**RISK RATING**
		Government extension service or national climate forum reporting					**M**
INPUTS (£)	**DFID (£)**		**Govt (£)**	**Other (£)**	**Total (£)**	**DFID SHARE (%)**	
	£15 million						
INPUTS (HR)	**DFID (FTEs)**						

OUTPUT 2	Output Indicator 3.1		Baseline	Milestone 1	Milestone 2	Target (date)	Assumptions
Strengthened enabling environment for the supply, uptake and use of weather and climate services to support vulnerable groups (e.g. climate services road maps, national user groups, standards and protocols, market growth....	Number of Regional and National Climate Outlook forum processes initiated and/or strengthened (regional/national) [measured by level of satisfaction amongst user community]	Planned	0			6	A sustainable model for global/regional/national cooperation between multiple collaborators can be developed and agreed. Key output thta includes supply-side investment but this may need to be designed as a spearate and unique output given the budget.
		Achieved					
		Source					
		Programme reporting and participant/stakeholder feedback					
	Output Indicator 3.2		Baseline	Milestone 1	Milestone 2	Target (date)	
	Number of partnership networks with programmes to promote uptake and use of weather and climate information rated by identified stakeholders as 'useful' or 'very useful'	Planned	0			3	
		Achieved					
		Source					
		Programme reporting and stakeholder feedback					
	Output Indicator 3.3		Baseline	Milestone 1	Milestone 2	Target (date)	
	No of supply side investments that fill gaps identified through partnership arrangements	Planned	0			25	
		Achieved					
	Output Indicator 3.5		Baseline	Milestone 1	Milestone 2	Target (date)	
	Number of service agreements/MoUs in place between global and regional centres, and regional and national centres	Planned	0			8	
		Achieved					
		Source					
		Programme reporting					
IMPACT WEIGHTING (%)	Output Indicator 3.6		Baseline	Milestone 1	Milestone 2	Target (date)	
60%	Number of RCCs and NMHS's using in house processing of GPC data to generate new and/or improved climate services as a result of CLIMATISE support	Planned	0			10	
		Achieved					
		Source					RISK RATING
		Programme reporting					H
INPUTS (£)	DFID (£)		Govt (£)	Other (£)	Total (£)	DFID SHARE (%)	
	£90 million						
INPUTS (HR)	DFID (FTEs)						

OUTPUT 3	Output Indicator 2.1		Baseline	Milestone 1	Milestone 2	Target (date)	Assumptions
Improved knowledge on how to tailor climate services through an innovative interdisciplinary research programme (a) supports the generation, uptake and use of weather and climate services and (b) builds sustained intellectual leadership in climate science in South Asia *(Mostly linked to Component C, see SA report Table 1)*	Number of research outputs directly contributing to the development, uptake or understanding of new climate services	**Planned**	0			10	A 'critical mass' of research capacity can be attracted and retained
		Achieved					
		Source	Programme reporting/feedback from global, regional and national producers and users of weather and climate information				
	Output Indicator 2.2		**Baseline**	**Milestone 1**	**Milestone 2**	**Target (date)**	
	Number of peer reviewed climate and social science	**Planned**	0			50	
		Achieved					
		Source	Programme reporting				
IMPACT WEIGHTING (%)	**Output Indicator 2.3**		**Baseline**	**Milestone 1**	**Milestone 2**	**Target (date)**	
15%	Number of Asian scientists and researchers [disaggregated by gender] working in Asian institutes that have built expertise the development of user-led weather and climate services	**Planned**	0			40	
		Achieved					
		Source	Programme reporting				**RISK RATING**
							M
INPUTS (£)	**DFID (£)**		**Govt (£)**	**Other (£)**	**Total (£)**	**DFID SHARE (%)**	
	£20 million						
INPUTS (HR)	**DFID (FTEs)**						

OUTPUT 4	Output Indicator 1.1		Baseline	Milestone 1	Milestone 2	Target (date)	Assumptions
Strengthenned global-regional-national networks and partnerships and greater regional cooperation to support the improved generation, uptake and use of climate information.	Volume of government and donor funding coordinated around agreed "roadmaps" for development of climate	**Planned**	?? Possibly 1			£500 million *Or 4*	Suitable working arrangements between SASCOF, FOCRAII, ASEANCOF, ADB, USAID and WMO and Agrciulture, DRR,
		Achieved					
		Source					Pan Asian initiatives are able to exert influence and demonstrate impact at the regional and national levels
		Financial tracking					
	Output Indicator 1.2		**Baseline**	**Milestone 1**	**Milestone 2**	**Target (date)**	
	Number of joint initiatives between regional centres, intermediaries and users supporting a better enabling environment rated by identified decision makers as 'useful' or 'very useful' including active partcipiation of women (e.g. meetings, data protocols, value for money research, political engagement, development partner coordination, shared platform to access tools etc) [note: the detail of the work programme will be further developed during Inception Stage].	**Planned**	0			3	
		Achieved					
		Source					
		Reporting/stakeholder feedback, dissagregated by gender?					
	Output Indicator 1.3		**Baseline**	**Milestone 1**	**Milestone 2**	**Target (date)**	
	Number of countries where project consortia use their influence to generate regular dialogue on weather and climate services across government (measured through increased support for DRR and agricultural extension activitites and support for NMHSs from national budgets *OR through numbers of sector strategies and investment plans that incorporate climate resilience*)	**Planned**	0			5 *or 15*	
		Achieved					There are 5 target countries including India and the project is targetting between 2 and 4 "sectors"
		Source					
		ACPC/WMO/AMCOMET reporting/national budgets/NMHS records					
IMPACT WEIGHTING (%)	**Output Indicator 1.4**		**Baseline**	**Milestone 1**	**Milestone 2**	**Target (date)**	
15%		**Planned**	0			50	
		Achieved					
		Source					**RISK RATING**
		Government extension service or national climate forum reporting					**M**
INPUTS (£)	**DFID (£)**		**Govt (£)**	**Other (£)**	**Total (£)**	**DFID SHARE (%)**	
	£15 million						

Notes:
All targets and milestones are indicative and will be further refined during the Inception Stage
All indicators to be disaggregated for gender and other parameters as required
All targets at output level relate to 'added value' as a result of the CLIMATISE programme

Appendix 3 Other supporting material

End notes (All websites accessed between July and August 2015)

[i] 'Supply' side climate services include investment in developing infrastructure for improving the observational network, computational facilities for handling weather and climate data, as well as human capacity building in NHMS for developing weather-based products for enhancing climate services. It includes data, analysis, processing, modelling, prediction, downscaling, interpretation, assessment and the development of climate scenarios. 'Demand' side investment has a greater focus on users and decision makers (policy, practice), user requirements in specific sectors such as water, agriculture, DRR and health. It emphasizes two-way communications between users and providers of information and often involves different kinds of intermediary or boundary organisations, such as NGOs, agricultural advisories or community or faith groups involved in supporting local communities. While both are needed, the categorisation is useful to ensure that information reaches vulnerable communities.

[ii] The WMO provides information on the gender dimension of climate services: http://www.wmo.int/gender/content/areas-focus. See also the Evidence Review and Stakeholder Analysis Report.

[iii] The UK Government has previously funded programmes to help developing countries cope with a changing climate, as well as research programmes into the impacts of climate change. While the current strategy is under development, priorities include promoting economic development, women and girls and providing a leading role in humanitarian emergencies.

[iv] Stakeholder Analysis Report, 2015; Evidence Review, 2015; Wilby, 2009

[v] See Evidence Review Annex 4 and Stakeholder Analysis Report for more information about these initiatives

[vi] http://www.bbc.co.uk/news/world-asia-33251100

[vii] http://www.bbc.co.uk/news/world-asia-33843920

[viii] The UK Government has previously funded programmes to help developing countries cope with a changing climate and implemented research programmes on the impacts of climate change. The current strategy is under development but priorities include promoting economic development, women and girls and providing a leading role in humanitarian emergencies.

[ix] https://www.southasiawaterinitiative.org/SAWIAlignment

[x] https://ccafs.cgiar.org/donors

[xi] https://www.gov.uk/government/news/uk-and-us-join-forces-to-boost-natural-disaster-warning-systems

[xii] http://devtracker.dfid.gov.uk/projects/GB-1-201884/documents/

[xiii] The criteria were defined by the project team based on DFID's terms of reference and other projects reviewed during the Evidence Review.

[xiv] This option assumes that barriers such as the (i) lack of knowledge on the demand for services; (ii) scientific knowledge of what is possible with weather prediction and climate models and (iii) lack of data provision, access and communications between users and producers of information are preventing effective decision making in response to weather warnings and future climate change.

[xv] More information is available on the WMO GFCS web site: http://www.gfcs-climate.org/Norway_2

[xvi] The TRACKS project in Bangladesh provides an example of what some of this action research would entail. http://projecttracks.net/presentations-2015/

[xvii] Heat wave work could build on ongoing initiatives with CDKNhttp://cdkn.org/2015/06/opinion-feeling-the-heat-in-pakistan-can-we-plan-for-heat-waves/

[xviii] See http://www.esa.int/Our_Activities/Observing_the_Earth/SMOS/Mapping_moisture and http://pmm.nasa.gov/TRMM/TRMM-based-climatology

[xix] Reanalysis data are from historical climate model runs, which can be used to provide high resolution data sets based on coarser boundary conditions.

[xx] https://www.wmo.int/sids/content/wmo-severe-weather-forecasting-demonstration-project-swfdp

[xxi] Based on discussions with DFID regional team.

[xxii] For more information, refer to this 2009 USAID options report on the Kabul River http://mom.gov.af/Content/files/World_Bank_Strategic_Options.pdf

[xxiii] https://www.gov.uk/government/organisations/department-for-international-development/about