United Nations Development Programme

Country: Malawi

PROJECT DOCUMENT[1]

Project Title: Strengthening climate information and early warning systems in Eastern and Southern Africa for climate resilient development and adaptation to climate change – Malawi.

UNDAF Outcome 1.3: Targeted population in selected districts benefit from effective management of environment; natural resources; climate change and disaster risk by 2016.

UNDP Strategic Plan Primary Outcome: Promote adaptation to climate change.

Expected Country Programme Outcome 1: National policies, local and national institutions effectively support equitable and sustainable economic growth and food security by 2016.

Expected UNDAF Outputs: 1.3.1 Environment, natural resources, climate change and disaster risk management mainstreamed in policies, development plans and programmes at national level and implemented in 14 disaster-prone districts; **1.3.2** Data and knowledge on the impact of climate change, environmental degradation and natural disasters collected and made accessible to decision makers and government, private sector and civil society; and **1.3.3** Coordination mechanisms and implementation arrangements for climate change, environment, natural resources, and disaster risk management established and used at national level and disaster-prone districts.

Executing Entity/Implementing Partner:
Department of Disaster Management Affairs (DoDMA), Office of the President and Cabinet.

Responsible Partners: Ministry of Environment and Climate Change Management (Department of Climate Change and Meteorological Services, Environment Affairs Department, Department of Forestry, Department of Surveys), Ministry of Water Development and Irrigation (Department of Water Resources), and Ministry of Agriculture and Food Security (MoAFS[2]).

[1]For UNDP supported GEF funded projects as this includes GEF-specific requirements

[2] During the implementation phase, the project team (task force (consisting of desk officers from DCCMS in Blantyre, DWR and DoDMA in Lilongwe) team will be empowered to identify departments in the MOAFS that will benefit from the capacity building activities and include them as recipients of training that is conducted. These types of decisions are within the purview of the project board to make, taking into account the budget of this project and coordination with other ongoing initiatives. The following departments could be considered: i) Agricultural Extension Services; ii) Research and Technical Services; iii) Fisheries; and iv) Agricultural Planning Services.

Brief Description

The projected climate change scenario in Malawi shows an increase in mean temperature of between 2 and 3ºC by 2050, a decrease in total annual rainfall and water availability and increase in erratic rainfall events. Increases in temperature and erratic rainfall will result in more frequent and intense droughts, floods and severe weather – including strong winds and associated storm surges over Lake Malawi.
Such climate-related hazards are already having increasingly adverse effects on the country and future climate change is likely to further exacerbate the situation. A large proportion of the Malawi population has a low capacity to adapt to climate change. Climate change impacts are likely to be particularly negative on Malawi's rural population as a result of their high dependence on rain-fed agriculture and natural resource-based livelihoods. Malawi's ability to plan for, respond to, and minimise the impacts of climate change and prevent, respond to and mitigate natural disasters, however, is currently hindered by a limited capacity in the national weather, hydrological and climate observation and monitoring networks. Malawi's capacity to adapt to climate-related hazards should therefore be developed to limit the negative impacts of climate change and address the country's socio-economic and developmental challenges effectively.

One way to support effective adaptation planning – particularly for an increase in intensity and frequency of droughts, floods and strong winds – is to improve climate information and early warning systems (EWS). Malawi's climate information and EWS are limited in their ability to monitor and forecast weather conditions, communicate warnings, respond to disasters, and plan for long-onset changes that require transformation in economic development. Improving climate information and EWS components requires investment in infrastructure and technical capacity. Drought and Mwera wind warnings will provide time for appropriate planning and adjustment of farming and fishing practices respectively. Similarly, flood warnings will enable local communities to move to locations of safety with their possessions, stored food and livestock. For Malawi to improve the management of these climate-related hazards it is necessary to: i) enhance the capacity of hydro-meteorological services and networks to understand and predict climatic events and associated risks; ii) develop a more effective and targeted delivery of climate information including early warnings; and iii) support improved and timely responses to forecasted climate-related risks. Barriers that need to be overcome to establish effective EWS in Malawi include the following: i) limited financial resources directed towards hydro-meteorological and disaster risk management, which has resulted in an obsolete and inadequate weather and climate observation network; ii) limited human and technical forecasting capacity; and iii) reduced and poorly defined coordination of weather and climate information dissemination including early warning preparedness, response, and risk management.

This LDCF financed project, implemented by the Department of Disaster Management Affairs under the Office of the President and Cabinet – in collaboration with key Responsible Parties, namely Department of Climate Change and Meteorological Services and Department of Water Resources – will: i) establish a functional network of meteorological and hydrological monitoring stations and associated infrastructure to better understand climatic changes; ii) develop and disseminate tailored weather and climate information (including early warnings for drought, floods and Mwera winds) to meet the needs of end-users in particular local farmers and fishermen in at least 7 disaster prone priority districts, namely Phalombe, Dedza, Kasungu, Lilongwe, Salima, Nkhotakota, Karonga and Nkhata Bay; iii) integrate weather and climate information and early warning systems into national sector specific policies and district development plans in at least 7 priority disaster-prone districts; and iv) establish cooperation agreements with national hydro-meteorological counterparts in Mozambique to improve warnings for tropical cyclones, flooding, Mwera winds and drought. The project is expected to be completed by December 2017; and is embedded in the overarching UNDP support to Disaster Risk Management (DRM) and UNDAF. It specifically responds to the priorities in the Malawi Growth Development Strategy-II on disaster risk reduction, climate change management and food security.

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Atlas Award ID:	00074326
Project ID:	00086781
PIMS #	5092
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End Date	September 2017
Management Arrangements	NIM
PAC Meeting Date	31 July 2013

Total resources required	US$ 14,894,907
Total allocated resources:	US$ 14,894,907
• Regular (GEF/LDCF)	US$ 3,600,000
• UNDP	US$ 6,100,000
• DFID	US$ 1,356,607
• Government	US$ 3,838,300

Agreed by (Government):

Date/Month/Year

Agreed by (Executing Entity/Implementing Partner):

Date/Month/Year

Agreed by (UNDP):

Date/Month/Year

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List of Acronyms

AAP	African Adaptation Programme
ACPC	Area Civil Protection Committee
ADRMO	Assistant Disaster Risk Management Officer
ASWAp	Agriculture Sector Wide Approach
AWP	Annual Work Plans
AWS	Automatic Weather Station
CCA	Climate Change Adaptation
CO	Country Office
CPC	Civil Protection Committee
CSO	Civil Society Organization
DCCMS	Department of Climate change and Meteorological Services
DCPC	District Civil Protection Committee
DFID	Department for International Development
DoDMA	Department of Disaster Management Affairs
DPR	Disaster Preparedness and Relief
DRR	Disaster Risk Reduction
DSA	Daily Subsistence Allowance
DWR	Department of Water Resources
ECRP	Enhancing Community Resilience Programme
ENR	Environment and Natural Resources
EWS	Early Warning System
FA	Focal Area
FACE	Funding Authorization and Certified Expenditures
FEWSNet	Famine Early Warning System Network
FFEWS	Flood Forecasting Early Warning System
GDP	Gross Domestic Product
GEF	Global Environmental Fund
GIS	Geographical Information System
GoM	Government of Malawi
GTS	Global Telecommunications Systems
HACT	Harmonised Approach to Cash Transfers
HFA	Hyogo Framework for Action
IFRMS	Integrated Flood Risk Management Strategy
IP	Implementing Partner
LDCF	Least Developed Country Fund
LPAC	Local Programme Advisory Committee
MDG	Millennium Development Goal
M&E	Monitoring and Evaluation
MoAFS	Ministry of Agriculture and Food Security
MoECCM	Ministry of Environment and Climate Change Management
MoWDI	Ministry of Irrigation and Water Development
MoLGRD	Ministry of Local Government and Rural Development

MVAC	Malawi Vulnerability Assessment Committee
NAPA	National Adaptation Programme of Action
NCCP	National Climate Change Programme
NDPRC	National Disaster Preparedness Relief Committee
NDRM	National Disaster Risk Management
NGO	Non-Governmental Organization
NIM	National Implementation Modality
NSO	National Statistical Office
NSSD	National Strategy for Sustainable Development
OPC	Office of the President and Cabinet
RP	Responsible Party
SOP	Standard Operating Procedures
SRBMP	Shire River Basin Management Project
UNCT	United Nations Country Team
UNDP	United Nations Development Programme
UNDAF	United Nations Development Assistance Framework
UNFCCC	United Nations Framework Convention for Climate Change
VCPC	Village Civil Protection Committee
WB	World Bank

1 SITUATION ANALYSIS

1. Malawi is particularly vulnerable to climate change and variability. The projected climate change scenario in Malawi shows an increase in mean temperature of between 2 and 3ºC by 2050, a decrease in total annual rainfall and water availability and increase in erratic rainfall events3. The combination of increased temperatures and reduced rainfall is likely to result in considerable loss of agricultural output and a reduction in the extent of land suitable for rain-fed agriculture production of the staple maize crop. Increases in temperature and erratic rainfall will result in more frequent and intense droughts, floods and severe weather – including strong winds and associated storm surges over Lake Malawi.

2. The vulnerability of Malawi's economy and local communities to climate change is as a result of a number of compounding factors, namely its :i) unique and highly degraded ecosystems; ii) socio-economic and demographic situation – including high population growth rates in combination with high poverty levels – which reduces capacities to cope with climate change; iii) limited financial capacity to finance adaptation measures; iv) over dependence on rain-fed agriculture; v) heavy reliance on natural resources, particularly within the agricultural and fisheries sector; vi) limited knowledge on climate change and variability at community level to inform adaptation practices; vii) sub-optimal agricultural productivity and practices, and limited diversification within the household economy both on and off-farm; viii)limited access to affordable and sustainable clean energy sources; and ix) limited organization at local levels for policy dialogue around climate change.

3. The impacts of climate-related hazards in Malawi have already severely disrupted food production, led to the displacement of communities, loss of life and assets, and caused an overall reduction of community resilience. For example, during the 1992/93 rainy season, landslides killed over 500 people and caused extensive damage to infrastructure in parts of Mulanje and Phalombe districts. From 1979 to 2008, natural disasters in Malawi affected nearly 21.7 million people and killed about 2,596 people. Sectors already experiencing negative impacts include agriculture, fisheries, infrastructure, health, education and hydroelectric power production. The 2011-12 droughts had severe effects on food security in 15 districts4 with ~2 million people affected, particularly in the southern districts.

4. Increases in temperatures, droughts, floods and severe weather will negatively affect crop growth and many aspects of the agricultural value chain including drying, storage and transport to market. Fisheries will be affected by both the direct and indirect effects of climate change. The direct effects of climate change include changes in the abundance and distribution of exploited fish species. The increased frequency and severity of extreme events such as floods and storms will increase the hazards faced by fishermen and is likely to damage infrastructure such as fish ponds. Furthermore, water levels of some large shallow lakes fluctuate with rainfall anomalies, resulting in the aforementioned knock-on effects. For example, Lake Chilwa nearly dried-up in November 2012, and – even after the rainy season – water levels were still considerably in May 2013. An Economic Vulnerability and Disaster Risk Assessment showed that drought has a greater threat than floods in terms of geographical range and likely economic effect5. Malawi was found to be worst affected by the droughts of 1987, 1992, 1994, 2004 and 2005. While meteorological droughts of 1992, 1994 and 2005 were national level events, the droughts of 1987, 2004 and 2012 were local in their geographic extent.

5. There is limited detailed data for Malawi on the projected economic costs of climate change and the additional costs and benefits of adaptation. Assessments of other African countries facing

[3] CEPA May, 2012: Draft Position Paper: Towards Development of Climate Change Policy in Malawi. ECRP and DISCOVER Consortia.

[4]Chikhwawa, Nsanje, Phalombe, Zomba, Balaka, Mangochi, Ntcheu, Dedza, Kasungu, Lilongwe, Salima, Nkhotakota, Karonga, Nkhata bay and Machinga.

[5]IFPRI/RMSI (2010) Malawi: Economic Vulnerability and Disaster Risk Assessment. Economy-Wide Impacts of Droughts and Floods.

similar challenges, however, indicate that the economic costs of climate change in Africa could equal an annual loss in GDP of ~1.5 to 3% by 2030 under a business-as-usual scenario. In the long-term, these costs could increase rapidly to a loss of ~10% of GDP by 2100. Assessments undertaken indicate high benefits incurred by adaptation compared to costs. For example, appropriate adaptation measures could reduce the economic costs of climate change in Africa from ~2 to 1% of GDP by 2040 and from 10 to 7% of GDP by 2100. Adaptation measures need to be carefully planned for, and managed, to reduce the negative effects of climate change on socio-economic returns in Malawi.

6. Economic growth and infrastructure development are planned to achieve poverty reduction – the primary goal of the MGDS II of the Government of Malawi (GoM). However, the increasing incidence of climate-related hazards and their impacts on livelihoods, infrastructure and the environment continue to pose a threat to development and poverty reduction in Malawi. Without significant adaptation efforts, the negative effects of climate change will undermine years of development assistance and asset accumulation in Malawi. This will threaten macro- and micro-economic stability, socio-economic development, and achievement of the Millennium Development Goals (MDGs) as well as the Malawi Growth and Development Strategy II (MGDS II 2011-2016).One way to support effective adaptation planning – in particular for an increase in intensity and frequency of droughts and floods – is to improve climate information and early warning systems. Accurate weather and climate information and forecasting are essential for planning and managing economic production and for the provision of social services, particularly under a changing climate.

7. Monitoring climate change, forecasting impacts and using early warning systems to disseminate data to a range of stakeholders from national to local level are important components of successful long-term adaptation. Meteorological services provide real-time, short-term, seasonal and long-term forecasts – as well as other meteorological parameters – for planning and management of agricultural production, water resource management, solar energy use, research, disaster and rescue operations, transport, trade and tourism, and environmental-related diseases. Meteorological parameters are particularly important for the design, construction and management of physical infrastructure. Furthermore, they are necessary for understanding climate change and variability, as well as climate change impacts on socio-economic development. The more extensive the available information, the better the climate can be understood and future conditions can be assessed, at the local, regional, national and global level6.

8. The GoM recognizes the fact that no meaningful reduction in poverty can be achieved in the country without addressing the impacts of disasters and climate change. Thus, it is indicated in MGDS II Theme 3 (2012-2016) that in responding to these challenges, the GoM will implement a number of strategies including: i) strengthening disaster risk management coordination mechanisms; ii) developing an integrated national EWS; and iii) implementing mitigation measures in disaster prone areas.

1.1 The problem this project seeks to address

9. The fundamental problem that this project seeks to address is that the current weather and climate information (including monitoring) and early warning systems in Malawi are not functioning as optimally as they could for effectively supporting adaptive capacity of local communities and key sectors. This constrains management and early warning activities, as well as restricts long-term planning, better knowledge of expected future climate change impacts, in particular those associated with the expected increase in frequency and intensity of droughts, floods and strong winds. The current state of climate information and early warning systems in Malawi, if not improved, will significantly undermine social and economic development under a changing climate.

[6]Zhu, X. 2011.Technologies for Climate Change Adaptation – Agriculture Sector – TNA Guidebook Series.UNEP Risø Centre on Energy, Climate and Sustainable Development Risø DTU National Laboratory for Sustainable Energy, Denmark.

10. Weather and climate information as well as disaster management, has mostly till now focused on relief and rehabilitation (reactive actions) in Malawi. In years of excessive rains, flood disaster management is prevalent, whilst the management of food and water shortages follows the years of droughts. The country is aware of areas that are prone to floods and droughts, but still needs to identify effective early warning and mitigation measures.

11. The generation of weather and climate data and accurate and timely forecasts in Malawi is limited by: i) obsolete and poorly maintained hydro-meteorological observation networks with geographic coverage biased to the western parts of the country; ii) limited data and information management systems; iii) limited technical forecasting capacity based on a range of meteorological, environmental and oceanographic data from various sources and in various formats7; iii) limited number of trained personnel to operate and maintain climate information and early warning system observation infrastructure; and v) poor regional agreements on information sharing with hydro-meteorological services in Mozambique. The communication and dissemination of weather and climate information and warnings is limited by: i) inadequate protocols, agreements and thus coordination between leading institutions, namely the Department of Disaster Management Affairs (DoDMA), Department of Water Resources (DWR) and Department of Climate Change and Meteorological Services (DCCMS), for communicating and issuing weather and climate information warnings; ii) insufficient understanding of the current and future climate risks; and iii) inappropriate communication and packaging of warnings for local communities. Despite the recognition of the impact of climate change on the frequency and intensity of disasters, and their resultant negative impacts on livelihoods and the national economy, Malawi still has very weak, poorly coordinated, and unreliable early warning systems in place.

1.2 Preferred solution

12. To allow Malawi the opportunity to better manage climate hazards, food security and agricultural production, scarce and dwindling water resources and make its socioeconomic development process less vulnerable to climate-related risks – it is essential to:

1. enhance the capacity of hydro-meteorological services and networks to monitor and predict weather and climate events and associated risks, e.g. floods, droughts and Mwera winds – strong winds[8];
2. develop effective and efficient ways of packaging weather and climate information, including contextualising with other environmental and socio-economic data, to produce early warnings/alerts and advisories; and
3. support improved and timely preparedness and response to weather and climate information and early warnings, including efficient delivery mechanisms using radio and telecommunications networks.

13. Access to accurate weather and climate data, and the capacity to analyse and interpret this at the national level, is important for effective early warning systems (EWS) and adaptation planning in Malawi. Effective and efficient climate information and EWS in Malawi should be based on the integration of regional and national early warning systems, GIS mapping of vulnerable areas, meteorological and hydrological information on flooding, droughts and severe storms, and community-based and/or traditional early warning systems. It should provide indicators for monitoring the impacts of climate change and facilitate climate hazard preparedness and adaptation

[7]Surface observations and station based forecasts, NWP (Numerical Weather Prediction) fields, satellite data and derived synthetic products, aviation reports and forecasts, satsounding data, satwind data, automatic satellite image interpretation data, road weather observations and forecasts, MOS (Model Output Statistics) data, ocean profile data, warnings based on the monitoring of incoming data, trajectories and geographical information (based on vector and raster data).

[8]Mwera winds are a major risk to fishing communities particularly on Lake Malawi and Lake Malombe. Therefore, there is a need to strengthen hydro-meteological services and networks to monitor and predict the occurrence of these winds. This will require a stronger link with Mozambique NMHS as well as improved coordination among DWR, DCCMS and DoDMA and effective communication strategy with the communities.

planning. In this way, climate can be systematically integrated into longer-term planning and investment decision-making.

14. The main recommendations from DCCMS and DWR to enhance the accuracy and efficiency of climate-related hazard warnings in Malawi include the need to: i) improve the coverage of and automate the weather and hydrological observation network; ii) improve accuracy of forecasting through acquisition of improved hardware and software; iii) strengthen data archiving systems including recovering data held in paper/perishable/obsolete formats; iv) improve capacity to analyse and interpret historical and current weather and climate data; v) improve weather forecasting capabilities; vi) vii) increase the frequency of data collection; v) strengthen the collaboration and agreements with neighbouring and regional meteorological services to improve warnings for tropical cyclones, drought, flooding and Mwera winds; and vii) building support and awareness among local communities that have a demand for climate information and warnings; and viii) promoting greater collaboration between the providers and users (including user-agencies and local communities) of climate information9.

15. Strengthened weather/climate information and EWS can result in adequate: i) lead-times for local communities at risk of droughts, floods and strong winds to prepare and undertake risk reduction measures, including moving assets10 to safer locations, storing seed and food for dry months, and implementing flood resilience measures11; ii) interpretation, packaging and transfer of climate information for relevant user-agencies to minimise risk to life and livelihoods, including evacuating vulnerable groups, assisting local communities implement risk reduction activities, and implementing flood control and re-routing structures12; iii) agro- and hydro-meteorological information for informing integrated farm management and water resources management; iv) integration of climate information into planning and policy making processes; and v) packaging of weather and climate data and information for a range of other service providers, including applications related to building and management of infrastructure, land and air transport, and the private sector.

1.3 Barriers to the solution

16. The development of climate information and EWS to increase climate resilience and support for effective adaptation planning in Malawi – and thus the preferred solution – is constrained by a number of political, institutional, financial, technological and informational barriers that exist in the country. The LDCF financed project, in conjunction with a number of ongoing initiatives, aims to facilitate Malawi's development of the necessary skills and frameworks to assist the country in achieving the preferred solution in the long-term.

Key barriers that need to be addressed in order to contribute towards the achievement of the preferred solution include:

- *Limited financial resources available for hydro-meteorological services and disaster risk management, which has resulted in obsolete and inadequate weather and climate observation network and reduced capacity of DCCMS, DoDMA and DWR to fulfill their core mandates.*

17. One of the main reasons for the current state of obsoleteness of the climate information and early warning system in Malawi is that it simply has not received adequate public sector support. Currently, there is inadequate funding for disaster risk management and hydro-meteorological services – in particular EWS– in the national budget. The importance of disaster risk management informed by accurate and timely weather and climate information is not adequately addressed in

[9]Zhu, X. 2011. Technologies for Climate Change Adaptation – Agriculture Sector – TNA Guidebook Series. UNEP Risø Centre on Energy, Climate and Sustainable Development Risø DTU National Laboratory for Sustainable Energy, Denmark.
[10]Food, livestock and personal items.
[11]E.g. sandbags.
[12]Dam management, temporary flood defenses to prevent inundation of property and land

national policies and annual budgets and district development plans. The Department of Climate Change and Meteorological Services (DCCMS), Department of Water Resources (DWR) and Department of Disaster Management Affairs (DoDMA) have received limited funding from the government, relative to energy, transport and production sectors (such as agriculture). As a result, there has been i) a steady decline in the state of the hydro-meteorological observation networks in Malawi over the last 20-30 years; and ii) inadequate allocation of DoDMA's funding to fulfill its core mandate in a collaborative manner with DCCMS and DWR.

18. Although climate related hazards and EWS issues are crosscutting by nature – involving different sectors, stakeholders and partners – there are no line items for EWS and disaster risk management informed by accurate and timely weather and climate information in the budget for ministries, departments and district councils. This hinders ministries and departments –in particular the DCCMS, DWR and DoDMA, as well as district councils– in carrying out their respective responsibilities with regard to EWS and long-term socio-economic development planning. In particular, DoDMA has been forced to focus on post-disaster response activities relying on the international donor community to undertake preparedness and risk reduction activities. Furthermore, the basic components of a functioning weather/climate information system and EWS in Malawi have not been updated with appropriate automated equipment as well as data processing and archiving systems and have been poorly maintained. The current weather and climate observation infrastructure is not adequate for effective early warning provision or climate change adaptation planning. This is despite the realization that the future productivity of the agriculture and water sectors without accurate weather and climate data and information from DCCMS and DWR will be significantly undermined by climate change impacts.

19. Despite some recent upgrades to hydro-meteorological observation networks, the existing infrastructure remains insufficient to monitor climate and weather across the full extent of Malawi. For example, the automatic rain gauges and weather stations are concentrated in the western half of the country, while many of the lakeshore areas do not have reliable rainfall and weather data collection facilities. A recent – 2012 – functional review of DoDMA noted that the flood EWS only covers major rivers, leaving out many small rivers, which results in severe flooding and related damage and loss of life. As a result of the outdated state of the weather and climate observation network, an increase in lead times to warn communities has not been possible. There is a need for government to support DCCMS, DWR and DoDMA in developing an updated and upgraded comprehensive multi-hazard national EWS, which will encompass warnings of floods, drought and strong winds.

- *Limited technical and human capacity for monitoring and forecasting extreme weather and climate change.*

20. The technical capacity required to identify climate-related hazards and their potential impacts on vulnerable communities is limited in Malawi. Even with increasing realization of the effects of climate change, there is a strong perception that the benefits associated with efficient climate information and EWS management – including effective climate change adaptation planning – are not immediate and are less tangible when compared to water, energy, agriculture supply, and productivity orientated infrastructure activities. Therefore, disaster risk reduction and climate change management sectors are currently poorly funded with limited experience in coordination and cooperation.

21. These challenges have resulted in limited computational equipment, software (model code and associated routines) and human (scientific and technical) capacity to program and run the model codes, as well as effectively identify climate hazards and forecast their potential impacts on vulnerable communities. In particular, the data archiving system installed is currently not functioning and therefore archiving of data is not occurring (September 2012). As a result, data is archived in Excel spreadsheets and printed out. Furthermore, highly skilled forecasters are often not retained by the Malawian government. This is because they are not able to effectively use their skills as a result of low institutional capacities and insufficient funds. This has resulted in limited manpower especially

skilled forecasters, technicians and IT specialists. Few existing staff members have experience producing hazard, risk and vulnerability maps.

22. The assessment of existing GIS capacities for disaster risk management and climate change adaptation has shown that to date a dedicated GIS (Geographic Information Systems) unit is operated only at the National Statistical Office (NSO) in Zomba. No dedicated GIS or remote sensing units exist within other departments or agencies. The key players operating at a national level with GIS and/or remote sensing software and data, are the Geological Survey Department (GSD), the National Statistical Office (NSO), Land Survey Department, Bunda College and the Ministry of Agriculture and Food Security (MoAFS). The level of training and the academic background in Geo-Information technology of individuals varies between and within institutions and existing capacities within the departments or agencies and are often based on single individual capacities. In general, personnel work independently from each other. Efforts are being made to establish dedicated GIS units within both the Land Survey Department and the Geological Survey Department (GSD).

23. Malawi is yet to develop a comprehensive multi-hazard national risk assessment to aid micro and national level planning exercises. This gap needs to be filled to meet national priorities regarding increased infrastructure development for growth and development. A number of initiatives have tried to fill the gap for certain districts. However, these initiatives have limitations in that most of these assessments are based on historical occurrence of climate hazards and do not consider future risks under the context of climate change.

- *Limited protocols and agreements and related SOPs for DoDMA, DCCMS and DWR at regional, national and local levels with regards to weather, hydrological and climate data and information collection, exchange, analysis, interpretation and early warning dissemination.*

24. At present, a weak enabling environment – including limited protocols and agreements and appropriate communication platforms – exists for coordinating mandates and related responsibilities as well as to assist data and information exchange between DoDMA, DWR and DCCMS. As a result, at times mandates have been overstepped and/or confused. DoDMA is mandated to provide early warnings using climate and hydrological information provided by national hydrology (DWR) and meteorology (DCCMS) services. DWR is mandated to monitor surface water flows, and to issue flood warnings based on the data collected from a surface (including rivers and lakes) monitoring observation network. In some cases, DCCMS has also gone beyond reporting weather information only but has also provided information on floods warnings through its weather forecasts. Furthermore, DoDMA through the Office of the President and Cabinet (OPC) has also been reporting flood risk information that the DWR is of the opinion falls more within their mandate.

25. Malawi has an existing Flood EWS. The weaknesses in this system includes: i) limited training at a district level on what to do when an early warning message is received; ii) limited standardization in communication of early warning messages; and iii) limited cross-border cooperation with Mozambique regarding tropical cyclones, flooding, Mwera winds and drought and in particular for predicting flooding in southern Malawi. A clear system of communicating weather, hydrological and climate information to the communities is non-existent. Warnings are issued at national level, passing through a number of bureaucracies and many departments. Processing information between numerous departments causes delays, failing to achieve the intended purpose of early warnings. Although drought, flooding and severe weather are frequent occurrences in Lake Malawi and in most disaster prone districts in the country, communities do not receive timely information about the likelihood of climate hazards to allow evacuation and/or to adapt their livelihood activities as necessary. This leads to loss of life, assets and livelihoods. A core function of DoDMA is to facilitate the dissemination of warnings and provide communication, coordination and information management support in the event of climate-related hazards. Current Standard Operational Procedures (SOPs) are not well designed or practiced. There are significant procedural delays between data collection, synthesis and communication to local communities, who have to decide in a very short period to relocate – pending a flood event – or to plan with regards to drought

events or strong winds forecasted over Lake Malawi. There is a need to have more clarity regarding responsibilities, powers and procedures in place to guide these institutions.

- *Limited consolidation and linkages of effective governmental and non-governmental weather, hydrological and climate information dissemination channels (including physical mechanisms) and early warning systems.*

26. Currently, there are multiple ongoing early warning projects being implemented in Malawi in addition to ongoing national government initiatives. Existing projects have arisen in the last few years in response to both drought and flood crises, and are being implemented by a number of agencies. However, the role of national agencies in these projects is limited at present, with the majority of being implemented through the actions of NGOs and CSOs. Furthermore, there is currently little horizontal or vertical coordination between existing projects as well as national, district and community levels. There are also many gaps in the existing early warning networks in terms of geographic coverage and the hazards for which warnings are produced – in general there is a bias towards flooding with less emphasis placed on drought, agricultural stresses and severe weather such as Mwera winds over Lake Malawi. At present a range of dissemination methods are used including radio (national and local), email, television, print media, internet websites, telephone, regional and national workshops and cell phones. There is limited understanding of the effectiveness of these methods particularly regarding effective information, education and communication materials needed to ensure the dissemination methods are appropriate for all vulnerable persons in a community. Furthermore, there are no national guidelines for the development and implementation of EWS projects, which has led to a range of different and discrete approaches and projects being implemented throughout Malawi. This diversity represents a good baseline situation for evaluation of successful approaches within the national context, as well as to work towards coordinating approaches and guiding new project development activities.

- *Limited capacity at a district level to effectively manage early warning systems and related disaster risk reduction efforts resulting in poor community preparedness and response.*

27. At a district level, DoDMA relies on underdeveloped district council staff to plan, implement and evaluate early warning and disaster management activities. Although DoDMA has recruited and deployed Assistant Disaster Risk Management Officers (ADRMO) in 14 disaster prone districts since 2010, these are junior officers with limited decision-making powers. The absence of senior officers in the district councils – as recommended in the 2004 Functional Review Report on Local Assemblies – hinders DoDMA to function effectively at district level. As a result, DoDMA carries out its operations for the districts centrally from headquarters and this causes delays in the operations. DCCMS also has limited reach at the district level, as some stations are located far from DCCMS's offices.

28. Except where NGOs are present in the area, most Village Civil Protection Committees (VCPCs) have limited capacity and do not have trained personnel within the villages who can provide support in relocation and rescue. In some cases, these local decentralized institutions only exist on paper. Households rely on assistance from the district, which is usually provided too late to save any assets. Risk assessment and early warning systems are not upgraded and updated to meet the challenges posed by disasters.

29. Often there is a lack of practical capacity at the community level about the use of early warning information. For example, often when they receive early warnings, they do not know the required action to take. In the event that they do know what action is required, they do not have the means and adequate support available to carry out any action. According to experiences from NGOs who work in some of the disaster prone districts, because of such delays, coupled with the local knowledge that exists within communities (which has not been tapped adequately), communities have sometimes not taken flood warnings seriously since they feel they have better knowledge of the area. Limited integration of weather and climate information and warnings into sector-specific national policies, hazard and vulnerability maps, and local contingency and development plans hinders timely

response to warnings received at district level and adequate sector-specific planning for climate resilient socio-economic development.

2 STRATEGY

30. The LDCF project will contribute to overcoming the above identified barriers by strengthening the generation and use of reliable climate information and early warning systems in Malawi, largely through improving national capacities to generate and use climate information in planning for, and management of, climate hazards and long-term strategic planning. This will be achieved by transferring appropriate technology, infrastructure and skills to hydro-meteorological services (DCCMS and DWR), disaster risk management agencies (DoDMA), other weather and climate information user-agencies (MoAFS) and end-users (local communities) in the country, through the following complementary outcomes – which are integrated into the overarching and national UNDP supported programme on DRM:

- Outcome 1: Enhanced capacity of the Department of Climate Change and Meteorological Services (DCCMS) and Department of Water Resources (DWR) to monitor and forecast extreme weather, hydrology and climate change.
- Outcome 2: Efficient and effective use of hydro-meteorological and environmental information for early warnings and long-term development plans.

31. The LDCF will target 7 of the 15 disaster prone districts [13](hereafter referred to as priority districts), as prescribed in the UNDAF 2012-16, and is designed to integrate with on-going EWS activities implemented by both government and NGO partners. Through Outcome 1, LDCF resources will be used, in conjunction with other ongoing initiatives to assist the Government of Malawi (GoM) to address some of the fundamental barriers to the deployment of an operational weather, climate and hydrological monitoring system and forecasting extreme weather and longer-term climate variability. This will be achieved by increasing the national coverage of the monitoring system and increasing the accuracy and timeliness of forecasts and alerts.

32. Through outcome 2, LDCF funding will be used to increase the proportion of the local population that has access to adequate climate information, both for early warning purposes and for long-term planning. The approach will be to support the timely sharing and dissemination of relevant weather and climate data and information with users at both the national and district levels. SOPs for disseminating and responding to weather and climate forecasts – including warnings for floods, droughts and strong winds – will be developed and demonstrated in 7 priority districts, namely Karonga, Salima, Nkhota-kota, Rumphi, Nkhata-bay, Dedza and Phalombe. National systems will be linked to existing community-based systems and decentralised observation networks. It is expected that this will show the socio-economic benefits of adequate climate services that will support the up-scaling, operation and maintenance of the system in the long term.

2.1 Project rationale and policy conformity

33. The Government of Malawi ratified the United Nations Framework Convention on Climate Change (UNFCCC) on 21 April 1994 as a non-Annex 1 country[14]. By signing and ratifying the UNFCCC, Malawi has committed to the adoption and implementation of policies and measures designed to adapt to climate change, e.g. *inter alia* National Adaptation Programmes of Action (NAPAs), National Communications (NCs) and National Adaptation Plans (NAPs). In 2002 and 2009respectively,Malawi submitted its Initial and Second National Communications (I/SNC) to UNFCCC, which included a national GHG inventory system, an assessment of the country's status of

[13]Chikhwawa, Nsanje, Phalombe, Zomba, Balaka, Mangochi, Ntcheu, Dedza, Kasungu, Lilongwe, Salima, Nkhotakota, Karonga, Nkhata bay and Machinga.

[14]Maindb.unfccc.int/public/country.pl?country=MW

vulnerability and adaptation to climate change, and recommendations for adapting to and mitigating climate change. In 2006, Malawi developed and submitted its National Adaptation Programme of Action (NAPA) to UNFCCC. The NAPA includes a list of nine priority projects, many of which are yet to be rolled out and implemented.

34. The LDCF project responds to priority adaptation needs and actions identified in Malawi's NAPA[15,16].More specifically, the LDCF project activities aim to address NAPA: i) project priority 3 - *improving agricultural production under erratic rains and changing climatic conditions* which features improved early warning systems; ii) project priority 4 -*improving Malawi's preparedness to cope with droughts and floods* which includes strengthening drought and flood forecasting and early warning systems through human and technical capacity building; and iii) project priority 5 - *improving climate monitoring to enhance Malawi's early warning capability and decision making and sustainable utilization of Lake Malawi and lakeshore areas resources* which features climate monitoring and early warning systems for Lake Malawi and lakeshore areas for improving pre-disaster preparedness of rural fishing and farming communities.

35. The LDCF project aims to strengthen the weather, climate and hydrological monitoring capabilities, early warning systems and delivery of available information for responding to extreme weather and planning adaptation to climate change in Malawi. This aligns with the expected outputs[17] of UNDP's national support to disaster risk management, following the MGDS II (2012-2016), UNDAF (2012-2016[18]) and CPD (2012-2016[19]) priorities – particularly on climate change, disaster risk management and agriculture and food security. In particular, the LDCF project aligns with the MDGS II Theme 3: Social Support and Disaster Risk Management, sub-theme 3.2 Disaster Risk Management; and two of the MGDS II's Key Priority Areas, namely:1) Agriculture and Food Security, specifically 1.1. Food Security; and 9) Climate Change, Natural Resources and Environmental Management, specifically 9.1 Climate Change Management (see Section 2.2 for further details).

36. The project complies with national priorities relevant for supporting national development goals and for specifically achieving MDGs 1 and 7. Within goals 1 and 7, the LDCF project is consistent with Target 1C: "Halve, between 1990 and 2015, the proportion of people who suffer from extreme hunger and poverty" and Target 7C: "Halve, by 2015, the proportion of the population without sustainable access to safe drinking water and basic sanitation". This is because of the importance of EWSs in mitigating loss in agricultural productivity and impacts on water supply as a consequence of climate-related hazards. The LDCF project will benefit households reliant on rain-fed agriculture in areas affected by droughts and floods.

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[15] In implementing priority interventions identified in Malawi's NAPAs, the project is consistent with the Conference of Parties (COP-9) and satisfies criteria outlined in UNFCCC Decision 7/CP.7 and GEF/C.28/18. The project focus is aligned with the scope of expected interventions as articulated in the LDCF programming paper and decision 5/CP.9 and LDCF updated operational guidelines GEF/LDCF.SCCF.13/04. As climate impacts fall disproportionately on the poor, the project recognizes the links between adaptation and poverty reduction (GEF/C.28/18, 1(b), 29).

[16] The process for developing NAPAs is highly consultative and the prioritization process relies on the following criteria (as per Decision 28/CP.7):"Criteria for selecting priority activities. A set of locally-driven criteria will be used to select priority adaptation activities. These criteria should include, *inter alia*: a) Level or degree of adverse effects of climate change; b) Poverty reduction to enhance adaptive capacity; c) Synergy with other multilateral environmental agreements; (d) Cost-effectiveness. These criteria for prioritization will be applied to, *inter alia*: a) Loss of life and livelihood; b) Human health; c) Food security and agriculture; d) Water availability, quality and accessibility; e) Essential infrastructure; f) Cultural heritage; g) Biological diversity; h) Land-use management and forestry; i) Other environmental amenities; j) Coastal zones, and associated loss of land."

[17]Output 1: Disaster risk management mainstreamed in policies and development plans; Output 2: Data and knowledge on the impact of natural disasters collected and made accessible to decision makers in Government, Private Sector Civil Society, and Communities; and Output 3: .Coordination mechanisms and implementation arrangements for DRM/DRR established and used at national level and in the 15 disaster-prone districts. .

[18]Under the UNDAF 2012 - 2016 Theme 1 – Sustainable and Equitable Economic Growth and Food Security, UNDP is the lead agency for the Outcome 1.3: Targeted population in selected districts benefit from effective management of environment, natural resources, climate change and disaster risk by 2016

[19]In the new CPD and UNDAF, UNDP will contribute under the Outcome "Climate Change, Environment, Natural Resources and Disaster Management" mainly concentrate on: 1. Mainstreaming; 2.Coordination; and, 3. Data and Knowledge Management;

2.1.1 Consistency with the policies and objectives of the Least Developed Country Fund

37. The project fits well with the GEF Result-Based Management Framework for Adaptation to Climate Change. The project contributes directly to Objective 2: "increase adaptive capacity to respond to the impact of climate change". The information that will be generated through this project will be used in making some decisions at the local level, at short, mid- and long-term, for example crop and variety selection, emergency preparedness, land use planning.

38. The project has been designed to meet overall GEF requirements in terms of design and implementation. For example:

a) Sustainability: The project is designed to deliver lasting lessons on the usefulness, operation and maintenance of the hydro-climate monitoring network, by demonstrating how enhanced climate information can better serve disaster management, risk reduction and long term planning. The project will also work with local communities in 7 disaster prone districts to enhance their participation in the early warning system, creating conditions for long-term sustainability.
b) Monitoring and Evaluation: The project is accompanied by an effective and resourced M&E framework, that will enable an on-going adaptive management of the project, ensuring that lessons are learnt, management decisions are taken based on relevant and up-to-date information, and regular progress reports are available for concerned parties.
c) Replicability: The project will generate a thorough, costed, report on lessons learned that will enable the replication of project outputs and outcomes in other regions. Conditions for broader replicability will have been facilitated through the increase in national coverage of the hydro-climate monitoring system and the development of Standard Operating Procedures, which will enable the further integration of climate information into planning at all levels, and which will set the conditions for operating an EWS country-wide.
d) Stakeholder involvement: Following on from the NAPA process, the design of this project was undertaken in a participatory manner. Moreover, the design of the project has ensured the appropriate involvement of stakeholders in project development and implementation (See Section 2.9 for stakeholder involvement plan). Specific activities to be undertaken by the LDCF project – based on the above NAPA priorities – were developed and selected through a participatory approach including multi-stakeholder consultations, and have been endorsed during a validation consultation held on 25 April 2013 (see Annex 3 and 11).
e) Multi-disciplinary approach: The project was designed and is intended to be implemented in a multi-disciplinary approach that brings together all sectors who are producers or users of climate information, starting with agriculture and water, but including also private sector stakeholders, NGOs and community based organizations. The project is intended to assist Malawi in providing climate services to all sectors.
f) Gender equality: The project design integrates gender considerations in a Malawi context. The project intends to ensure that women play an adequate part in the early warning system that they benefit from climate information that is relevant to them and their roles, and that the information is presented and transmitted in a way that is accessible to them, considering their specific constraints.
g) Complementary approach: The project builds on on-going initiatives and programming in Malawi. The project therefore builds on on-going efforts to review the legislative texts, institutional make-up of key DRM organizations, as well as emergency preparedness planning at the local level. The project also intends to pursue active coordination with other partners working on climate change and DRM in the country, through continued discussions among donors.

39. This project is also aligned with the GEF Result Based Management Framework for Adaptation to Climate Change by including activities which are aligned with key GEF outcomes and indicators, mainly:

a) Outcome 2.1: Increased knowledge and understanding of climate variability and change-induced threats at country level and in targeted vulnerable areas, *Outcome Indicator 2.1.1, Relevant risk*

information disseminated to stakeholders, Output indicator 2.1.2.1 Type and scope of monitoring systems in place; and

b) Outcome 2.2: Strengthened adaptive capacity to reduce risks to climate-induced economic losses, *Output Indicator 2.2.2.1 % of population covered by climate change risk reduction measures.*

40. The proposed project has been prepared fully in line with guidance provided by GEF and the LDCF Trust Fund. The project follows the guidance from the 'Programming Paper for Funding the Implementation of NAPA's under the LDC Trust Fund (GEF/LDCF 2006). The project focus is also aligned with the scope of expected interventions as articulated in the LDCF programming paper and decision 5/CP.9. As climate impacts fall disproportionately on the poor, the project recognizes the links between adaptation and poverty reduction (GEF/C.28/18, 1(b), 29). The project has been screened using the UNDP Environmental and Social Safeguards to ensure that the design includes measures to minimise any risks and pressures

41. The project is also consistent with the principles governing the LDCF**:**

a) **Country ownership:** The Government of Malawi has ratified the UNFCCC and is classified among the non-Annex 1 parties. These countries have also developed and submitted their National Adaptation Plans of Action (NAPA) and are entitled to benefit from the LDC Fund for the implementation of priority measures identified in their respective NAPAs. In implementing priority interventions identified in the NAPAs, the project is consistent with the Conference of Parties (COP-9) and also satisfies criteria outlined in UNFCCC Decision 7/CP.7 and GEF/C.28/18.This project conforms to country ownership and leadership as, among other things, it is aligned to government policies and strategies as well as management systems and procedures (see Section 2.2).
b) **Compliance with programme and LDC Fund policies:** The project complies with the NAPA-identified urgent needs, all of which are relevant for supporting national development goals and for achieving MDGs 1, 3, 6 and 7
c) **Financing:** The project is designed to accommodate the additional adaptation costs of priority actions identified in the NAPAs and build on several other baseline projects and programmes. The co-funding for this project is also within the stated guidelines, with more than $5m in prospective co-funding. To achieve the LDCF project outcomes that will be embedded in the overarching UNDP DRM support, the project will build on several baseline projects – identified through in-country stakeholder consultations – which also represent $30,200,000 of co-financing leveraged by this project. It will also coordinate efforts with one climate change UNDP project which is conducting work focused on climate change in the country and represents $400,000 of co-financing leveraged by the LDCF project. The relevance of the co-financing to the proposed LDCF project is outlined below and will be further elaborated on during the project preparation phase (see Section 2.3).
d) **Institutional Synergy and Coordination:** The project outcomes will be implemented through national execution. The PIF therefore outlines project management costs that will be incurred by implementing partners at the national level (below 5%).

2.2 Country ownership: country eligibility and country drivenness

42. By signing and ratifying the UNFCCC and Hyogo Framework for Action (HFA), Malawi has, respectively, committed to the adoption and implementation of policies and measures to adapt to climate change and to manage existing climate risks, including enhancing preparedness and response capability to likely disasters.

43. The LDCF project is linked and well-aligned to national priorities and measures identified for implementation reflected in the MGDSII (2011-2016), United Nations Development Assistance Framework (UNDAF), National Disaster Risk and Management (NDRM) Policy, and NAPA. Furthermore, to develop a project that reflects the needs of national stakeholders and for local partners to feel ownership of the project, the LDCF project is based on information received from three

stakeholder consultations conducted in Malawi from September 2012 to April 2013. The programme is part of the over-arching DRM support to Malawi, as described in the DRM Project Support Document, which was developed in 2011-2012 following extensive consultations with stakeholders.

2.2.1 Legal and Policy Framework

44. United Nations Development Assistance Framework (UNDAF 2012-2016) for Malawi acknowledges that – in the context of climate change – improved disaster management enhances the sustainability of economic growth, particularly in districts that are prone to natural disasters. The LDCF project is consistent with three specific output areas from the UNDAF, namely, 1.3.1) Environment, natural resources, climate change and disaster risk reduction mainstreamed in policies, programmes and plans implemented in 14 disaster-prone districts; 1.3.2) Data and knowledge on the impact of climate change, environment and natural resources and disaster risk management made accessible to decision makers and government, private sector and civil society; and 1.3.3) coordination mechanisms and implementation arrangements for climate change, environment and natural resources and disaster risk management established and used at national level and disaster-prone districts.

45. The Malawi Growth and Development Strategy II (MGDS II 2011-2016) outlines Malawi's five year development strategy for the period 2011 to 2016, and serves as a guide for creating wealth and reducing poverty in Malawi through sustainable economic growth and infrastructural development based on six thematic areas. MGDS II is built six thematic areas[20] from which priorities within priorities are derived. The LDCF project has been developed in alignment with sub-theme 3.2 Disaster Risk Management under Theme 3 Social Support and Disaster Risk Management. This theme is aimed at continued provision of social support to the vulnerable and strengthening disaster risk management. Sub-theme 3.2 provides a number of strategies for supporting Malawi's preparedness, response and recovery to the increase in magnitude, frequency and impact of disasters as a result of climate change, population growth and environmental degradation. The LDCF project is particularly aligned to following sub-theme 3.2 strategies: i) strengthening DRM coordination mechanisms among stakeholders; ii) enhancing capacity on the use of Geographical Information System (GIS) and other remote sensing technologies; iii) developing an integrated national EWS; iv) implementing mitigation measures in disaster prone areas; and v) promoting awareness, access, distribution and utilisation of reliable and relevant DRM information. Although disaster risk management is embedded as a sub theme in the MGDS, the integration of disaster risk reduction into all sustainable development policy and planning processes at all levels, cuts across all the themes of the MGDS II.

46. The MGDS II includes nine Key Priority Areas[21]. The LDCF project is consistent with the goals and mid-term expected outcomes of two of the Key Priorities, namely: 1) Agriculture and Food Security, specifically 1.1. Food Security; and 9) Climate Change, Natural Resources and Environmental Management, specifically 9.1 Climate Change Management. See Table 1 below for the mid-term expected outcomes, key strategies and focus actions/activities of the Food Security and Climate Change Management key priorities towards which the LDCF project will contribute.

Table 1: MGDS II (2011-2016) two key priorities – Food Security and Climate Change Management – including the specific relevant mid-term expected outcomes, key strategies and focus actions/activities with which the LDCF project aligns.

Goal	Mid-term expected	Key strategies	Focus Actions/Activities

[20]These are: Sustainable Economic Growth; Social Development; Social Support and Disaster Risk Management; Infrastructure Development; Governance; and Gender and Capacity Development.

[21]1) Agriculture and Food Security; 2) Energy, Industrial Development, Mining and Tourism; 3) Transport Infrastructure and Nsanje World Inland Port; 4) Education, Science and Technology; 5) Public Health, Sanitation, Malaria and HIV and AIDS Management; 6) Integrated Rural Development; 7) Green Belt Irrigation and Water Development; 8) Child Development, Youth Development and Empowerment; 9) Climate Change, Natural Resources and Environment Management.

	outcome		
1.1. Food Security			
To ensure sustained availability and accessibility of food to all Malawians at all times at affordable prices.	Food self-sufficiency at household and national levels.	Ensuring effective early warning system	• Improve collection, analysis and dissemination of agricultural statistics. • Procure equipment. • Develop support infrastructure.
	Enhanced agricultural risk management.	Strengthening and scaling up market-based risk management initiatives	• Develop weather related insurance product. • Strengthen weather forecasting capability for agriculture.
9.1 Climate Change Management			
To enhance resilience to climate change risks and impacts.	Improved climate change mitigation and adaptation measures.	Improving weather and climate monitoring, production systems, and information and knowledge management systems.	• Produce weather forecasts. • Derive climate seasonal forecasts. • Prepare and communicate information on weather and climate. • Strengthen coordinationamong stakeholders. • Modernize climate changedatabase. • Establish GTS linkages. • Undertake data management activities. • Train personnel. • Procure equipment. • Provide support infrastructure. • Produce and disseminatehigh quality climateinformation and tools.
		Promoting dissemination of climate change information for early warning, preparedness and response.	• Conduct awarenesscampaigns. • Recruit and train personnel. • Intensify coordinationamong stakeholders. • Develop a communicationstrategy. • Produce high qualityclimate information and toolsfor risk management.
		Mainstreaming climate change issues in sectoral policies, plans and programmes.	• Incorporate climate changeissues into national andsectoral development plansand policies. • Train personnel.

47. The Disaster Preparedness and Relief (DPR) Act of 1991 and MGDS provide strategic direction to disaster risk management for the country. Two other relevant policy documents that aim to address vulnerability and poverty are: i) a draft National Disaster Risk Management (NDRM) Policy which includes the aim to enhance the disaster risk management coordination role of DoDMA; and ii) a draft National Climate Change Policy which will guide responses to commitments under the UNFCCC and Kyoto Protocol, specifying various activities to be undertaken for climate change mitigation and adaptation. The National Strategy for Sustainable Development (NSSD) complies with the UNFCCC objectives: i) to provide effective weather and climate disaster early warning and enhance awareness, uptake and response by the general public; and ii) to provide reliable weather and climate information and advisors for use in agricultural production, industrial production and water resource management. The Agriculture Sector Wide Approach (ASWAp) acknowledges the need for improvement of EWSs to mitigate the effects of climate change on agricultural production. The third strategic objective included in this agriculture development plan is "sustainable management of the effects of climate change". Improved EWSs for droughts, floods and pest outbreaks are suggested to

mitigate the effects of droughts and floods. Goal 2 of the National Biodiversity Strategy and Action Plan is aligned with the LDCF project. It includes provision to strengthen and build human infrastructure capacity for effective information dissemination.

48. The NAPA specifies the need for improving technologies to inform climate resilient development planning and sector management. The development of EWSs is a priority and is expected to be beneficial to multiple sectors, including agriculture, water, health and energy. EWSs are highlighted as being required for Priorities 3, 4 and 5 of the NAPA. NAPA project priority 3: "Improving agricultural production under erratic rains and changing climatic conditions" features improved EWSs. NAPA project priority 4: "Improving Malawi's Preparedness to cope with droughts and floods" features the implementation of both flood and drought EWSs. The project includes priority activities for strengthening the "Forecasting and Early Warning system" including "Capacity building (training staff to man the systems)." Malawi's NAPA project priority 5: "Improving climate monitoring to enhance Malawi's early warning capability and decision making and sustainable utilization of Lake Malawi and lakeshore areas resources" features climate monitoring and an EWS on Lake Malawi and lakeshore areas for pre-disaster preparedness to rural fishing and farming communities. It provides benefits to the fisheries, transport, tourism, water and hydropower energy sectors.

2.2.2 Institutional Framework

49. Three key departments play various roles in the provision of Climate Change and Disaster Risks related early warning in Malawi. These are i) the Department of Disaster Management Affairs (DoDMA) in the Office of the President and Cabinet (OPC); ii) the Department of Climate Change and Meteorological Services (DCCMS) in the Ministry of Environment and Climate Change Management (MoECCM); and iii) the Department of Water Resources in the Ministry of Irrigation and Water Development (MoWDI).

50. DoDMA is a Government agency in the OPC, which is mandated to coordinate and oversee disaster risk management programs and projects being implemented by various stakeholders in the country with the aim to build and improve resilience of households, communities and the nation to disaster risks. The Department was established in 1994 by the DPR Act (1991), which was enacted after the Phalombe floods catastrophe to coordinate and implement measures to alleviate effects of disasters. The Act emphasized establishing the institutional functions required for the coordination of disaster risk management programmes and activities in the country, comprising: i) the Secretary and Commissioner for Disaster Management Affairs in the Department of Disaster Management Affairs (DoDMA); and ii) the National Disaster Preparedness and Relief Committee (NDPRC), Civil Protection Committees (CPCs).

51. Specific to this project, DoDMA acts as the mouthpiece through which weather related early warning messages are announced by the DWR and DCCMS. The NDPRC provides policy level guidance to DoDMA and is responsible for coordinating the implementation of measures to alleviate disasters, while the Civil Protection Committees constitute the frontline decentralized institutions at the Area and Village levels (ACPC and VCPC), providing community level coordination of preliminary disaster impact assessments in the affected communities before any relief operations are initiated. These institutions also serve as entry points for any dissemination of disaster early warning information at the community level.

- The DCCMS has grown in the coverage of its network as well as the number of its mandates since establishment. The mission of the department is to provide reliable, responsive and high quality weather and climate services to meet national, regional and international obligations through timely dissemination of accurate and up to-date data and information for socio-economic development. Thus, its mandate is to monitor, predict and provide information on weather, climate and climate change that would contribute towards the socio-economic development of the

country. The objectives of the department as derived from its mandates are as follows: To monitor, analyze and predict weather and climate. The thrust of this objective is to ensure that weather forecasts are produced for early warning purposes. This information is vital for advisory on natural disaster early warnings for the development of climate change adaptation strategies.

- To provide weather and climate data and information for various socio-economic sectors such as Aviation, Agriculture, Water, Marine, Construction, Insurance, Tourism, Health, and Sports and Recreation.
- To carry out research and development that would improve quality of weather and climate data and information for the general public. The main focus is to carry out research for all aspects of meteorology that can be disseminated to *inter alia* the general public through mass media.
- To establish and maintain a well-equipped network of meteorological stations. This objective intends to ensure that meteorological data and information is reliable, timely and up to date.
- To strengthen the policy and regulatory framework on climate change, climate and weather.

52. DWR is responsible for the development and management of water resources in the country for use by all sectors. This includes management of surface water resources, groundwater, water quality, administration of the Water Resources Act, and implementing regional and international agreements and obligations on trans-boundary water courses. The Department is organized into four Divisions namely; Surface Water, Ground Water, Water Quality Services and the Water Resources Board Secretariat.

53. The Surface Water Division is responsible for the monitoring, assessment, conservation, management and development of the surface water resources. This includes responsibility over the monitoring network, and storage and dissemination of data to users. The Surface Water Division is structured into three regions and thirteen districts. The three regions coincide with the three main governmental regions in Malawi: North, Central and South. The districts are divided along hydrological and logistical boundaries, and generally can include more than one governmental district. Four of the districts are run by a central district office in charge of two districts each. Blantyre district office manages both Blantyre and Zomba districts, while Mzuzu district office manages Mzimba and Nkhata Bay districts. Each district office has a team who is responsible for the stations in their area.

54. Civil Society Organizations (CSOs) play a crucial role in climate change adaptation and disaster risk reduction programmes and activities in the country. Their entry point to communities is primarily through vulnerability assessments. Vulnerability is conceptualised in relation to specified outcomes (chronic poverty, malnutrition) and is mediated by both household responses (coping strategies) and policy interventions (risk reduction, risk mitigation, risk coping)[22] .
Several Non-Governmental Organizations (NGOs) were identified as having been involved for a considerable time in implementing different types of projects and activities relating to disaster risk management and climate change adaptation. Most of these NGOs implement community based early warning activities and conduct capacity building of Civil Protection Committees to enhance their effectiveness in carrying out disaster related activities in their communities. NGOs/CBOs were involved in the design of the LDCF project such as DIPECHO (consortium led by Christian Aid) and DISCOVER (consortium of NGOs led by Concern Universal).

2.2.3 Stakeholder baseline analysis

55. A wide range of stakeholders has contributed to the LDCF project formulation process in various ways. Their contributions have included provision of background documents, participation in face-to-face consultations, and participation in stakeholder feedback workshops (see Annex 3: List of stakeholders).Multi-stakeholder consultations conducted to inform the design of the LDCF project included: i) an initial inception workshop in September 2012; ii) a stakeholder follow-up workshop to

[22] Devereux *et al*., 2006

obtain feedback on proposed project framework in December 2012; and iii) a validation workshop on 25 April 2013. These consultations built upon the consultations that had already been undertaken during the development of the DRM Project Support Document, which is the overarching UNDP led support programme on DRM.

56. Consultations were attended by national operational focal points and government departments responsible for generating and using weather/climate information and early warning systems, as well as a number of development partners, NGOs and civil society organisations. Bi-lateral stakeholder consultations included a range of additional meetings that were held between September 2012 and April 2013 with bi- and multi-lateral organisations, government departments, and NGOs, as well as private sector partners. The Implementing Partner (IP) and Responsible Partners (RPs) played a considerable role in determining the activities for the LDCF project and were involved in most of the consultations undertaken above.

57. All consultations were conducted by an international consultant and/or national consultants with support from the UNDP Country Office. Details of stakeholder consultations – including reports, programmes and participant lists – are included in Annex 3. Details of stakeholder involvement during the project implementation phase are provided in Section 2.9.

2.3 Design principles and strategic considerations

58. Hydrological and climate monitoring is recognized by the GoM as a core public service provided to all economic sectors. As such, this project is founded on a solid baseline of ongoing national programming that provides the existing infrastructure, staff and resources of the early warning network. This includes all programming deployed by the Department of Disaster Management Affairs (DoDMA), Department of Climate Change and Meteorological Services, Department of Water Resources, and Ministry of Agriculture and Food Security (MoAFS[23]) (see section 2.4). This project comes as an add-on to these ongoing initiatives to ensure that climate change dimensions are taken into account in the deployment of short-, medium- and long-term weather and climate services.

59. A key principle governing the design of this project is that, while the project cannot cover all needs in terms of infrastructure and climate-related information, it can provide the means by which national coverage by an efficient EWS will be increased to a level able to cope with climate change induced shocks and changes in the future. It is assumed that this increased coverage, along with the (existing and new) technical capacity to analyse climate information, will allow the country to benefit from efficient, accurate and legitimate climate services on which to underpin development planning. Furthermore, the project also proposes that activities at the local level to demonstrate the efficiency of the early warning system will serve as lessons towards the development of an up-scaling strategy to be led by the government. The project therefore aims to deliver concrete lessons towards the sustainable deployment of EWS at all levels in the country.

60. Another strategic principle that governs the design of this project is the use of LDCF funding to provide value added to nationally-led baseline programming. This provides long-term anchoring for LDCF interventions, ensures that the conditions for long-term sustainability continue to be present even after the end of the intervention, and encourages stronger ownership. This project is therefore building on ongoing programming delivered by GoM through the Department of Climate Change and Meteorological Services(Ministry of Environment and Climate Change Management), Department of

[23] During the implementation phase, the project team (task force (consisting of desk officers from DCCMS in Blantyre, DWR and DoDMA in Lilongwe) team will be empowered to identify departments in the MOAFS that will benefit from the capacity building activities and include them as recipients of training that is conducted. These types of decisions are within the purview of the project board to make, taking into account the budget of this project and coordination with other ongoing initiatives. The following departments could be considered: i) Agricultural Extension Services; ii) Research and Technical Services; iii) Fisheries; and iv) Agricultural Planning Services.

Water Resources (Ministry of Water Development and Irrigation) and the Department of Disaster Management Affairs (Office of the President and Cabinet), in addition to being closely linked to ongoing programming in the Ministry of Agriculture and Food Security (MoAFS[24]).

2.3.1 Baseline projects and on-going initiatives

61. The LDCF project is focused on strengthening the capacity of national and sub-national entities to monitor climate change, generate reliable hydro-meteorological information (including forecasts) and combine this information with other environmental and socio-economic data to improve evidence-based decision-making for early warning and adaptation responses as well as planning. At present, however, there are many projects and programmes – both climate and non-climate related – being implemented in Malawi. Therefore, to ensure that the LDCF funds are used in a strategic manner, the LDCF project aims to build upon existing weather/climate information and EWS-related activities implemented by both government and NGOs. This includes coordinating with donor supported water resource management and meteorological services baseline projects, community-based EWS and disaster risk reduction efforts in the country and strengthening the national framework for EWS implementation. See detailed descriptions of baseline projects – including linkages with the LDCF project – in Annex 1 as well as Section 2.4. A summary of baseline projects is presented below:

- The **Enhancing Community Resilience Project (ECRP, 2011-2015) –** funded largely by the British Department for International Development (DFID) – is focusing on developing flood and drought early warning systems with a focus on mitigation and risk reduction initiatives in 11 vulnerable districts including Nsanje, Dedza, Salima, Karonga, Balaka, Chikwawa, Kasungu, Machinga, Mulanje, Mwanza, Nsanje, and Thyolo. Two NGO consortia established in 2011:i) the Concern Universal led-DISCOVER *"Developing Innovative Solutions with Communities to Overcome Vulnerability through Enhanced Resilience"* which is implementing activities in Nsanje, Dedza, Salima, Karonga and Balaka; and ii) Christian Aid-led consortium which is implementing activities in Chikwawa, Kasungu, Machinga, Mulanje, Mwanza, Nsanje, and Thyolo districts. ECRP uses the Esoko agricultural profiling and messaging service platform for disseminating weather warnings to ~ 500 farmers in these districts.
- **Programme Support to Disaster Risk Management (UNDP, PS DRM, 2012-2016, $ 1.35 million)** focuses on undertaking capacity development at a national, district and community level to reduce disaster risks and shocks to vulnerable communities. This includes providing support for multi-sector preparedness and planning and response capacity. In particular, the PS DRM aims to provide support for: i) mainstreaming disaster risk management in national development plans, policies and programmes; ii) increasing the availability of data and knowledge on the impact of natural disasters to decision makers in government, private sector, civil society, development partners and communities; and iii) establishing coordination mechanisms and implementation arrangements for disaster risk reduction at national level and in the 15 disaster-prone districts, namely Karonga, Salima, Nkhota-kota, Rumphi, Nkhata-bay, Mangochi, Dedza, Ntcheu, Balaka, Zomba, Phalombe, Machinga, Blantyre Chikwawa and Nsanje. The LDCF project is embedded in this overarching UNDP support programme.
- **Programme Support to Environment and Natural Resources (UNDP, PS ENR, 2013-2016, $1.7 million)** will provide support to the GoM for mainstreaming environment and natural resources management in policies, development plans and programmes at national level and implemented in 15 disaster prone districts; ii) increasing the availability of data and knowledge on effective management and use of environment and natural resources to decision makers in government, private sector, civil society, development partners and communities; and iii) establishing coordination mechanisms and implementation arrangements for the effective

[24] During the implementation phase, the project team (task force (consisting of desk officers from DCCMS in Blantyre, DWR and DoDMA in Lilongwe) team will be empowered to identify departments in the MOAFS that will benefit from the capacity building activities and include them as recipients of training that is conducted.

management of environment and natural resources national level and in the 15 disaster-prone districts.

- The **Department of Water Resources (DWR)** is responsible for the development and management of water resources in the country for use by all sectors. This includes management of surface water resources, groundwater, water quality, administration of the Water Resources Act, and implementing regional and international agreements and obligations on trans-boundary water courses. The DWR has an annual operation and maintenance budget of US$ 530,303.
- The **Department of Disaster Management Affairs (DoDMA)** is a Government agency which is mandated to coordinate and oversee disaster risk management programs and projects being implemented by various stakeholders in the country with the aim to build and improve resilience of households, communities and the nation to disaster risks. The Department was established in 1994 by the DPR Act (1991), which was enacted after the Phalombe floods catastrophe to coordinate and implement measures to alleviate effects of disasters. The DoDMA has an annual operation and maintenance budget of US$ 253,515.
- The **Department of Climate Change and Meteorological Services (DCCMS)** in the Ministry of Environment and Climate Change Management (MoECCM) is the entity mandated with the provision of weather and climate services. This includes monitoring, predicting and providing information on weather, climate and climate change that would contribute towards the socio-economic development of the country. The DCCMS has an annual operation and maintenance budget of US$ 171,757.

62. The LDCF project will finance the additional adaptation costs of priority actions needed to ensure that the current EWS system and use of climate information (and associated projects) can cope with future changes in the frequency and intensity of climate hazards; and hence strengthen the on-going overarching UNDP DRM programme. Table 2 below indicates each of the specific associated baseline and the indicative co-financing amounts upon which this LDCF project will build.

63. UNDP Malawi has put in place a system in the new UNDAF (2012-2016) to streamline the development of new projects and programmes for the country. This entails that all donor projects are merged into more substantive programmes covering climate change, environment and natural resources, sustainable energy and disaster risk management. Programme Support Documents (PSDs) have been developed for each of these areas and the objective is that all new projects are fully merged within these PSDs. There are four substantive Programme Support projects, namely: i) Programme Support to Climate Change (PSD CC); ii) Programme Support to Environment and Natural Resources (PSD ENR); and iii) Programme Support to Disaster Risk Reduction (PS DRM), and iv) Programme Support to Sustainable Energy aim to streamline development projects in the country. Under PSD CC the following outputs are being delivered: i) climate change mainstreamed in policies, development plans and programmes at national level and implemented in 15 disaster-prone districts; ii) data and knowledge on the impacts of climate change collected and made accessible to decision makers in Government, private sector and civil society; iii) coordination mechanisms and implementation arrangements for climate change established and used at national level and in 15 disaster-prone districts; iv) implementation modalities and financing mechanisms for National Climate Change Investment plan established and operationalized at national and district levels; and v) programme management and advisory support. This LDCF project will leverage parallel co-financing from all four UNDP support programmes (Table 2).

64. In addition to these projects, the LDCF project will link and coordinate with on-going activities under the: i) Shire River Basin Management Program Phase 1 Project (SRBMP); ii) Integrated Flood Risk Management Strategy (IFRMS); iii) National Climate Change Programme (NCCP) and Programme Support to Climate Change coordinated by the UNDP; iv) the World Bank's Weather-Based Insurance Project; v) United States Agency for International Development's (USAID) expanded vulnerability mapping project; vi) the activities of the Malawi Vulnerability Assessment

Committee (MVAC); vii) the Famine Early Warning Systems Network (FEWSNet); viii) Southern African Regional Climate Outlook Forum (SARCOF); ix) Group on Earth Observations' (GEO) AfriGEOSS initiative – and in particular African Monitoring of the Environment for Sustainable Development (AMESD) and Monitoring of Environment and Security in Africa (MESA); x) WMO's Global Framework Climate Services (GFCS) initiative; and xi) the Malawi Red Cross's EWS activities.

65. Further details on the SRBMP and IFRMS are provided below.

- The Shire River Basin Management Program Phase 1 Project (SRBMP, 2012-2018, ~$125 million) is funded by the WB, implemented by the MWDI and aims to establish coordinated inter-sectoral development planning and coordination mechanisms, undertake the most urgent water related infrastructure investments, prepare additional infrastructure investments, and develop up-scalable systems and methods to rehabilitate sub-catchments and protect existing natural forests, wetlands and biodiversity in the Shire River Basin. The project will be providing irrigation and flood management infrastructure in the Shire River basin, as well as training and infrastructure for the hydro-meteorological services – this includes the installation of considerable ground- and surface-water measuring equipment in the Shire River Basin in order to provide real-time information to a control centre within the DWR. Although first year procurement is underway, most catchment management activities as well as locations for hydromet station installation are still being planned[25].SRBMP is being implementing in 8 of Malawi's identified 15 identified disaster prone districts that fall within the Shire River Basin in the country. These include Nsjane, Chikwawa, Blantyre, Zomba, MachingaMangochi, Balaka and Ntcheu. Other districts in the Shire River Basin include Thyolo, Mwanza and Chiradzulu[26].
- The Integrated Flood Risk Management Strategy (IFRMS, 2012-2018, $3.9 million) is a component of the SRBMP and is in the early stages of implementation. It will to complement large-scale irrigation and river management infrastructural investments undertaken through the SRBMP through support for accurate and timely hydrological measurements. The main aim of IFRMS is to develop a 5-year Action Plan for strategic flood risk management of the Shire River Basin. This will provide the GoM with an Integrated Implementation Plan, based on sound and detailed diagnostics, and essential guidelines to address the flood hazard situation in the Shire River Basin in an organized manner.

Table 2: Specific Baseline Projects and indicative co-financing amounts

Funding source	US $
Co-financing sources	
DFID, Enhancing Community Resilience Programme (ECRP)	1,356,607
UNDP, Programme Support for Disaster Risk Management (PS DRM)	1,350,000
UNDP, Programme Support for Climate Change (PS CC)	1,550,000
UNDP Programme Support for Environment and Natural Resources (PS ENR)	1,700,000
UNDP Programme Support for Sustainable Energy (PS SE)	1,500,000
Government of Malawi, Department of Water Resources budget allocation	2,121,212

[25]WB March 2013. Shire River Basin Management Program (Phase-1) Project (P117617). Implementation Status and Results, Malawi

[26] Discussions with the WB during the design phase indicated that the main infrastructural inputs from the WB project were focused in the lower portion of the basin and in particular in the Nsanje and Chikwawa districts. However, other districts that have been identified for SRBMP include Zomba, Mangochi, Machinga and Blantyre. During the inception phase of LDCF project implementation, locations for the installation of AWSs will be prioritised based further input from DCCMS, civil society organisations and local communities. When implementation commences, coordination with WB financed activities should – in particular - take place in Malawi between the Implementing Partner for this project, UNDP and World Bank local offices. At that point, discussions should focus on the exact location and district for installation of observation equipment, how the Malawian system on EWS, which is being supported by UNDP and WB can be strengthened in an integrated way, including compliance with system specifications and standards.

Government of Malawi, Department of Disaster Management Affairs budget allocation	1,014,060
Government of Malawi, Department of Climate Change and Meteorological Services budget allocation	703,028
Least Developed Country Fund (LDCF) project grant requested	3,600,000
Total	**14,894,907**

66. This LDCF project will be implemented as part of a broad multi-country programme that will implement similar initiatives on climate information and Early Warning Systems in at least 10 countries in Africa (including Benin, Burkina Faso, Ethiopia, Liberia, Malawi, Sierra Leone, São Tomé & Príncipe, Tanzania, Uganda and Zambia). These individual country projects have been developed with a view to aligning regional priorities and identifying opportunities to increase efficiency and efficacy through a multi-country approach.

67. In all project countries, upgrades and rehabilitation of the hydrometeorological monitoring network will be complemented by providing local stakeholders with training and capacity-building in operation and maintenance of the improved infrastructure (Outputs 1.1 and 1.2). In addition, project countries will be provided with training and capacity-building for modelling and forecasting climate and weather, as well as generating tailored climate information packages and sector-specific Early Warnings (Outputs 1.4, 1.5, 2.1, 2.2, and 2.3). It is anticipated that there will be considerable scope for much of these training and capacity-building activities to be undertaken in coordination with other project countries, which will result in an increase in the cost-effectiveness of LDCF project investments.

68. All 10 LDCF African EWS projects will include activities, which will require considerable technical support in specialized applications related to the design and implementation of standard operating procedures and tailored warnings/advisories, and the communication of advisories/warnings (Outputs 2.2 and 2.3). The appointment of suitably qualified technical staff to provide technical support to all project countries, including Malawi, will improve the coordination and standardization of activities between all project countries. In addition all project countries will benefit from shared information, lessons learned and identified best-practices. For example, the training of junior and senior hydrologists and meteorologists to produce forecasts and develop tailored hydro-meteorological information can be undertaken through regional workshops, which will allow all project countries to share costs such as workshop facilities and accommodation, hiring technically skilled trainers and purchasing/developing appropriate training materials.

69. By strengthening ties and collaboration between regional stakeholders, the individual projects will benefit from sharing relevant data and information packages (for example, in the case of shared watersheds and river systems). Stakeholders in Malawi who will benefit from participating in regionally-aligned training and workshops will include DoDMA/OPC, MoAFS, MoLGRD, private sector, civil society, development partners and communities in EWS pilot districts. Relevant national sector policies, strategies and plans which will be strengthened through regionally-aligned workshops and training activities will include the National Disaster Risk Management Policy as well as District Development Plans in priority drought and flood prone districts. The development of standardized processes for disseminating drought, flood and severe weather early warnings through DoDMA in Output 2.1 will be enhanced by the shared knowledge, experiences and best-practices of all project countries participating in regionally-aligned activities. In the case of the Malawi LDCF project, protocols and agreements for strengthening interactions and coordination between DCCMS, DWR, DoDMA, MoAFS and related institutions will be enhanced by including the skills and experiences from neighbouring countries.

70. All of the abovementioned African climate and Early Warning Systems projects will include an output that will develop a sustainable financing strategy for ongoing operation and maintenance of the newly enhanced hydrometeorological networks, which may include leveraging financing and logistic support from private sector companies and relevant socio-economic sectors, notably aviation and telecommunications (Output 2.4). Wherever possible coordination of activities, which include public-private partnerships between various project countries, will assist participating private sector companies to engage efficiently and cost-effectively with the LDCF projects, and will simultaneously improve the negotiating position of each individual government. Further details on the cost-effectiveness benefits of this approach are provided in section 2.6.

2.3.2 National and local benefits

71. Malawi is highly dependent on the climate-sensitive sector of agriculture. Decision-making in this sector is reliant on climate information to inform long-term development plans. Monitoring of the predicted increases in temperature and rainfall vulnerability is therefore necessary to allow Malawi to effectively adapt to the impacts of climate change.

72. The LDCF project will introduce new infrastructure – including weather stations and forecasting facilities – while building upon, and being integrated into, the existing DCCMS and DWR infrastructure and capacity. LDCF project activities will complement existing meteorological, hydrological and disaster risk reduction support programmes being implemented by UNDP and WB, DFID. This will benefit national hydro-meteorological infrastructure for the effective and efficient use of information for making early warnings and long-term development plans. The LDCF project will also benefit DCCMS, DWR and DoDMA by developing human and technical capacity. This will provide a basis for understanding climate change and for enhancing the existing fragmented EWSs to build resilience to droughts and floods.

73. This climate information infrastructure and training, together with the availability of appropriate hard- and software at centralised and decentralized offices, will improve: i) the accuracy and spatial coverage of available climate information; and ii) the use of this information in providing tailored, sector-specific information to sectors and societies vulnerable to the impacts of climate change at a national level. Additionally, strengthening the current institutional framework of the DCCMS and DWR to ensure collaboration with technical departments of line ministries will result in a streamlined approach to the development of tailored information and the issuing of climate-related early warnings. At present: i) the spatial coverage of Automatic Weather Stations (AWS) is not sufficient to provide the required data to inform forecasts on the 1-7 day timescale; ii) the provision of data from the manual stations is unreliable; iii) there is a lack of skilled personnel to process the available climate data; and iv) there is limited co-ordination of climate and early-warning related activities in Malawi. The infrastructure, training and institutional co-ordination provided through the LDCF project will therefore be of great benefit at a national scale.

74. As an adaptive measure, climate information and early warnings will benefit: i) the poorer segments of society, which do not necessarily benefit from large protective infrastructure projects[27]; and ii) hydro-meteorological services and other user-agencies with regards to long-term planning and extension services.

75. Outcome 1 of the project will focus its interventions on enhancing capacity to monitor and forecast weather and climate. This will build upon flood, drought and disaster risk reduction-related baseline projects at both national and local level, namely PS DRR and ECRP. Forecasting facilities, an integrated data and information management system (IMS) and a monitoring/forecasting platform

[27]World Bank.2010.Natural hazards, Unnatural disasters: Effective prevention through an economic lens. World Bank and United Nations.231 pp.

will be established for operationalising collaboration arrangements and procedures for drought, and severe weather monitoring and forecasting between DWR and DCCMS.

76. 7 meteorological and 6 hydrological technicians, 2 communications operators and system administrators, and 25 weather and gauge readers will be trained. This will improve the monitoring and forecasting capacity within Malawi. This will be complemented by the development of an operations and maintenance (O&M) toolbox – including refresher courses – and the establishment of internal arrangements and procedures between DCCMS and DWR.

77. Outcome 2 of the project will support the timely sharing and dissemination of relevant weather and climate data and information with users at both the national and district levels. Standard Operating Procedures (SOPs) for disseminating and responding to weather and climate forecasts – including warnings for floods, droughts and severe weather – will be developed and demonstrated in the 7 priority districts of the 15 identified disaster prone districts [28] as prescribed in the UNDAF 2012-16. Weather and climate information and alerts – including drought and Mwera wind warnings – will be made accessible to decision makers in DoDMA/OPC, MoWDI, MOAFS, Ministry of Local Government and Rural Development, private sector, civil society, development partners and communities.

78. Governmental and non-governmental communication channels and procedures for issuing forecasts and warnings will be strengthened. This includes the development of SOPs, radio and SMS-based dissemination systems, and a national weather and climate information and EWS communication and coordination strategy at the national and local levels.

A business plan and model for commercial products and services will be developed. This will be informed by a comprehensive study to establish the viability of different sources of revenues – rated as mixed good/commercial as well as public good services. A sector-specific marketing strategy and programme will be developed and implemented to capitalise on potential income streams.

Local Level

79. At a local level, 10 automatic hydrological stations will be installed and 50 hydrological monitoring stations will be rehabilitated in key rivers in catchment areas of 7priority districts[29], namely Karonga, Salima, Nkhota-kota, Rumphi, Nkhata-bay, Dedza and Phalombe.

80. 25 automatic, 18 manual and 53 rainfall logging stations will be rehabilitated and20 AWSs will be installed to cover blind spots in the existing observation network in the eastern parts of Malawi, Lake Malawi and lakeshore areas, including 7 drought and flood prone priority districts, namely Karonga, Salima, Nkhota-kota, Rumphi, Nkhata-bay, Dedza and Phalombe.

81. Twelve forecasters in DCCMS (eight meteorologists) and DWR (3 hydrologists)will be trained to produce customized drought and severe weather forecasts and alerts – including advisories, watches and warnings –in 7priority districts, Mwera winds that affect fishers on Lake Malawi, and commercial products.

82. The dissemination of tailored weather and climate information – including drought and Mwera wind alerts tailored for local farmers and fishers – as well as the development of integrated cost-benefit analyses will benefit local communities in the 7 priority districts. Additionally, these districts will benefit from the mainstreaming of weather and climate information into the operationalization of national policies, annual budgets and local development plans, including the

[28]Chikhwawa, Nsanje, Phalombe, Zomba, Balaka, Mangochi, Ntcheu, Dedza, Kasungu, Lilongwe, Salima, Nkhotakota, Karonga, Nkhata bay and Machinga.

[29]Chikhwawa and Nsanje districts in the Lower Shire have been left out under this activity because this is adequately covered by the World Bank's Shire River Basin Management Project and Integrated Flood Risk Management Strategy.

National Disaster Risk Management Policy and district development plans. These districts will also benefit from the development of national standardized flood, drought and severe weather early warning processes, as well as the strengthening of communication channels and the issuing of forecasts and warnings.

83. A radio and SMS-based information dissemination system will be developed for timely early warnings in the 7 priority districts. Furthermore, the use of radio, television, print media, SMS-based partnerships, satellite phones, and cell phone call centres/hotlines – as well as local community-specific methods such as flags, drums, village chiefs, religious leaders, and school and community drama – will be promoted. The establishment of internet connections, provision of training and equipment – including High Frequency(HF) radios, two-way radios and smart phones – will add to the information dissemination system. Therefore, a range of dissemination technologies including traditional methods and community user groups (e.g. fisher groups) will be used in addition to radios and cell phones for disseminating warning. This is because not all farmers, fishers and in general not all individuals in community areas have cellphones. For example, two-way radios will be integrated into this system to assist community members, farmers and fishers with no cell phones, on a different service provider contract, or with limited electricity. This system will be coordinated by VCPCs/DCPCs at the district level in collaboration with designated community groups where present. Therefore, a focus of the activity will include developing linkages between existing community groups and VCPCs/DCPCs. Where there are no community groups the establishment of community groups, e.g. fisher groups for Mwera winds, will be undertaken to assist with the dissemination of warnings." A comprehensive review of existing early warning systems and the development of an early warning system dissemination national and local toolbox" will be used to inform the development of this system. Cell phones will be provided to community champions and these will be linked to VCPCs/DCPCs. Community champions will be responsible to further relay the information via two-way radios as well as other methods.

General local level benefits

84. At the local level, early warnings and climate information– if disseminated correctly and acted on appropriately – can provide economic benefits for example through improved crop yields and by reducing losses of agricultural produce, infrastructure (especially roads and bridges), and disruption to people's livelihoods. This has further knock-on effects on people's health and well-being, and thus positively benefits communities and social structures. Communities will immediately benefit through warnings related to agriculture, fisheries, and water and flood management. The number of beneficiaries has the potential to grow hugely if warnings extend to a reasonable percentage of the total population, e.g. through a mobile phone relay or similar system. Many of the beneficiaries will be women, especially within the agriculture sector where they often make up the majority of smallholder farmers, yet are most vulnerable to food insecurity. There may also be other benefits to developing the communication systems associated with early warnings – for instance radios can also be used for arranging medical evacuations.

85. As traditional gender roles mean that women are generally responsible for water collection and family health, women will benefit directly from improvements to water resource management. In recognition of the importance of gender, the sector has made efforts to address gender equality for several years, and gender issues are reflected in the overall strategic policy and planning frameworks. Gender-sensitive methods, including gender sensitive household surveys will ensure that women are targeted by systems established.

2.3.3 UNDP comparative advantage in Malawi

86. The LDCF project is aligned with UNDP's comparative advantage in the areas of capacity building, providing technical and policy support, as well as providing expertise in project design and implementation. Specifically, the LDCF project will build upon UNDP's comparative advantage

stemming from experience in working with governments and communities in Malawi and globally on: i) establishing and strengthening institutional, policy and legislative mechanisms; ii) building capacity; iii) undertaking risk assessments; iv) mainstreaming climate change adaptation, disaster risk reduction and early warning systems into development planning; and v) harnessing best practices and community-based approaches across different thematic areas for climate change adaptation and disaster risk reduction. This includes experience with initiatives focused on transferring knowledge and technology via South-South cooperation.

87. The **UNDP Country Office (CO) in Malawi** is well placed to oversee the implementation of the LDCF project. This is because it has built close connections with DoDMA through its support to the implementation of many disaster management and early warning projects in the country. UNDP also leads the United Nations Country Team (UNCT) Task Force on DRR to promote collaboration on DRR issues among various UN agencies in Malawi. The approach ensures synergies on disaster risk reduction issues between different agencies, and facilitates support to the national government in a coordinated manner.

88. In Malawi, UNDP has played a pivotal role among the UN agencies and other development partners in supporting the government of Malawi, through DoDMA, in mainstreaming DRR and early warning system aspects into national and local level development planning processes. This has also included institutional and policy support which has among others resulted in the development of the National Disaster Risk Management Policy for Malawi.

89. UNDP is particularly well positioned in Malawi, as a locally-based UN agency with a comparative advantage and proven track-record in capacity development and successful implementation of upstream activities. Accordingly, UNDP can provide a vital co-ordination role for catalysing enhanced capacity to adapt to climate change risks and impacts across sectors in Malawi (one of the MGDS II goals).To ensure that the necessary capacities and institutional mechanisms are achieved at both the national and district levels, UNDP will maintain its upstream focus. Furthermore, UNDP will facilitate and ensure transformational impacts at the community level.

90. UNDP –in partnership with UNICEF – has performed meaningful work in disaster risk reduction targeted at vulnerable groups, especially women and children. The UNDP's comparative advantage as a donor and UN mandate holder on DRM issues will allow it to play a crucial role in mobilising financial and technical support to the government of Malawi in the operationalization of the National DRM policy.

91. UNDP Malawi has put in place a system in the new UNDAF (2012-2016) to streamline the development of new projects and programmes for the country. This entails that all donor projects are merged into more substantive programmes in the following thematic areas: i) Climate Change; ii) Environment and Natural Resources; iii) Sustainable Energy; and iv) Disaster Risk Management. Programme Support Documents (PSDs) have been developed for each of these areas, with the aim that all new projects are fully merged within these PSDs. The PSD documents articulate linkages between different projects financed by different donors and funds. This LDCF project has been designed in a way to integrate with UNDP's Programme Support on DRM, which is providing $ 2,000,000 co-financing for the project. In this way, the activities under the LDCF project are streamlined with other donor projects in the areas of DRM, as well as climate change, natural resources and sustainable energy. A DRM advisor is also placed in DoDMA to support this structure and the underlying programmes.

92. UNDP's strategic positioning on strengthening climate information and early warning systems in Malawi is informed not only by its comparative advantage, but also by its position as a global leader on South-South cooperation. UNDP has considerable experience in managing LDCF projects in the region –in particular those relating to disaster management, early warning and climate change adaptation. UNDP has been using an approach based on the principle of optimising resources and capacities through multi-sectoral and multi-stakeholder driven partnerships in Malawi,

particularly through its DRR and management projects. The country office in Malawi is supported by Regional Technical Advisors at the UNDP offices in Pretoria, as well as by policy, adaptation, economics and climate modelling experts in New York, Cape Town and Bangkok.

2.4 Project Objective, Outcomes and Outputs/activities

93. The objective of the LDCF project is *"to strengthen the weather, climate and hydrological monitoring capabilities, early warning systems and delivery of available information for responding to extreme weather and planning adaptation to climate change in Malawi."*

This will be achieved by delivering two integrated and complementary outcomes:

1. Enhanced capacity of the Department of Climate Change and Meteorological Services (DCCMS) and Department of Water Resources (DWR) to monitor and forecast extreme weather, hydrology and climate change.
2. Efficient and effective use of hydro-meteorological and environmental information for making early warnings and long-term development plans.

The overall budget for the LDCF project is US $ 3,600,000 over four years (Table 3).

Table 3: LDCF budget by outcome.

LDCF Outcome	LDCF Funding (US$)	Indicative Co-financing (US$)
1. Enhanced capacity of the DCCMS and DWR to monitor and forecast extreme weather, hydrology and climate change.	2,446,440	3,266,021
2. Efficient and effective use of hydro-meteorological and environmental information for making early warnings and long-term development plans.	963,560	7,674,886
Project Management	190,000	354,000
Total	**3,600,000**	**11,294,907**

The baseline situation (*without the LDCF project*) and adaptation alternative (*with the LDCF project*) –including relative outputs and indicative activities – are detailed below for each outcome.

Outcome 1: Enhanced capacity of the DCCMS and DWR to monitor and forecast extreme weather, hydrology and climate change.

94. To achieve Outcome 1, a sustainable network of synoptic, agro-meteorological and hydrological observation stations will be established and strengthened under the DCCMS and DWR. Modern forecaster facilities (computers, storage and networking) will be installed to assist the DCCMS and DWR in processing and displaying meteorological and hydrological data respectively, as well as integrating and using raw data for weather and climate forecasting purposes. Technical capacity at DCCMS and DWR will be built to operate and maintain the infrastructure installed. Furthermore, institutional capacity at DCCMS and DWR will be developed to use the data collected from the modernised weather and climate observation and information management systems to issue reliable weather forecasts and alerts, in particular for floods, droughts and strong winds. This will provide a basis for understanding climate change and for enhancing the effectiveness of existing fragmented early warning systems in the country.

95. A protocol and agreement will be developed based on existing mandates, to ensure collaboration between the DCCMS and DWR for the management and operation of automatic and manual stations, data collection, data exchange, data processing, data analysis, water resource assessment and warnings, and communication mechanisms – in particular for flood, drought and severe weather risks. Furthermore, the capacity of DCCMS will be strengthened to work efficiently and effectively with DoDMA, MoWDI (in particular DWR) and MoAFS to consolidate and customise

weather and climate services for government user-agencies, private sector, civil society and development partners. Cooperation agreements with national hydro-meteorological counterparts in Mozambique will be developed to improve warnings for tropical cyclones, flooding, Mwera winds and drought. LDCF project activities under this outcome will complement existing GoM meteorological and hydrological services, as well as support programmes including PSD DRM (UNDP) and ECRP (DFID) (see further details below and relevant co-financing amounts in **Error! Reference source not found.**). This will provide a solid platform which LDCF funds can build additional adaptation benefits.

96. The overall budget for this outcome under the LDCF project is US $5,712,461. This includes US $ 2,446,440 LDCF project grant requested and US $ 3,266,021 indicative co-financing (Table 4).

Table 4. Total project value for Outcome 1

Funding source	**US $**
Co-financing sources	
Department of Water Resources	1,541,047
Department of Disaster Management Affairs	245,569
Department of Climate Change and Meteorological Services	510,746
DFID, Enhancing Community Resilience Programme (ECRP)	484,329
UNDP, Programme Support for Disaster Risk Management (PS DRM)	484,329
LDCF project grant requested	**2,446,440**
Total	**5,712,461**

Baseline situation and associated baseline projects (without LDCF project)

97. The Surface Water Division of DWR under MoWDI is responsible for collecting hydrological data (principally river gauge and lake level data) and developing and issuing flood warnings. The Hydrology section of the Surface Water Division is responsible for water resources assessments, maintaining the hydrometric network, and offering hydrological advisory services. In addition, MoWDI has responsibilities to support any necessary emergency provision of water supplies for the public affected by floods, to support the rehabilitation of or design inputs to structures damaged by floods, and indirectly to make necessary technical inputs to catchment management and long term flood mitigation efforts. The DWR collects river flow data on a daily to monthly basis through a network of 158 manual hydrometric stations (see Annex 5 and 6 for the location and operational status of existing stations)[30]. This includes five stations to monitor the levels of Lake Malawi. There are an additional six hydrological monitoring stations, which were installed in the late 1990s under the SADC Hydrological Cycle Observing System (HYCOS) Phase 1 Project, which are equipped with automatic data collection platforms. Long-term data from 144 of these gauging stations is stored in the MoWDI's HYDSTRA database. Approximately 94% requires re-coding as it was encoded in obsolete formats.

98. The Surface Water Division is structured into three regions and thirteen districts. The three regions coincide with the three main governmental regions in Malawi, namely North, Central and South. The districts are divided along hydrological and logistical boundaries and generally can include more than one governmental district. Four of the districts are run by a central district office in charge of two districts. Blantyre manages both the Blantyre and Zomba districts, while Mzuzu manages the Mzimba and Nkhata Bay districts. Each district office has a team who is responsible for the stations in their area.

[30]Atkins Report. 2012. Appendix E. Institutional Capacity Development Building

99. Surface water monitoring is done manually from these stations and the data is sent to the DWR. At key stations, observers use mobile phones, telephone and radios to transmit readings to the Chief Hydrological Officer in Lilongwe, where water exceeds threshold values. Gauge readers must therefore be "at station" close to full time before and during flood events. The observers must have a charged phone, credit and adequate phone signal for this to work. Gauge reading is hazardous, particularly when it is dark and raining, and gauge readers presently receive very little remuneration for their efforts. These factors in themselves represent a significant risk to effective flood warning[31]. Furthermore, the lack of real-time information hinders the functioning of a rapid-response flood EWS.

100. Whilst the current hydrological monitoring and predictive capacity of the country is relatively low, significant investment is being made available by the World Bank through the Shire River Basin Management Project (SRBMP) and Integrated Flood Risk Management Strategy (IFRMS), namely through i) providing flood risk assessment tools, including the development of a hydrodynamic modelling framework; ii) enhancing flood preparedness and response through development of a flood forecasting and early warning system for the Shire Basin (including 8 of Malawi's identified 15 identified disaster prone districts, namely Nsjane, Chikwawa, Blantyre, Zomba, Machinga Mangochi, Balaka and Ntcheu as well as other Shire Basin districts, Thyolo, Mwanza and Chiradzulu; iii) building capacity for flood risk management in Malawi, including institutional development and capacity building; and iv) reducing flood risk and building resilience in Malawi through structural interventions such as check dams, gabions, sand bags, catchment improvement and food and grain stores. Therefore, SRBMP and IFRMS will include central data management and hydrological capacity building at a national level as well as the installation of automated hydrological stations along key rivers in the Shire River Basin. This will include the procurement and installation of 15 new/refurbished river level gauges equipped with telemetry via Meteosat (and manual observation), 15 automatic rainfall gauges equipped with telemetry via Meteosat, and one new Meteosat ground station receiver at the DWR in Lilongwe. Furthermore, the project will upgrade the existing Meteosat ground station at the DCCMS in Blantyre, and build capacity to use and maintain the new equipment (See Annex 1 for the proposed project sites for automated river and rainfall gauge installation under the SRBMP and IFRMS).

101. The DCCMS – under the Ministry of Environment and Climate Change Management – is responsible for establishing and maintaining the weather and climate observation network in Malawi. This includes data collection, analysis and exchange, as well as the production of weather and climate information and products (including weather related warnings and forecasts), to support social and economic development. The National Meteorological Centre is responsible for issuing weather forecasts and warnings of severe weather to the general public and other specialized users.

102. The DCCMS includes four divisions which oversee and guide a number of offices, namely: i) Management and Support Division which is responsible for policy guidance on both technical and administrative matters, and oversees the Human Resource Management, Finance, and Administration offices; ii) Monitoring and Prediction System Division, which is responsible for planning and co-coordinating weather and climate monitoring and forecasting, and oversees the National Forecasting Observatory; iii) Meteorological Engineering and Communications Division responsible for Station Networks maintenance, meteorological engineering and information, and communication services; and iv) Weather, Climate and Climate Change and Research Services Division, which is responsible for planning general public and commercial weather and climate services, and oversees the Aeronautical Meteorological, Agro-meteorological, Climate services, Public Weather Services, climate change issues and research services.

103. The weather and climate observation network – managed by the DCCMS Head Quarters (HQ) through three regional centers (North, Central and South) –comprises: i) 18 full synoptic

[31]Atkins Report. 2012. Appendix E. Institutional Capacity Development Building

meteorological stations, where data is collected four times daily between 5am and 5pm provided to regional centres over the phone; ii) 4 main aviation synoptic stations which report on an hourly basis; iii) 28 AWSs, which send daily updates using the Airtel GSM network directly to DCCMS HQ; iv) 43 rainfall logging gauges, where data is collected on daily basis; v) 53 volunteer observing stations, where data is observed daily but collected on a 10 day basis as well as on a monthly basis; vi) one satellite receiving station (METEOSAT Second Generation) at DCCMS in Blantyre, which receives images every 15 minutes; and vii) two obsolete and non-functional radars at Lilongwe and Chileka Airport stations. Stations at Chileka and Lilongwe International Airports are open 24 hours daily (see Annex 4 for locations of existing stations, and Table).

104. Each regional center (North, Central and South) relays the observed data to DCCMS headquarters in Blantyre mainly via telephone and in some cases via email. DCCMS then archives the data in Excel spreadsheets[32] and relays some of the data through the WMO GMTS center in Pretoria, South Africa. Observations at 22 main synoptic stations are done by fully trained Meteorological Assistants, who initially undergo a six-month weather observations training course as well as on-the-job training and refresher courses from time to time. DCCMS has 5 technicians and engineers that maintain the various pieces of equipment in the observation network.

105. In terms of national coverage of the observation network, blind spots exist in: i) eastern Chikwawa; ii) north eastern Nsanje; iii) Makanjila, Malindi and Namwera areas as well as central parts of Mangochi; iv) western parts of Zomba; v) eastern Balaka; vi) eastern Dedza; vii) southern Salima; viii) eastern Dowa; ix) southern and northern Nkhota-kota; x) the whole of Ntchisi; xi) eastern and northern Kasungu; xii) western Mchinji; xiii) south western Lilongwe; xiv) southern and western Mzimba; xv) Livingstonia area in Rumphi; xvi) Nyika Plateau; xvii) southern Karonga; and xviii) southern and central Chitipa. In general, coverage is biased towards the west of the country, with the lakeshore and eastern parts of Malawi less well covered. There is only one AWS for Lake Malawi, situated on Likoma Island, and most of the river and large water bodies catchment areas are not adequately covered. Floods that occur in flood-prone districts, such as Karonga and Salima, originate upstream in catchment areas. Most of the catchment areas above flood prone regions are not adequately covered with automated observation stations. As a result flooding cannot be accurately forecasted in a timely manner. There is a need to increase observations in catchment areas for all major rivers in the country and on Lake Malawi – including smaller rivers that are at present not included in the observation network.

106. In addition to the poor spatial coverage, existing stations only partially function as a result of: i) vandalism; ii) limited spare parts; iii) inefficient maintenance; and iv) incorrect calibration. Furthermore, reporting of information from manual stations is frequently inaccurate or absent. This is as a result of inadequate diligence or technical capacity of personnel to collect and transmit readings via mobile phone, telephone and/or radio. Regarding AWSs and rainfall logging stations, data collection and transmission is hindered by limited airtime availability for GSM transmission and expired licenses for Timeview software, respectively.

107. Most of the existing stations under the DCCMS are in need of rehabilitation. Manual and automatic stations do not have the full complement of equipment and sensors required for efficient functioning. This includes – for manual weather stations – missing or non-functional thermometers, barometers, wind speed and direction masts, solar sensors, radiotelephones for communication, and weather fences, and – for automatic stations – missing or non-functional sensors, data loggers, GPRS modems, dry cells, computer servers and software, power supply, weather fences, solar panels, armoured cable, batteries, wind speed and direction masts. The DCCMS's radar stations at Lilongwe and Chileka are obsolete and in need of upgrades. Furthermore, there are no facilities for lightning detection, and the upper air and pilot balloon stations are non-functional.

[32]DCCMS HQ prints this out and keeps printouts for 3 months.

Table 5: Status of existing meteorological and hydrological stations under the Department of Meteorology in Malawi

Station type	Existing	Fully operational
Full synoptic stations	22 of which 4 are the main aviation stations	4
Rainfall logging gauges	43	0
Automatic Weather Stations	28	0
Volunteer observing stations	53	0
Radar	2	0
Satellite receiving stations	1	1

108. Accurate prediction of weather and climate events requires country-specific information, as well as regional data and information from other countries obtained through regional and global producing centres. Malawi is party to the Convention of the World Meteorological Organisation (WMO) to facilitate the exchange of data and information regionally and globally. However, only a small portion of the required information and data from Malawi reaches the international communications network i.e. WMO GMTS center in Pretoria. This is as a result of the obsolete and inadequate status of meteorological infrastructure in the country. Weather and climate observations from Malawi are therefore not being effectively incorporated into regional and global circulation models. This decreases the accuracy of these models for the Malawian context; and highlights the need to improve and include more station data into the WMO Global Telecommunication Systems (GTS).

109. DCCMS uses the following tools for forecasting and generating early warnings: i) surface synoptic chart analysis – hand drawn based on station observations from Malawi as well as other countries; ii) tracking severe weather systems such as heavy storms and tropical cyclone positions in collaboration with Mozambique's National Institute of Meteorology; iii) numerical weather prediction products (including European Centre for Medium-range Weather Forecasts operational and ensemble forecast models, those run by the National Oceanic and Atmospheric Administration (NOAA), United Kingdom Met Office and South African Weather Service (Portable Unified Model)); iv) MSG satellite images via EumetCast system from EUMETSAT receiving station in Blantyre[33]; v) bulletins from regional specialized meteorological centre (La Réunion, DMC); vi) statistical analyses of daily to monthly ground-based observations; and vii) flash flood guidance from the South African Weather Service.

110. DCCMS currently provides the following weather and climate information to user agencies, including the MWDI – in particular the DWR – and MoAFS as well as the public:

- daily and five day weather forecasts;
- flood information and related forecasts such as: i) seasonal, seven day and daily rainfall forecasts; ii) severe weather warnings for strong winds/storms and cyclones; iii) 50 mm rainfall threshold warnings; and iv) Mwera[34] warnings over Lake Malawi; and
- drought information and relevant forecasts such as: i) seasonal rainfall forecasts; and ii) 10-day agro-meteorological bulletins.

111. Daily weather forecasts are produced every morning at the DCCMS in Blantyre as well as at the airports in Chileka and Lilongwe. Five-day forecasts are also produced twice a week. A seasonal forecast is produced one a year in September before the rainy season starts. Generally, forecast models are statistical and produced using Excel spreadsheets by the DCCMS. These are then presented at the Southern African Regional Climate Outlook Forum (SARCOF) meeting where a consensus forecast is produced by SARCOF. The consensus forecast, once approved by the Office of the President and Cabinet, is released to the media and public. The consensus forecast has course

[33]At present, satellite imagery is not being used as effectively as it should to support daily weather forecast activities.

[34]Mwera winds are a major risk to fishing communities particularly on Lake Malawi and Lake Malombe. Therefore, there is a need to strengthen hydro-meteological services and networks to monitor and predict the occurrence of these winds. This will require a stronger link with Mozambique NMHS as well as improved coordination among DWR, DCCMS and DoDMA and effective communication strategy with the communities.

resolution and only presents total seasonal rainfall. This is not useful for stakeholders as there is high spatial climate variability across Malawi. Other information that could be of more relevance to user-agencies and end-users includes parameters such seasonal onset, seasonal length, risk of flood events or strong winds. At present DCCMS does not supply any climate change specific products - > 6 month forecasts and climate change projections. Climate change models are not used routinely to produce information for long-term development planning.

112. Medium-range weather forecasting and climate prediction tools can be applied to extend warning times and produce pre-warning information. However, the DCCMS does not have the technical capacity for conducting accurate and fine-scale short-, medium- and long-term forecasting, in particular for droughts. Furthermore, DCCMS does not undertake numerical modelling as a result of limited availability of forecasting equipment including modern meteorological facilities and human resources. At present, DCCMS's computers also have insufficient speed and memory for basic modern meteorological tasks, including satellite image and model data analysis display and presentation. Furthermore, meteorologists at the DCCMS do not have the capacity to fully utilise satellite products and images through dynamic models.

113. During flooding and severe weather events, river levels are continuously monitored and the observed data are sent – by DWR gauge readers – to the flood officer at the headquarters of the DWR in Lilongwe. Depending on the water levels and the outlook of a weather forecast of a catchment area provided by DCCMS, a flood warning will be issued by DWR. As soon as precipitation values of more than 50 mm are observed at one of the meteorological stations, a warning message is sent to the DWR, MoIWD by DCCMS. This procedure has proved to be ineffective, particularly over public holidays, weekends and during the night as a result of different working times between DCCMS and DWR. For example, in certain cases during heavy rains there are no individuals to issue flood warnings. There is a need for the roles and the responsibilities of DWR and DCCMS to be reviewed with regards to issuing flood warnings. There is also a need for DCCMS and DWR to collaborate and work together for the management and operation of automatic and manual stations, data collection, data exchange, data processing, data analysis, water resource assessment and warnings, and communication mechanisms – in particular for flood, drought and severe weather risks – as well as the WMO flash flood guidance procedures.

114. The significant shortage of weather and climate monitoring stations, forecasting facilities and skills in Malawi negatively affects the country's ability to monitor, detect and predict climate variability and climate change. A combination of limited forecasting and prediction capacity and non-operational, poorly functioning and obsolete infrastructure – as well as poor spatial station coverage of weather stations– is currently reducing the ability of the DCMMS to provide detailed and accurate weather and climate information and products to support social and economic development**.** This includes<1 day now casts and 1-10 day weather, 1-6 month seasonal and > 6 month climate forecasts and climate change projections for informing flood and drought preparedness, as well as the implementation of risk reduction and mitigation measures and long-term development planning.

115. Despite the achievements of the GoM in providing hydro-meteorological services to user-agencies and the public, infrastructure, knowledge and skills for the implementation of modern weather and climate forecasting is still required. In particular, a stable coordination mechanism between DCCMS and DWR is crucial, especially with reference to flood and drought monitoring, forecasting and early warning. The development of appropriate structures for improved data exchange between DCCMS and DWR is needed. As a condition for successful flood and drought monitoring, forecasting and early warning and climate change adaptation, it is recommended that appropriate protocols and agreements are developed to ensure collaboration between DCCMS and DWR regarding the management and operation of automatic and manual stations, data collection, data processing, data analysis and water resource assessment and warnings.

Adaptation alternative (with LDCF project)

116. The five outputs under Outcome 1 will build on the existing investments being made in the sector by GoM (baseline operations and maintenance annual activities described above), including projects supported by WB described Section 2.3 and in Annex 1.

- LDCF resources will be used to improve DCCMS and DWR's existing meteorological and hydrological observation network to ensure Malawi's monitoring of weather, climate and hydrology is able to cope with the additional impacts expected from climate change and that adaptation planning is based on reliable and extensive information. This will include installing automatic weather and hydrological stations, as well as rehabilitating existing manual and automatic weather and hydrological stations in at least 7 priority districts (disaster-prone districts), namely Karonga, Salima, Nkhota-kota, Rumphi, Nkhata-bay, Dedza and Phalombe and to cover blind spots in the existing observation network in the eastern parts of Malawi, Lake Malawi and lakeshore areas. Capacity development will be undertaken to sustain the enhanced observation network during and beyond the lifetime of the LDCF project. The outcome will enhance the coverage of spatial variability that exists to ensure that weather and climate data is collected within climate change vulnerable areas. This will assist accurate and region-specific weather, climate and hydrological modeling, as well as provide a platform for generating early warnings for drought, floods and Mwera warnings. Capacity development will be undertaken to enhance DCCMS and DWR's technical skills to monitor and forecast weather, hydrological and climate events, including floods, droughts and Mwera wind.
- The LDCF project is designed to integrate into the Programme Support that UNDP is providing to Disaster Risk Management in the country. As such, project activities will cover the 15 disaster prone districts in the country – as directed by the UNDAF. This LDCF project will enhance the efficacy of baseline projects ECRP and PS DRM under a changing climate by increasing the accuracy and area-specificity of weather and climate data recorded. Weather and climate data are needed for input into flood forecasting models for the Shire River Basin districts, as well as flood and drought forecasting and risk reduction and mitigation measures being implemented in the project districts under the ECRP and UNDP PS DRM projects. The LDCF project will be installing and rehabilitating observation stations in the same districts in which the ECRP and UNDP PS DRM projects are implementing risk reduction and mitigation measures. Weather and climate data and information collected for these priority districts will be used by the ECRP and PS DRM projects to design risk reduction and mitigation measures for flood and drought prone districts. The enhanced accuracy of weather and climate data collected, as well as the automated real-time network established, will assist in more timely and accurate flood and drought forecasting products.
- To ensure that LDCF funds will not be duplicating or overlapping with activities that are already ongoing in 8 of the 15 disaster prone districts that fall within the Shire River Basin. In terms of support for observations, this has been designed and directed based on consultations with DCCMS and DWR. In total 40 sites have been proposed by DCCMS for observation equipment installation (see page indicative activities under Output 1.2). Rehabilitation will also include areas beyond the 15 priority districts see indicative activities under 1.2. During the inception phase of LDCF project implementation, locations for the installation of AWSs will be prioritised based further input from DCCMS, civil society organisations and local communities. When implementation commences, coordination with WB financed activities should – in particular - take place in Malawi between the Implementing Partner for this project, UNDP and World Bank local offices. At that point, discussions should focus on the exact location and district for installation of observation equipment, how the Malawian system on EWS, which is being supported by UNDP and WB can be strengthened in an integrated way, including compliance with system specifications and standards. Final locations will be determined during project inception as well as during project implementation, and will take into account the concern that observation stations should not be geographically limited.

117. Additionally, LDCF Outputs will align with the SRBMP and IFRM activities at a national level as well as at the regional and local level in the Shire River Basin districts. This will include

strengthening the hydrological and meteorological observation network as well as flood, drought and Mwera wind warning in the 7 disaster prone districts not directly covered by these projects as well as filling network gaps in eastern parts of Malawi, Lake Malawi and lakeshore areas in districts not covered by the Shire River Basin. LDCF funds will be used to integrate installed AWSs and AWLSs into the water information and flood forecasting systems being developed by the SRBMP and IFRM. This will also strengthen operational agreements and protocols for effective collaboration between DCCMS and DWR as well as building on the current and planned upgrades to DCCMS and DWR's data and information systems. A forecasting/monitoring platform and database will be established to link DWR and DCCMS's official websites and information management systems to assist in the operationalization of protocols and agreements. This will integrate into the government intranet site for data sharing that is being developed under the SRBMP and IFRM. In particular Output 1.1 will align with WB SRBMP and IFRMS, including providing flow and river level measurements in rivers in the 7 districts not currently covered by SRBMP and IFRMS. At a national level, the majority of the central data management and hydrological modeling capacity building and coordination activities are being undertaken by the SRBMP.

Output 1.1: 10 Automatic Hydrological Stations (AHSs) installed in 7 disaster prone districts, namely Karonga, Salima, Nkhota-kota, Rumphi, Nkhata-bay, Dedza andPhalombe and 50 hydrological monitoring stations rehabilitated in key rivers in catchment areas – excluding the districts covered by the SRBI.

118. Activities under this output will increase the capacity of the DWR to monitor and forecast river and lake water level and flow measurements across the country. This will be achieved by installing AHSs in 7 disaster prone districts and undertaking repairs and upgrades to existing manual hydrological stations in key rivers. By increasing the availability and geographical coverage of real-time hydrological data across Malawi, the DWR will have an enhanced capacity to forecast floods and issue warnings to vulnerable groups and sectors downstream.

119. All installed hydrological monitoring stations will automatically relay data to central servers via GPRS. Systems will be established to integrate data generated by the upgraded hydrological monitoring network into the national flood warning system, including data storage, information and forecasting systems being strengthened by the SRBMP and IFRMS. The LDCF project, by increasing the observation coverage, will contribute to data input for hydrological models, and thus increase the accuracy of these models for flood forecasting developed under SRBMP and IFRMS. During the inception phase of LDCF project implementation, catchments and locations for the installation and rehabilitation of automatic and manual hydrological stations will be revised. This will be based on further input from DWR, civil society organisations and local communities in downstream areas[35].

Output 1.1 includes the following indicative activities:

1.1.1 Undertake a systematic analysis of existing automatic and manual hydrological stations to determine gaps in coverage and priority stations for data rescue and rehabilitation. This will include reviewing and revising the situation and needs assessment report conducted by Aurecon in 2011 and developing a plan to integrate new stations installed into the DWR network including stations planned under the SRBMP and IFRBM.

[35] During the inception phase of LDCF project implementation, locations for the installation of AHSs will be prioritised based further input from DWR, civil society organisations and local communities. When implementation commences, coordination with WB financed activities should – in particular - take place in Malawi between the Implementing Partner for this project, UNDP and World Bank local offices. At that point, discussions should focus on the exact location and district for installation of observation equipment, how the Malawian system on EWS, which is being supported by UNDP and WB can be strengthened in an integrated way, including compliance with system specifications and standards.

1.1.2 Procure and install 10 automated hydrological stations in 7 disaster prone districts – Karonga, Salima, Nkhota-kota, Rumphi, Nkhata-bay, Dedza andPhalombe– including solar panels, batteries, data transmission software packages and networking facilities.

1.1.3 Undertake repairs to ~50 hydrological monitoring stations.

1.1.4 Procure automatic and manual hydrological conventional instruments, spare parts and sensors.

1.1.5 Integrate new hydrological stations into the existing DWR network, including the existing national flood warning system and activities under the SRBMP and IFRM. This will include reviewing and installing appropriate telecommunication infrastructure and creating linkages with DCCMS's observation network and forecasting systems.

Output 1.2: 25 automatic, 18 manual and 53 rainfall logging stations rehabilitated and 20 Automatic Weather Stations (AWS) installed to cover blind spots in the existing observation network in the eastern parts of Malawi, Lake Malawi and lakeshore areas including drought and flood prone priority districts, namely Karonga, Salima, Nkhota-kota, Rumphi, Nkhata-bay, Dedza and Phalombe– excluding districts covered by the SRBMP and IFRM.

120. Under Output 1.2, the geographical coverage of Malawi's weather and climate observation network will be extended through the installation of 20 AWSs. These will be installed to cover blind spots in the eastern parts of Malawi, Malawi Lake and lakeshore areas including drought and flood prone priority districts (Figure 1) – excluding districts covered by the SRBMP and IFRM.

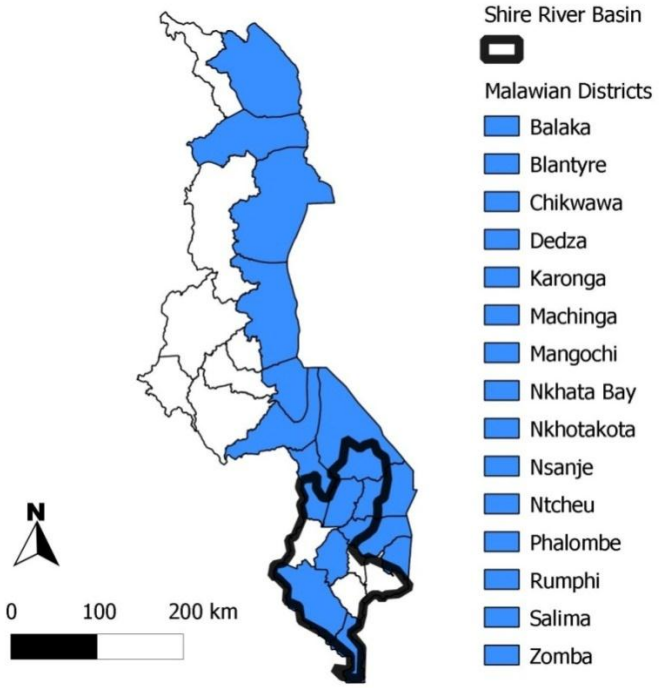

Figure 1.15 priority flood prone and drought prone districts in Malawi.

121. Specifically, locations for installation and rehabilitation will include: i) eastern Chikwawa; ii) north eastern Nsanje; iii) Makanjila, Malindi and Namwera areas as well as central parts of Mangochi; iv) western parts of Zomba; v) eastern Balaka; vi) eastern Dedza; vii) southern Salima; viii) eastern Dowa; ix) southern and northern Nkhota-kota; x) Ntchisi; xi) eastern and northern Kasungu; xii)

western Mchinji; xiii) south western Lilongwe; xiv) southern and western Mzimba; xv) Livingstonia area in Rumphi; xvi) Nyika Plateau; xvii) southern Karonga; and xviii) southern and central Chitipa[36].

122. LDCF resources will also be used to rehabilitate obsolete and poorly functioning stations. Manual observations will be continued at sites where it is not cost-effective to automate, for example at sites in remote locations and lacking communication facilities. Where manual stations are replaced with automatic stations, there will be an overlap of 36 months so that time series from different sensors can be matched. Long-term datasets to assist with weather and climate forecasting will be developed using historical observations as well as newly generated data from automated and upgraded stations. Newly installed AWSs will be equipped with GPRS mobile telecommunication facilities, which will allow for automated collection and relay of data.

Output 1.2 includes the following indicative activities:

1.2.1 Undertake a systematic analysis of existing and planned AWSs in Malawi to determine gaps in coverage and priority stations for data rescue and rehabilitation. This will include a plan to integrate new stations into the existing DCCMS network and to link these with the DWR hydrological network and forecasting information systems. This activity will be conducted in parallel with the Activity 1.1.1 above. A joint report will be generated.

1.2.2 Procure and install 20 automatic weather stations including solar panels, batteries, data transmission software packages, networking facilities and weather fences to cover blind spots in the existing observation network in the eastern parts of Malawi, Lake Malawi and lakeshore areas including drought and flood prone priority districts, namely not covered by the SRBMP and IFRM. This will include site assessments of potential sites by local staff (see Table 6 for a further breakdown of proposed locations for AWSs per district/area). During the inception phase of LDCF project implementation, locations for the installation of AWSs will be prioritised based on further input from DCCMS, civil society organisations and local communities.

Table 4: Potential areas for the 20 AWSs to be installed to work towards covering blind spots in the existing observation network including the 15 flood and drought prone priority areas highlighted in grey[37].

District/Area	No. of AWSs needed
Lake Malawi (small permanent rocks)	**2**
Nyika Plateau	**1**
Southern Region	
easternBalaka	1
easternChikwawa	1
Blantyre	1
Chiradzulu	2
Machinga	1
Mangochi (e.g.Makanjila, Malindi, Namwera)	2
Mulanje	1

[36] During the inception phase of LDCF project implementation, locations for the installation of AWSs will be prioritised based further input from DCCMS, civil society organisations and local communities. When implementation commences, coordination with WB financed activities should – in particular - take place in Malawi between the Implementing Partner for this project, UNDP and World Bank local offices. At that point, discussions should focus on the exact location and district for installation of observation equipment, how the Malawian system on EWS, which is being supported by UNDP and WB can be strengthened in an integrated way, including compliance with system specifications and standards.

[37] During the inception phase of LDCF project implementation, locations for the installation of AWSs will be prioritised based further input from DCCMS, civil society organisations and local communities. When implementation commences, coordination with WB financed activities should – in particular - take place in Malawi between the Implementing Partner for this project, UNDP and World Bank local offices. At that point, discussions should focus on the exact location and district for installation of observation equipment, how the Malawian system on EWS, which is being supported by UNDP and WB can be strengthened in an integrated way, including compliance with system specifications and standards.

Mwanza	1
Neno	1
north eastern Nsanje	1
Phalombe	1
Thyolo	1
westernZomba	1
Zomba - Lake Chilwa Basin	2
Northern Region	
southern and central Chitipa	2
Northern and southern Karonga(including southernRukulu River Basins)	2
Likoma – Chizumulu Island	1
southern and western Mzimba	2
Nkhata Bay	1
Rumphi (Livingstonia area)	1
Central Region	
easternDedza	1
easternDowa	1
eastern and northern Kasungu	2
south western Lilongwe	1
westernMchinji	1
southern and northern Nkhotakota	2
Ntcheu	1
Ntchisi	1
southernSalima	1
Total*(only 20 areas will be prioritised from these during the inception phase)*	**40**

1.2.3 Conduct upgrades – including replacing outdated sensors –to 25 existing automatic and 18 manual weather stations in Nsanje, Ngabu, Chichiri, Bvumbwe, Thyolo, Mimosa, Naminjiwa, Chileka, Makoka, Ntaja, Mangochi, Dedza, Salima, Balaka, Mwanza, Chitedze, Tembwe, Nkhotakota, Nkhata Bay, Kasungu, Mzimba, Mzuzu, Bolero, Karonga, Likoma. This will include shifting manual stations to suitable locations, replacing wind and temperature sensors, data loggers and GPRS modems for AWSs, and replacing thermometers and barometers for manual stations. In addition to this, weather fencing, power supply, solar panels and batteries will be financed where necessary to protect and ensure the adequate functioning of the stations rehabilitated.

1.2.4 Purchase and install licences and GPRS receivers for 53 existing rainfall-logging stations.

1.2.5 Procure conventional AWS instruments, spare parts and sensors.

1.2.6 Integrate AWSs into the existing DCCMS network, including reviewing and installing appropriate telecommunication infrastructure, and creating linkages with the DWR observation network and forecasting systems.

Output 1.3: Weather and climate forecasting facilities upgraded, including building on current and planned upgrades to DCCMS and DWR's data and information management systems under the SRBMP and IFRMS and operationalizing collaboration arrangements and procedures for drought and severe weather monitoring and forecasting between DWR and DCCMS.

123. LDCF resources will be used to upgrade the national DCCMS database and information management system to enable the management of current and historical weather and climate data processing and storage. A protocol and agreement between the DCCMS and DWR will be developed for data collection, data exchange, data processing, data analysis and flood, drought and severe

weather risk assessment and warnings. This will include strengthening collaborations and linkages between DCCMS and DWR with regards to the WMO's flash flood guidance procedures.

124. LDCF resources will be used to procure and install modern workstations including (software, computers, storage and networking/communication facilities) for supporting the visualization and manipulation of a range of data[38]. This will include the development of sophisticated forecasting facilities at the DCCMS in Blantyre and the Chief Hydrological office in Lilongwe to support automatic stations installed. This may include observations and station based forecasts, Numerical Weather Prediction fields, satellite data and derived synthetic products, aviation reports and forecasts, satsounding data, satwind data, automatic satellite image interpretation data, SCIT (Storm Cell Identification and Tracking) data, MOS (Model Output Statistics) data, warnings based on the monitoring conducted by regional and international centres, trajectories of cyclones and severe weather. Forecaster training under Output 1.5 will include the use of new software and modern workstations for strengthening prediction capabilities and forecasts, including editing and packaging weather and climate data into suitable formats. These facilities will be used to operationalize protocols and agreements between DCCMS and DWR as well as used to host and maintain the monitoring/forecasting platform developed. The DCCMS and DWR have indicated that these upgrades are needed to strengthen weather and climate monitoring and forecasting capabilities.

125. The installed hardware and software will provide the platform for skilled hydrologists and meteorologists to: i) visualize meteorological, environmental and oceanographic data from various sources and in various formats[39]; ii) produce standard and customized <1 day severe weather now casts, integrate 1-10 day weather forecasts, 1-6 month seasonal forecasts and >6 month climate forecasts with other relevant information e.g. current weather and climate; and iii) edit and package weather and climate data and information into a suitable format for user-agencies and end-users.

126. A monitoring/forecasting platform will be developed to facilitate the collaboration between the DWR and DCCMS and the operationalization of protocols and agreements developed with a focus on drought and severe weather. The monitoring/forecasting platform will be integrated into government intranet site for data sharing being developed under the SRBMP and IFRMS. Agreements and protocols developed will be developed based on a review of best practices of collaboration arrangements between national meteorological and hydrological systems and include the identification of key individuals, experts and desk officers in DCCMS and DWR for maintaining protocols and agreements including the monitoring/forecasting platform. The monitoring/forecasting platform will be linked to the early warning system/disaster risk management platform developed under Output 1.5. This will assist with strengthening interactions between DCCMS, DWR and DoDMA as well as related institutions including departments and structures put in place under UNDP's PS CC, DRM and ENR, in particular DoDMA and MoAFS.

Output 1.3 includes the following indicative activities:

1.3.1 Procure and install hardware and software required for modern meteorological forecasting facilities (computers, storage and networking) to support DCCMS at Blantyre and at the Chief Hydrological office in Lilongwe.

1.3.2 Upgrade and update the national DCCMS database and information management system including establishing back-up data servers, VPN and CLIMSOFT for existing and newly installed

[38] The exact needs in terms of hardware and software will be determined during the implementation phase of the project, based on which observations and data are required and available.

[39] surface observations and station based forecasts, NWP (Numerical Weather Prediction) fields, satellite data and derived synthetic products, aviation reports and forecasts, satsounding data, satwind data, automatic satellite image interpretation data, road weather observations and forecasts, MOS (Model Output Statistics) data, ocean profile data, warnings based on the monitoring of incoming data, trajectories, and geographical information (based on vector and raster data).

stations. The database should be able to handle vast amount of data from AWSs as well as rainfall loggers. This will build on upgrades planned under the SRBMP and IFRMS as well as work currently being undertaken by the UK Met office.

1.3.3 Undertake a data rescue and digitisation process from manual volunteer stations and DCCMS archives. This will enhance quality of data for weather forecast and climate change research. This will strengthen data digitisation efforts being undertaken under the SRBMP and IFRMS.

1.3.4 Develop and implement a protocol and an agreement between the DWR and DCCMS for data collection, data exchange, data processing, data analysis and flood, drought and severe weather risk assessment and warnings. This will include i) reviewing DCCMS's current data policies; ii) establishing best practices with regards to national meteorological and hydrological collaborations in other countries; and ii) identification of key individuals, experts and desk officers in DCCMS and DWR for maintaining protocols and agreements including the web platform. These individuals will work together to operationalize collaboration agreements and protocols with regards to drought and severe weather monitoring and forecasting.

1.3.5 Develop and establish a monitoring/forecasting platform and database linked to Durand DCCMS's official websites and information and management systems to assist the operationalization of Activity 1.3.4 as well as Outputs 1.4 and 1.5. This will build on the systems being planned under the SRBMP and IFRMS including the government intranet site for data sharing.

Output 1.4: Capacity developed for operating and maintaining observation networks and related infrastructure including training 7 meteorological and 6 hydrological technicians, 2 communications operators and system administrators, 25 weather observers and 25 gauge readers, raising local community awareness and developing an O&M toolbox including refresher courses.

127. Under Output 1.4, LDCF resources will be used to develop the human technical capacity as well as the internal arrangements, procedures and frameworks required to maintain and operate improved meteorological and hydrological observation networks and systems in Malawi. Capacity development support and provision of technical assistance will be planned to support the current structure and institutional framework for the DWR and DCCMS. A protocol and agreement will be developed between DWR and DCCMS for the management and operations of automatic and manual stations. An observation network operation and maintenance toolbox, including a dynamic detailed asset register for tracking spare parts and equipment procured and installed, will be developed.

128. A **'train the trainers'** approach will be used to maximize the impact of LDCF funds. Specific advanced technical training will be provided to 7meteorological and 6hydrological technicians to cover the operation and maintenance of AWSs and standard meteorological equipment installed. Agreements will be established with individuals trained to develop and conduct training courses for technicians working in the DWR and DCCMS and ensure that they remain in the relevant government departments for the minimum period after receiving the training. Training will also be provided to weather observers and gauge readers on routine servicing and maintenance of infrastructure installed, e.g. greasing anemometers and wind vanes, dusting equipment and unblocking rain gauges. The sustainability of LDCF project interventions will be strengthened through an awareness campaign undertaken by trained trainers to explain to the communities and staff manning the stations the benefits of the installed equipment and the need to prevent the equipment from being vandalized.

Output 1.4 includes the following indicative activities:

1.4.1 Develop an observation network quality control and maintenance toolbox, including remotely accessible and online refresher courses, handbooks and manuals for AWSs covering data communication skills, WMO Information Systems and the operation and maintenance of automatic

hydrological stations and manual stations. An online dynamic asset register for tracking spare parts and equipment procured and/or installed will be established.

1.4.2 Develop and implement a protocol and agreement between the DWR and DCCMS for the management and operations of automatic and manual stations, particularly where stations are in close proximity.

1.4.3 Train 7 meteorological and 6 hydrological technicians on technical aspects regarding the operation and maintenance of AWSs, standard meteorological equipment, and automatic hydrological stations. Factory and/or other training will be conducted by experts on the use of installed AWSs.

1.4.4 Conduct a refresher course on meteorological and hydrological observations for 25 weather observers and 25 gauge readers respectively– including staff at meteorological/hydrological stations and volunteer observers –on the maintenance of AWSs and rainfall logging systems and the operation of database and information management systems installed including CLIMSOFT users' training.

1.4.5 Train 1 communications operators and 1 systems administrators for operation, maintenance and repair of telecommunication equipment including Satellite Distribution System for Data Exchange (SADIS), Message Switching System Equipment for Global Telecommunications System (GTS), Internet Connectivity and factory training in WMO Information Systems (WIS). This should include training on building in-house capacity for these systems and providing support to system administrators to link and utilise Kenya Meteorological Department Processing Centre's data information and management systems.

1.4.6 Establish operation and maintenance training facilities including demonstration equipment, updating observation and recording manuals, and reference quality sensors at DCCMS in Blantyre and the Chief Hydrological office in Lilongwe.

1.4.7 Assist trained weather observers to conduct awareness raising of local communities situated close to stations installed and rehabilitated on the importance/benefits of installed equipment.

Output 1.5: Tailored drought, flood and severe weather forecasts and alerts produced – with a focus on agricultural stress and Mwera winds over Lake Malawi– by training 8 meteorological and 3 hydrological forecasters to build in-house capacity.

129. LDCF resources will be used to build human technical capacity to use the data collected from the modernized weather and climate observation and information management systems established. Data-sharing arrangements with regional hydro-meteorological service providers will be developed in order to support the improvement of regional forecast products through regional meteorological institutions.

130. Activities under this output will focus on enhancing the human resource capacity at DCCMS and DWR to make region-specific weather and climate forecasts to enable provision of accurate meteorological services to various users. This will include developing human capacity at DCCMS to utilize the hardware and software installed as part of output 1.3 i.e.: i) visualize meteorological, environmental and oceanographic data; ii) analyze and properly use satellite-based data and information; iii) produce and issue < 1 day severe weather now casts, 1-10 day weather forecasts and 1-6 months seasonal forecasts ; and iv) edit and package weather and climate data and information into a suitable format for user-agencies – including DWR and DoDMA – and local community end-users such as local farmers and fishers. This will include building capacity for generating accurate and timely forecast products including seasonal drought forecasts and drought alerts focused on assisting local community preparedness for agricultural stresses. Severe weather alerts (advisories, watches and warnings) for Mwera winds will also be developed for assisting fishers on Lake Malawi. Flood forecasting and flash flood guidance will also be developed for priority districts based on a review of

finalized SRMB and IFRMS activities during project inception. Forecasts and alerts developed will be informed by comprehensive needs assessment conducted under Outcome 2 as well as collaborative agreements and protocols developed between hydro-meteorological and disaster risk reduction institutions under Outcome 2.

131. A **'train the trainers'** approach will be used. This will include not only training forecasters in state-of-the-art and region-specific weather and climate forecasting techniques, but also in capacity building for other meteorologists and hydrologists at the DCCMS. This will include capacity building on the range of online tools and courses that are available for improving meteorological and hydrological skills. Agreements will be established with individuals trained to develop and conduct training courses for other meteorologists at the DWR and DCCMS, as well as to ensure that they remain in the relevant government departments for a minimum period after receiving the training.

Output 1.5 includes the following indicative activities:

1.5.1 Conduct training of 8 meteorological and 3 hydrological forecasters to build in-house capacity of other meteorologists (at DCCMS) and hydrologists (at DWR) for region and district-specific weather and climate forecasting including floods, droughts and severe weather. This will include training on conducting refresher courses on weather systems and their interpretation to enhance technical skills of forecasters in DCCMS and DWR i.e. using forecasting facilities installed under Output 1.3. There will be a focus on drought monitoring and forecasting for priority districts, and Mwera wind monitoring and forecasting for Malawi Lake (excluding WB financed activities in SRBMP target districts). Capacity for flood forecasting will also be developed based on a review of the finalised activities of the SRMB and IFRMS and within districts not covered by the WB financed projects.

1.5.2 Develop training packages and toolkits for assisting trained meteorologists and hydrologists to: i) build in-house forecasting capacity in the DWR and DCCMS; ii) enhance collaboration between the two departments for data collection, data exchange, data processing, data analysis and flood, drought and severe weather risk assessment and warnings; and iii) mainstream the online platform and integrated data storage and management systems developed under Output 1.3.

1.5.3 Support 2 short-term hydro-meteorological internships at Meteorological Services in Mozambique, South Africa or Kenya. A regional data sharing protocol and agreement will be developed during each of these internships to promote the exchange of information for particularly flash floods, droughts and severe weather between regional meteorological networks.

1.5.4 Field visits and stakeholder consultations undertaken to understand how users of early warning advisories and warnings use the information for managing climate and weather related risks and how their decision frameworks affect the interpretation of advisories and warnings

1.5.5 Develop tailored seasonal drought forecasts and high-resolution district level alerts (advisories, watches and warnings) focused on agricultural stresses. This will be based on surveys conducted of local community weather and climate information needs for effective drought and agriculture planning.

1.5.6 Develop and produce flood warnings for disaster prone districts not covered by SRMB and IFRMS and severe weather alerts for Mwera winds over Lake Malawi.

Outcome 2: Efficient and effective use of hydro-meteorological and environmental information for making early warnings and long-term development plans.

132. Outcome 2 will support the timely sharing and dissemination of relevant weather and climate data and information to users at both the national and district levels. SOPs for disseminating and responding to weather and climate forecasts – including warnings for floods, droughts and severe weather – will be developed and demonstrated in 7 disaster prone districts, namely Karonga, Salima, Nkhota-kota, Rumphi, Nkhata-bay, Dedza andPhalombe. The activities under this outcome will improve the resilience of local communities to climate change by enabling them to plan for, and respond to, climate change impacts. National systems will be linked to existing community-based systems and decentralised observation networks in the country.

133. LDCF project activities under this outcome will complement existing government (DCCMS, DWR, DoDMA and MoAFS) and non-governmental channels and procedures for issuing early warnings and climate information disaster risk management and community-early warning system activities under the UNDP PS DRM, PS ENR and DFID-ECRP (see further details below and co-financing amounts in Table 7).

134. The overall budget for this outcome under the LDCF project is US $ 8,638,446. This includes a US $963,560 LDCF project grant and US $ 7,674,886 indicative co-financing (Table 7).

Table 7.Total project value for Outcome 2.

Funding source	**US $**
Co-financing sources	
DFID, Enhancing Community Resilience Programme (ECRP)	513,682
UNDP, Programme Support for Disaster Risk Management (PS DRM)	736,709
UNDP, Programme Support for Climate Change (PS CC)	170,249
UNDP Programme Support for Environment and Natural Resources (PS ENR)	829,760
UNDP Programme Support for Sustainable Energy (PS SE)	823,360
Government of Malawi, Department of Water Resources budget allocation	1,501,421
Government of Malawi, Department of Disaster Management Affairs budget allocation	1,646,719
Government of Malawi, Department of Climate Change and Meteorological Services budget allocation	1,452,988
LDCF project grant requested	**963,560**
Total	**8,638,446**

Baseline situation and associated baseline projects (without LDCF project)

135. Much work is underway regarding early warning systems for flooding in Malawi. This includes the existence of a flood early warning system in the country. There are, however, no early warning systems and few initiatives focused on drought early warning systems, in particular regarding drought monitoring and forecasting.

136. The DCCMS uses a variety of communications channels to disseminate weather and climate forecasts and warnings. This includes radio, newspaper, post office mail, telephone, fax, email, internet, bulletins and newsletters. In terms of flood warning systems, a national Flood Early Warning System (FEWS) is in place for the country. Reporting and communication channels for the national FEWS follow the roles and responsibilities of institutions and stakeholders in disaster risk management as outlined in the operational guidelines for Disaster Risk Management (2011). See organogram of the National Disaster Risk Management Institutional in Figure 3.

137. In the event of a flood warning being issued, the MoWDI makes an announcement in form of a Press Release through different media channels such as radio, television and newspapers, and also sends the warning to DoDMA. A warning message is then sent from the MoWDI to both the

Technical Committee of DoDMA (DoDMA TC) and the District Commissioner in the respective district(s). The District Commissioner forwards the message to the local media (i.e. primarily radio stations) and the chairpersons of the Civil Protection Committees (CPCs) in flood-prone communities. Early warning messages are then broadcasted via radio and by the CPC members using whistles, megaphones and other locally adapted mechanisms. Before villages at risk can be evacuated by the CPCs, the local CPC chairperson has to ask the village headman for his/her permission to evacuate.

138. DoDMA, working with NGOs and District Councils, has built capacity of disaster risk management structures at community level through the CPCs so that they can effectively prepare for different types of disasters including floods. Flood Contingency Plans have been developed in some flood prone districts as a preparedness measure to facilitate effective and timely response when floods occur. Efforts are being made for the Flood Contingency Plans to also be prepared at community level so that the communities know what to do when floods occur in their areas. See Figure 3 4 below for a diagrammatic flow for the national flood early warning systems which aims to link national level reporting and warnings to community level through the district level. See Table 8 detailing the present roles of key institutions in flood warning, and preparedness. This current system is being strengthened by the SRBMP and IFRMS at a national level, and at a district and local level in the Shire River Basin. Currently there is no feedback mechanism for the DCCMS to obtain information from DWR and DoDMA on the weather and climate information and data provided. This lack of feedback mechanism is evident in the operational guidelines for Disaster Risk Management organogram and in the Malawi national Flood Early Warning System (FEWS) operation diagram (**Error! Reference source not found.** and Figure 3).

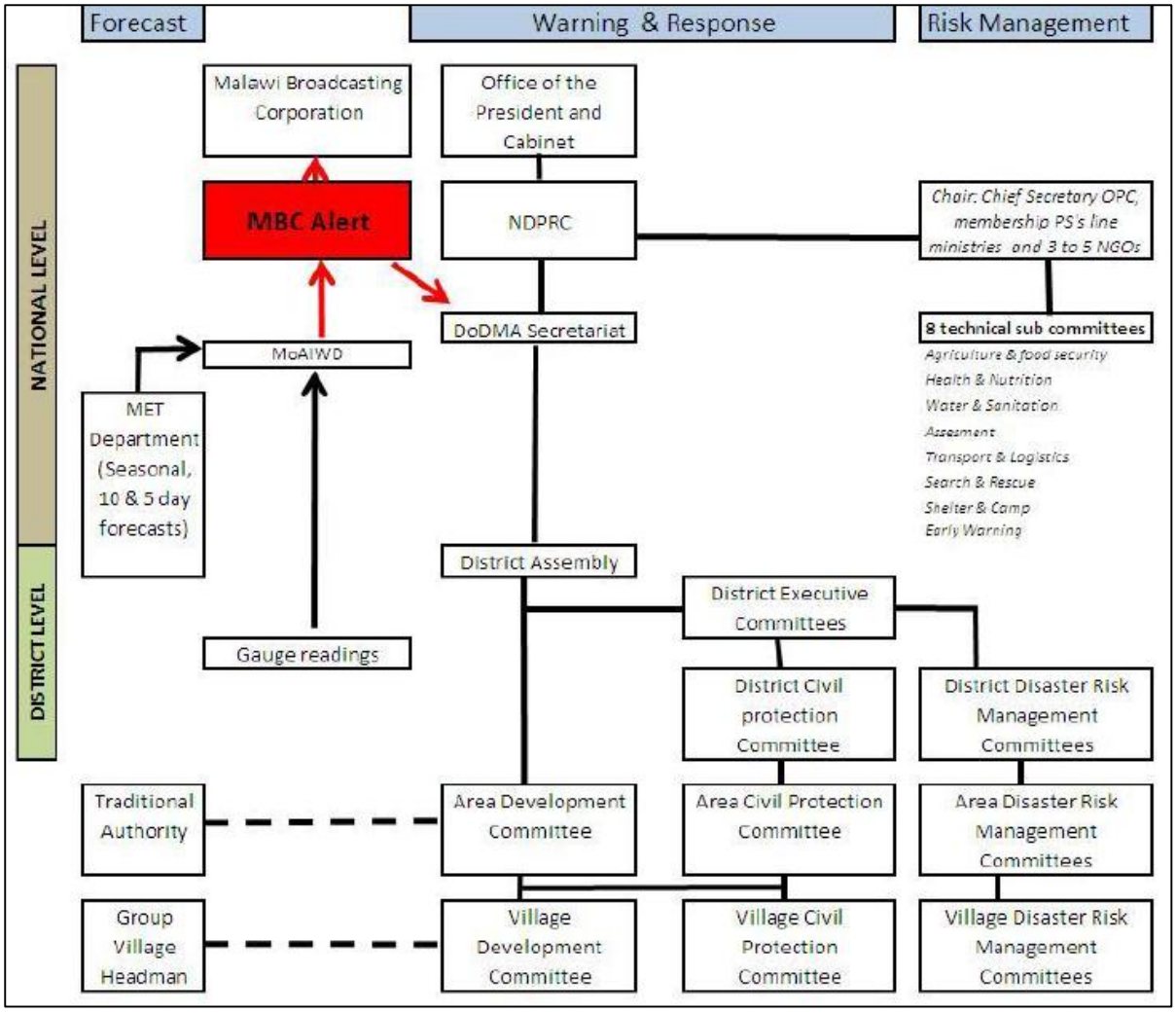

Figure 2. Roles and responsibilities of institutions and stakeholders in disaster risk management as outlined in the operational guidelines for Disaster Risk Management (2011).

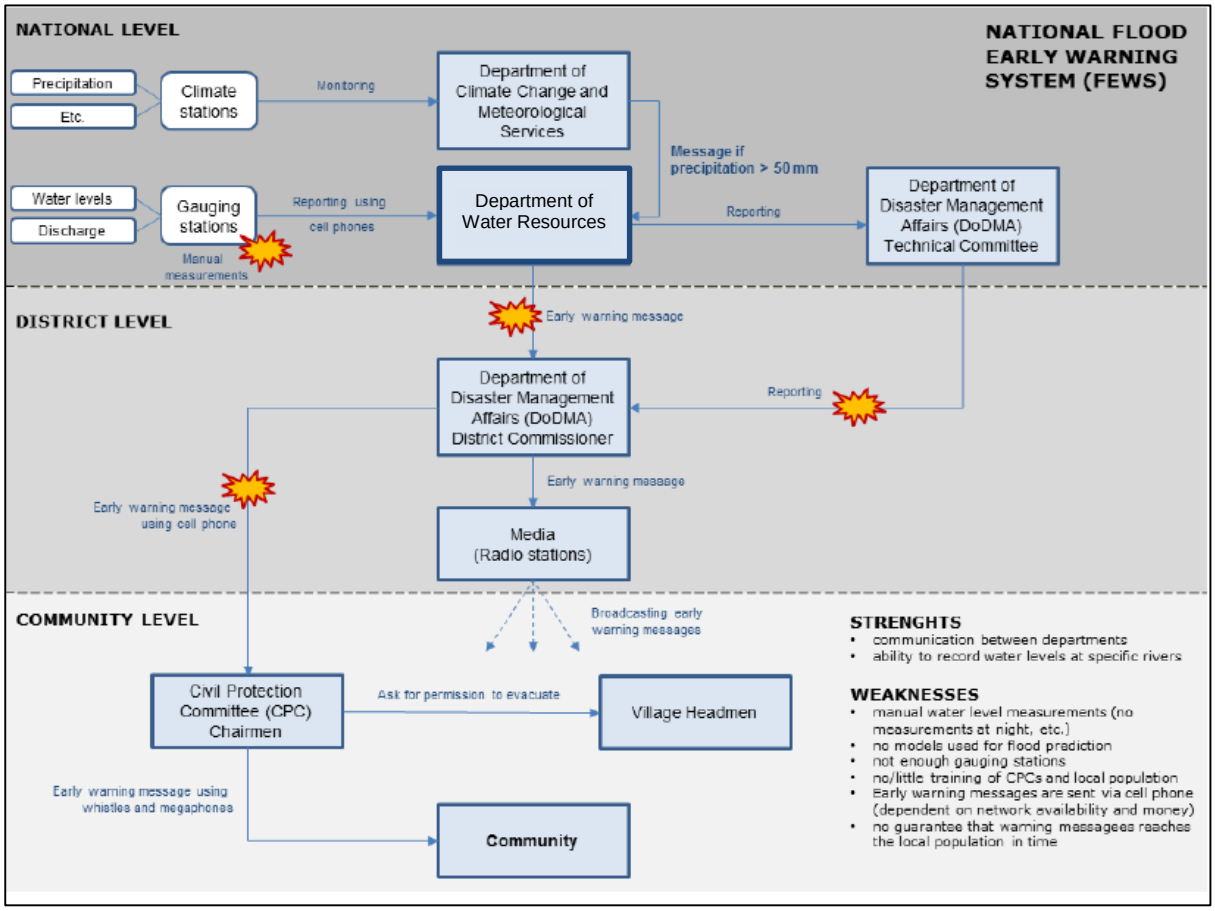

Figure 3. The Malawi national Flood Early Warning System (FEWS) which is maintained and operated jointly by the DCCMS, MoWDI and DoDMA. Red and yellow flash points represent potential faults in the system according to the interviewees[40].

Table 8. The present roles of key institutions in flood warning, and preparedness were and analysed by Atkins and are summarized in the matrix below. The whole information flow is done through the structure in Figure 3 below.

Role	The Malawi Disaster Risk Reduction Framework 2010-2011 definition	MoWDI	DCCMS	DoDMA	Districts	Communities

[40]Cooperazioneinternazionale COOPI. 2012. Consultancy to assess the current hazard mapping capacity and effectiveness of scenario based tools for long term planning mechanism.

Preparedness	The knowledge and capacities developed by governments, professional response and recovery organizations, communities and individuals to effectively anticipate, respond to, and recover from, the impacts of likely, imminent or current hazard events or conditions.	Data collection and management. Flood forecasting Develop flood warnings	Data collection and management. Weather forecasting	Lead role as defined in DoDMA Act. DoDMA should support districts to be self-reliant in a flood. DoDMA should take lead reliefDistricts cannot cope. Ensure national level agencies are prepared	Development of district contingency plans Mobilization and capacity development of communities Networking and resource mobilization	Development of village contingency plans Mobilization and capacity development of communities Participatory risk mapping and assessment Local level coordination and capacity building
Early Warning	The set of capacities needed to generate and disseminate timely and meaningful warning information to enable individuals, communities and organizations threatened by a hazard to prepare and to act appropriately and insufficient time to reduce the possibility of harm or loss.	Issue flood warnings	Short term weather forecasts and intense storm warnings	Ensure that flood warnings once issued are received by affected / responsible parties. Immediate responsibility to ensure communication of information on situation and immediate needs	Ensure flood warnings reach target communities once the national centre issues a warning	Implementation of responses to floods Community-based early warning system Capacity building

139. According to experiences of NGOs who work in some of the disaster-prone districts, communities have sometimes disregarded flood warnings because they feel they have better knowledge of the area and are aware of the shortcomings and inherent delays of the hydro-meteorological monitoring network. The most vulnerable members of the communities are children, women, those with disabilities, the chronically ill, and the elderly. It is for this reason that, during a flood event, communities evacuate children and the vulnerable first, followed by evacuation of food and later household assets. Communities that live along rivers and near confluences of the Shire and its tributaries are the most vulnerable and most need flood warnings. Most flood prone districts have contingency plans, but these lack funding. Except where NGOs are present in the area, most Village Civil Protection Committees (VCPCs) have limited capacity and do not have trained personnel within the villages who can provide support in disaster preparedness, risk reduction and mitigation measures. In some cases, these local decentralized institutions only exist on paper. Households rely on assistance from the district, which is usually too late to save any assets. Often there is a lack of practical capacity at the community level regarding appropriate responses to early warning information.

140. Even with the provision of improved weather and climate data, any early warnings and climate information packages generated will not be of value unless they are effectively disseminated

to specific end-users in priority drought and flood prone district. Currently, there are multiple ongoing decentralised and community based early warning projects being implemented in Malawi in addition to ongoing national government initiatives (see Table 9).

Table 9: Early warning projects implemented in Malawi.

Project	Activities	Districts covered
Preparedness ECHO (DIPECHO)	• community-based flood early warning systems • simple river level gauges in upstream villages read by community members	Chikhwawa Nsanje Salima
Enhancing Community Resilience Project (ECRP) – DFID	• community-based flood and drought early warning systems	Nsanje, Dedza, Salima, Karonga Balaka; Chikwawa, Kasungu, Machinga, Mulanje, Mwanza and Thyolo
Malawi Red Cross Climate Change Project – Finnish Red Cross 2012-ongoing	• mobile weather stations provided to the DCCMS for technical reports focused on area-specific farming information	Salima and Lilongwe
FEWS Net ongoing	• conducts regular field assessments of important indicators (crop growth, market prices and trade) • feeds this information and regional drought likelihood analyses tothe Ministry of Agriculture and Food Security	Regional
Malawi Vulnerability Assessment Committee ongoing (GoM and DFID)	• multilateral committee with members from government, UN, NGOs and civil society • provides early warning information with respect to the food security situation • information is used in i) the assignment of national budget to food security issues, ii) the identification of priority areas for disaster reduction and food aid dissemination, and iii) development of national policy. • makes use of indicators provided by FEWSNet.	Regional based on information provided by a range of partners including FEWSNet.
WB Integrated Flood Risk Management Strategy and Shire River Basin Management Project (IFRMS and SRBMP)	• enabling flood risk management through provision of flood risk assessment tools including the development of hydrodynamic modeling framework; • enhancing flood preparedness and response through development of a flood forecasting and early warning system including installing real-time telemetry-based observation system for Lower Shire River Basin and Ruo river flood areas; • building capacity for flood risk management including institutional development and capacity building; and • reducing flood risk and building resilience through structural interventions such as gabions, sand bags, catchment improvement and food and grain stores. • community-based flood warnings for a selection of river tributaries.	Districts in the Shire River Basin, particularly lower Shire River Basin and Ruo river
Weather Index-based Crop Insurance in Malawi – GFDRR World Bank 2013-	• agricultural early warning information for weather-based insurance • planning to install 16 AWSs	Still being determined

141. Existing projects have arisen in the last few years in response to both drought and flood crises, and are being implemented by a number of agencies. However, the role of national agencies in these projects is fairly limited at present, with the majority of them being implemented through the actions of NGOs and CSOs. There is currently little horizontal or vertical coordination between existing projects as well as national, district and community levels. For example, the USAID-funded FEWSNet maintains an existing National Food Security EWS. This system is perceived as having multiple strengths in terms of its monitoring capabilities and equipment, but it has limited and irregular feedback to the local population. The Malawi Vulnerability Assessment Committee (MVAC) currently focuses only on food security; however, significant opportunity exists to broaden its scope beyond food security. To achieve this, investment is required in coordinating and linking

ongoing initiatives and national efforts by effectively investigating the existing programmes and developing best practice guidelines and toolboxes. Current working modalities suffer from lack of staff capacity, thus resulting in limited top-down and bottom-up linkages. This can be achieved through effective participation of district assemblies in the process. Current best practices in the country need to be determined before making these links.

142. There are also many gaps in the existing early warning networks in terms of geographic coverage – strong focus on the Shire River Basin – and the hazards for which warnings are produced – in general there is a bias towards flooding with less emphasis placed on drought, agricultural stresses and severe weather such as Mwera winds over Lake Malawi. Furthermore, there are no national guidelines for the development and implementation of EWS projects, which has led to a range of different and discrete approaches and projects being implemented throughout Malawi. This diversity represents a good baseline situation for evaluation of successful approaches within the national context, as well as to work towards coordinating approaches and guiding new project development activities.

143. **UNDP's Programme Support to Disaster Risk Management (PS DRM)** focuses on undertaking capacity development at a national, district and community level to reduce disaster risks and shocks to vulnerable communities. This includes providing support for multi-sector preparedness, and planning and response capacity across 15 disaster prone districts. The PS DRM has a strong focus on establishing and using coordination mechanisms and implementation arrangements for disaster risk management are at national level and in the 15 disaster-prone districts, namely Karonga, Salima, Nkhota-kota, Rumphi, Nkhata-bay, Mangochi, Dedza, Ntcheu, Balaka, Zomba, Phalombe, Machinga, Blantyre Chikhwawa and Nsanje. The **Enhancing Community Resilience Project (ECRP)** is focusing on developing flood and drought early warning systems, specifically with regard to mitigation and risk reduction initiatives in 11 vulnerable districts including Nsanje, Dedza, Salima, Karonga, Balaka, Chikhwawa, Kasungu, Machinga, Mulanje, Mwanza, Nsanje, and Thyolo. ECRP provides weather and climate information (including 5-day forecasts and seasonal forecasts) to ~ 500 farmers using the Esoko web-based SMS-weather forecast platform. At present, there is a need to upscale these activities to include fishers and other members of the community as well as to strengthen linkages between ECRP and institutions such as DCCMS, DWR, MOAFS and DoDMA including national early warning system procedures. Although it has been highlighted that sms-based warnings are successful, there is a need to use an integrated approach when disseminating warnings to communities including integrating district governmental channels with non-government channels as well as radio and sms-based methods.

144. A present, the DCCMS is entirely funded by the Government. As a result, it suffers from operational funding shortages, which has prevented sufficient investments in improving weather and climate observation and information systems. This has in turn resulted in some sub-optimal strategic implementation practices. In the absence of other sources of funding, most of the DCCMS's funding requirements are administered by Government within the context of the performance of the economy and are therefore subject to national budgetary priorities and limitations.

145. The DCCMS uses a charging manual to determine the costs that for the provision of weather and climate data to a range of users including other government institutions. Government is considered one of the DCCMS's main customers. Specific sectors that the DCCMS aims to support include transport (mainly aviation), marine, agriculture, water resources, energy, building and construction, retail, legal, insurance, environmental, fisheries, sport and recreation, health, disaster preparedness, and banking. However, no formal business plan exists for the DCCMS and furthermore the viability of the different sources of revenues is not known. In particular, there is a need to provide clear guidance on the distinction between public, private/commercial and mixed good services which is currently not providing in the DCCMS's data policy. As a result, the question of which hydro-met services and products should be freely available and which should be charged for is a contentious 'political issue'. There is a need to explore ways of generating revenue streams from the DCCMS's services it provides.

146. Despite the achievements of the GoM and the support of the baseline and other projects additional support is required – in particular – to: i) strengthen coordination procedures and communication channels for sharing and disseminating weather and climate information to decision makers in government, private sector, civil society, development partners and local communities; and ii) enhance awareness at all levels on the impacts of climate change on socio-economic development and the importance of weather and climate information to assist local communities and sectors adapt to these impacts. A stable coordination mechanism between DCCMS, DWR and DoDMA is crucial, especially concerning flood and drought monitoring, forecasting and early warning. In general, there is a lack of coordination between these departments and ministries, and this leads to overstepping of mandates.

Adaptation alternative (with LDCF project)

147. The four outputs under Outcome 2 will build on the existing investments being made in the sector by GoM (baseline operations and maintenance annual activities described above), including projects supported by WB, DFID and UNDP described Section 2.3 and in Annex 1.

- LDCF resources will strengthen weather, climate and early warning information sharing and research among **DCCMS, DWR, DoDMA and MoAFS**. This will include increasing the availability of: i) weather and climate information and related products, including risk and vulnerability sector-specific maps; ii) tailored drought, agriculture stress and Mwera wind warnings; and iii) integrated economic evaluation of the costs and benefits of efficient and effective use of weather and climate information. This will support and guide adjustments to policies and domestic budgets.
- The LDCF project will provide the methods and tools through a comprehensive assessment of best practices to standardize the development of community and regional early warning systems, as well as to develop mechanisms to facilitate the flow of information and warnings between the central information centers (**DCCMS, DWR, DoDMA and MOAFS**) and the communities in priority disaster prone districts. A platform to store general climate and early warning system information (including information used to assess vulnerability) will be developed and be used to strengthen interactions and communication between DoDMA, DCCMS and DWR as well as other institutions. This will be linked to related databases such as **MVAC, UNFPA Vulnerability Profiling, as well as FEWSNet** agriculture and food security databases. A strong emphasis will be placed on feedback mechanisms regarding the use of warnings to inform future data production and information dissemination activities.
- Weather and climate information will be mainstreamed into national policies, annual budgets and local development plans in 7 flood and drought prone priority districts, namely Karonga, Salima, Nkhota-kota, Rumphi, Nkhata-bay, Dedza and Phalombe. The LDCF project will complement activities planned for implementation under the **PSD DRM and PSD ENR** in the at least 7 of the 15 disaster prone districts. This will include integrating accurate and timely weather and climate data and information into policy and budget revisions as well as operationalization of revised policies at a national level and development plans at a local level. Human and technical capacity of VCPCs and DCPCs will be developed for disseminating weather and climate information to local communities and assisting communities to respond in an appropriate manner.
- Fully-fledged and standardized processes for disseminating drought, flood and severe weather early warnings through **DoDMA** will be developed. Protocols and agreements developed and implemented for strengthening interactions and coordination DCCMS, DWR, DoDMA, MoAFS and related institutions for making early warnings and long-term development plans will build on existing mandates and agreements between the departments. Appropriate feedback mechanisms will be incorporated into existing operations and information exchange.
- The use of the Esokoweb-based SMS-weather forecast platform under **ECRP** has proved successful in three (Karonga, SalimaDedza) of the LDCF project's targeted 7 priority districts for ~500 farmers. The LDCF project will build on the successes of ECRP and expand these systems into Nkhota-kota RumphiNkhata-bay and Phalombe districts. A range of dissemination

technologies including traditional methods and community user groups (e.g. fisher groups) will be integrated into the system. This is because not all farmers, fishers and in general not all individuals in community areas have cell phones. The LDCF project will include developing linkages between existing community groups and VCPCs/DCPCs. Where there are no community groups the establishment of community groups, e.g. fisher groups for Mwera winds, will be undertaken to assist with the dissemination of warnings. This system will be coordinated by VCPCs/DCPCs at the district level in collaboration with designated community groups where present.

- This LDCF project will also inform risk reduction and mitigation measures as well as disaster preparedness activities being implemented in priority districts under **ECRP and PS DRM**. This will include: i) providing advanced drought warnings to enable communities to adjust their farming activities and store food in preparation for food shortages; ii) providing flood warnings to enable vulnerable communities to move their possessions, stored food and livestock to a safer location; and iii) providing Mwera wind warnings for safeguarding fishers' lives and assisting fishers to plan fishing activities accordingly.
- An improved enabling environment for development of sustainable revenue streams for DCCMS through the provision of climate services and products will be developed. This will strengthen the **DCCMS's** current data policy and developing a business model for commercial products and services.

148. Additionally, LDCF resources will complement and align with the SRBMP and IFRM activities in the 8 Shire River Basin districts by focusing activities in the additional seven identified disaster prone districts namely, Karonga, Salima, Nkhota-kota, Rumphi, Nkhata-bay, Dedza and Phalombe. These districts have been identified as extremely vulnerable to floods, droughts and Mwera wind over Lake Malawi and Lakeshore areas.

Output 2.1: Weather and climate information and alerts – including drought, flood and severe weather warnings, integrated cost-benefit analyses and hazard and vulnerability maps – made accessible to decision makers in DoDMA/OPC, MoAFS, MoLGRD, private sector, civil society, development partners and communities.

149. Under Output 2.1, a comprehensive assessment of existing government and non-governmental early warning systems and processes will be undertaken. This will be used to identify overlap, gaps and needs in existing systems, particular in information gathering and dissemination to local levels in the 7 priority disaster-prone districts. Protocols and agreements will be developed and implemented for data and information exchange among DCCMS, DWR, and DoDMA and other appropriate institutions. A platform to store general climate, early warning system and disaster risk management information (including information used to assess vulnerability) will be developed and be used to strengthen interactions and communication between DoDMA, DCCMS and DWR as well as other institutions. This will be different to the web platform developed for technical information and data exchange between DWR and DCCMS under Output 1.3 and will include information on all components of early warning systems including preparedness, response and recovery and have an emphasis on preparedness and feedback mechanisms between user agencies and the DCCMS.

150. Handbooks, manuals and policy and information briefs to highlight the value of enhanced hydro-meteorological services and early warning systems to policy and decision-makers, civil society organisations, development partners and local communities. This will include disseminating risk and vulnerability assessments for *inter alia* floods, droughts and severe weather, integrated assessments of the costs and benefits of adaptation to support policy and domestic budget adjustments, as well as the operationalization of revised national policies and local development plans in 7 priority districts.

Output 2.1 includes the following indicative activities:

2.1.1 Undertake a comprehensive review of existing national, district and local early warning systems – including existing early warning systems under NGOs as well as weather and climate information exchange mechanisms, communication channels and dissemination mechanisms between DCCMS, DWR, DoDMA, NGOs and end-users – to identify overlap, gaps and needs in existing systems, particular in information gathering and dissemination to local levels in the 7 flood and drought prone priority districts, namely Karonga, Salima, Nkhota-kota, Rumphi, Nkhata-bay, Dedza and Phalombe. This review will include all on-going EWS projects in Malawi.

2.1.2 Develop and implement protocols and agreements for information exchange and dissemination among DCCMS, DWR, DoDMA and related institutions.

2.1.3 Develop and promote a climate and early warning system platform and database (including procuring and installing the relevant hardware and software, and building the capacity of individuals to operate and maintain the online platform) maintained jointly by DoDMA, DCCMS and DWR. The most appropriate department for hosting this platform will be determined during project implementation and will be based on results of activity 2.1.2. The platform will store general climate and early warning system information (including information used to assess vulnerability) and will be used to strengthen interactions and communications between DoDMA, DCCMS and DWR as well as other institutions. Specifically the platform will: i) be used to share and combine information on climate hazards, exposure and vulnerability with decision makers in MoWDI, MoAFS, MECCM, OPM, and other ministries as necessary e.g. MoH as well as the private sector, civil society, development partners and local communities (with internet connection); ii) provide a medium for the DCCMS to obtain feedback from user-agencies such as DoDMA, MOAFS, and Department of Surveys as to how the data and information was used; iii) provide a platform to combine data and information on past and future hazards with exposure and vulnerability, including early warning system information on preparedness, recovery and response actions to the private sector, civil society, development partners and local communities (with internet connection); and iv) provide an online 'clearing house' for all early warning system information including information on current, planned and ongoing EWS projects in the country, the roles of VCPCs/DCPCs and best practises regarding weather and climate information and warning dissemination, preparedness, response and recovery. This will be linked to related databases such as MVAC, UNFPA Vulnerability Profiling, as well as FEWSNet agriculture and food security databases. A strong emphasis will be placed on feedback mechanisms regarding the use of warnings to inform future data production and information dissemination activities.

2.1.4 Train 2 surveyors from the Department of Surveys, 3 hazard and vulnerability mapping personnel from DoDMA, DCCMS and DWR, and 1 meteorologists from DCCMS for producing hazard and vulnerability maps in a collaborative and integrative manner covering 7 priority disaster prone districts, Karonga, Salima, Nkhota-kota, Rumphi, Nkhata-bay, Dedza and Phalombe.

2.1.5 Household surveys of targeted users of climate information conducted to understand the social and economic costs and benefits of using advisories and warnings to mitigate risks associated with agriculture and water management

2.1.6 Develop handbooks, manuals and policy and information briefs to highlight the value of enhanced hydro-meteorological services and early warning systems to policy and decision-makers, civil society organisations, development partners and local communities.

Output 2.2: Weather and climate information mainstreamed into the operationalization of relevant national sector policies, annual budgets and local development plans including the National Disaster Risk Management Policy and District Development Plans in priority drought and flood prone districts – excluding districts covered by SRBMP and IFRM.

151. LDCF resources will be used to mainstream weather and climate information, and early warning systems into sector specific policies, investment plans and annual budgets and 7 district

development plans, Karonga, Salima, Nkhota-kota, Rumphi, Nkhata-bay, Dedza and Phalombe. Revisions of the policies and plans will be disseminated to hazard-prone districts through workshops and provision of conditions for the district's officers to translate polices further downstream. Guidelines will be developed and capacity building undertaken of DCCMS, DWRM and DoDMA to facilitate inter-sectoral sharing of weather and climate information related to disaster risk management including integrated economic evaluation assessments, sectoral risk and vulnerability maps and alerts, advisories, watches and warnings.

Output 2.2 includes the following indicative activities:

2.2.1 Build the capacity of DCCMS, DWRM and DoDMA to facilitate inter-sectoral sharing of weather and climate information related to disaster risk management including integrated economic evaluation assessments, sectoral risk and vulnerability maps and alerts, advisories, watches and warnings. This will include conducting workshops to promote the online platform developed above. A strong emphasis will be placed on feedback mechanisms regarding the use of weather and climate information to inform future data and information dissemination.

2.2.2 Integrate weather and climate information into the finalization and operationalization of the National Disaster Risk Reduction Management Policy and other relevant policies – especially climate change, fisheries and energy.

2.2.3 Integrate weather and climate information into 7 district development plans for priority districts, namely Karonga, Salima, Nkhota-kota, Rumphi, Nkhata-bay, Dedza and Phalombe. This will be informed by Activity 2.1.1 and 2.2.2 and include a review of current district development plans to identify gaps and needs as well as the development of guidelines for integrating weather and climate information into district development plans.

2.2.4 Operationalize revised policies and district development plans at national and local levels in 7 disaster prone districts. These will be disseminated down to VCPCs and DCPCs and communities through training, workshops and meetings. Conditions for the district offices to further translate policies and workplans downstream will be created.

Output 2.3: Governmental and non-governmental communication channels and procedures for issuing forecasts and warnings are reviewed and strengthened– including standardising SOPs, alert dissemination systems using a range of successful dissemination approaches and developing a national weather and climate information and early warning system communication and coordination strategy– at a national and local level in7 priority districts.

152. Under Output 2.3, SOPs for disseminating weather and climate information in particular drought and severe weather (e.g. Mwera wind) warnings across all levels will be strengthened. This will be complemented by an EWS dissemination toolbox, which will include a trainer manual on the use of a range of national and local media for disseminating weather and climate information alerts to end-users. This will include the production of leaflets and pamphlets on meteorological terms, definitions and meanings in English and local languages. DoDMA, including VCPCs and DCPCs, will be facilitated and equipped in the 7 priority districts to support SOPs and implement successful approaches for disseminating warnings. Capacity of VCPCs and DCPCs will be developed to engage and train communities to respond effectively to weather and climate warnings.

153. This will include the development of a two-way radio and SMS-based warning system for flood, drought and severe weather (in particular, Mwera winds over Lake Malawi), which will be linked to existing early warning systems under the ECRP, SRBMP and IFRMS. The two-way system will provide: i) alerts to local communities at risk; and ii) a communication channel to disseminate feedback on the usefulness and impact of the alert received as well as the current status of the particular weather or climate extreme being experienced. This will be channeled through existing

early warning systems described in the baseline situation above, particularly ECRP, SRBMP and IFRMS. Guidelines will be developed and capacity building undertaken for VCPCs and DCPCs in 7 priority districts for disseminating weather and climate information. A national weather and climate information and early warning system communication and coordination strategy will be developed to coordinate decision makers in government, private sector, civil society and development partners in the communication of weather and climate alerts to local communities.

Output 2.3 includes the following indicative activities:

2.3.1. Develop a national weather and climate information and early warning system communication and coordination strategy to standardise processes and interaction at a national level.

2.3.2 Standardise SOPs for disseminating weather and climate information including alerts across all levels, e.g. community-level, local-level, state/province-level and national level.

2.3.3 Develop an early warning system dissemination national and local toolbox including a trainer manual on the use of radio, television, print media, SMS-based partnerships, satellite phones, and cell phone call centres/hotlines, including local community-specific methods such as flags, drums, village chiefs, religious leaders, community groups and school and community drama. Successful approaches will be promoted at a national and local level in the 7 priority districts. This will be based on lessons learned from a number of on-going baseline projects in the country (see Annex 2 for examples of good practise regarding disseminating warnings highlighted through the DIPECHO project). This will include the production of leaflets and pamphlets on meteorological terms, definitions and meanings in English and local languages.

2.3.4 Equip and facilitate DoDMA, VCPCs and DCPCs to support the dissemination of weather and climate information and warnings in 7 priority districts, including establishing internet connections, providing training and equipment such as including HF radios, two-way radios and cell phones.

2.3.5 Development of an alert dissemination system for time sensitive (flood, drought and mwera wind) warnings by building on existing dissemination measures and linking with local early warning systems in 7 priority districts. Specifically, this activity will build on the Esoko agricultural profiling and messaging service platform used by the ECRP baseline project. Furthermore, the importance of cooperative responsibility of relevant service providers will be promoted. A range of dissemination technologies including traditional methods and community user groups (e.g. fisher groups) will be used in addition to radios and cell phones for disseminating warning. This is because not all farmers, fishers and in general not all individuals in community areas have mobile phones. For example, two-way radios will be integrated into this system to assist community members, farmers and fishers with no cell phones, on a different service provider contract, or with limited electricity. This system will be coordinated by VCPCs/DCPCs at the district level in collaboration with designated community groups where present (see Activity 2.3.4 above). Therefore, a focus of the activity will include developing linkages between existing community groups and VCPCs/DCPCs. Where there are no community groups the establishment of community groups, e.g. fisher groups for Mwera winds, will be undertaken to assist with the dissemination of warnings." Activity **2.1.1** "comprehensive review of existing early warning systems" and **2.3.3** "development of an early warning system dissemination national and local toolbox" will be used to inform the development of this system. Cell phones will be provided to community champions and these will be linked to VCPCs/DCPCs. Community champions will be responsible to further relay the information via two-way radios as well as other methods identified in Activity 2.1.1.

Output 2.4 Improved enabling environment for development of sustainable revenue streams for DCCMS through the provision of climate services and products.

154. The improvement of forecasting and other services and products provided by DCCMS in conjunction with the growth of elements of Malawi's economy and private sector, could position

DCCMS to accrue higher revenue streams from the private sector as well as government disbursements. Output 2.5 focuses on developing a business plan and model for commercial products and services. This will be informed by a comprehensive study to establish the viability of different sources of revenues – rated as mixed good/commercial as well as public good services. This study will include a market analysis of the need for improved forecasting and other services and products by the private sector and government institutions – and the fees/reimbursements these entities are willing to pay. Activities will need active engagement with customers to determine user-specific needs in terms of product/service, frequency of update and form of delivery. A sector-specific marketing strategy and programme will be developed and implemented to capitalise on potential income streams.

Output 2.4 includes the following indicative activities:

2.4.1 Review, proposed revisions and update the DCCMS data policy.

2.4.2 Evaluate the costs and benefits of accurate, timely and accessible weather and climate forecasts (including tailored flood, drought and Mwera wind forecasts and alerts).

2.4.3 Evaluate market potential for weather and climate products in Malawi (weather insurance, warnings for hydroelectric producers, agricultural warnings, flood warnings) and develop a commercial strategy.

2.4.4 Based on the above activities develop 1-3 weather and climate products with commercial potential.

2.5 Key indicators, risks and assumptions

Indicators

155. The indicators are designed to measure change in the coverage, impact, sustainability and replicability of the LDCF project. These indicators track progress in achieving project objectives and outcomes. The baseline, target, source of verification, risks and assumptions per indicator are detailed in the Project Results Framework (see Section 3). Baseline values and targets per indicator will be verified within the first six months of project implementation.

At the level of the project objective and the two project outcomes, indicators are:

Objective: To strengthen the weather, climate and hydrological monitoring capabilities, early warning systems and available information for responding to climate shocks and planning adaptation to climate change in Malawi.

Indicators:
1. Capacity as per capacity assessment scorecard (Annex 12).
2. Domestic finance committed to DoDMA, DCCMS and DWR to monitor and forecast weather, climate and hydrological variability and change.

Outcome 1: Enhanced capacity of the DCCMS and DWR to monitor and forecast extreme weather and climate change.

Indicators:
1. Percentage of national coverage of climate monitoring network (fully operational).
2. Frequency and timeliness of climate-related data availability.

Outcome 2: Efficient and effective use of hydro-meteorological and environmental information for early warnings and long-term development plans**.**

Indicators:

1. %of population with access to improved climate information and flood, drought and Mwera wind warnings (disaggregated by gender).
2. Policies, annual budgets and development plans that integrate climate information (type and level of development plans).

Risks, mitigation/reduction measures and assumptions

156. Risks, mitigation/reduction measures and assumptions to the LDCF project are summarised below, and assigned to indicators in the Project Results Framework (see Section 3). The risks are further detailed in the Risk Log in Annex 8.

#	Risk	Mitigation/reduction measure	Assumption
1	Delayed implementation of baseline projects by the government and donors negatively affects LDCF project outcomes.	Continuous lobbying and sensitization of the policy makers based on evidence from the pilot sites to secure cooperation and commitment.	Baseline projects are implemented according to the timeline identified in the design phase of the LDCF project, and achieve the desired outcomes and objectives.
2	Installed hydro-meteorological equipment fails because it is vandalised or not maintained.	Awareness raising activities will be undertaken in target communities to highlight the importance of the installed equipment. In addition, the equipment will be housed within a secure fence.	Communities living in proximity to installed hydro-meteorological equipment commit to taking active measures to prevent the equipment from being vandalised; and the equipment is adequately maintained by the responsible institution.
3	Climate shocks occurring during the design and implementation phase of the LDCF project result in disruptions to installed equipment and severely affect communities, prior to the EWSs being established.	Disaster mitigation and response activities will be prioritized at the target communities whilst the EWS is being established.	Any climate shocks occurring whilst the EWSs are being established will not be so severe as to result in a relocation of the communities where the effectiveness of the EWSs will be tested, or to irreparably damage hydro-meteorological equipment.
4	Local information technology and telecommunications infrastructure restricts the transfer of data from installed equipment to necessary recipients, and restricts communication amongst key role players and end-users.	The LDCF project has been designed in accordance with local conditions, taking, where applicable, the latest available international technology into account.	Information technologies and telecommunications systems implemented or used through the LDCF project are best suited to the local context and do not restrict the transfer and communication of information.
5	Procurement and installation of hydro-meteorological equipment, including hardware and software, is delayed because of complications with the release of funds and/or national procurement procedures.	Effective administrative planning will be undertaken, with support from UNDP CO, which will include procuring equipment at an early stage in the project implementation phase.	UNDP CO and HQ will co-ordinate with the IP to ensure effective administrative planning and the timely procurement and installation of equipment.
6	Lack of commitment from communities where EWS	The LDCF project will avoid a 'top down' approach and seek to create	Awareness-raising activities and the demonstration of the advantages of

#	Risk	Mitigation/reduction measure	Assumption
	are established undermines the effectiveness of the LDCF project demonstrations.	community ownership of the EWSs through community training and encouraging participation in project activities.	responding to the information provided through the established EWS will ensure the commitment of the communities participating in the LDCF project.
7	Alerts and warnings required by communities are not feasible to produce due to scientific or technological failure.	The LDCF project will ensure that the training provided is based on the most up to date scientific and technical advances in the fields of hydrology and meteorology. A regional team of experts will be available on a full-time basis to provide support to work towards ensuring state-of-the-art technology and scientific methodology – suitable to the local context – is used.	The most up to date technology and scientific approaches and advances are feasible and appropriate for meeting the LDCF project needs. The level of error for forecasting is within the minimum thresholds appropriate for the LDCF project activities.

2.6 Cost-effectiveness

157. Quantifying the cost effectiveness of improved climate information and early warning system investments is acknowledged to be difficult, and is therefore not regularly undertaken[41]. Cost-benefit analyses of investments in improved climate monitoring and effective early warning systems are scarce. However, evidence suggests that investment in prevention is more cost-effective than spending on relief[42]. In developed countries in general, the benefits of improved weather services to inform severe weather warnings exceed costs by an average of more than 10 times (taken from Tsirkunov and Rogers, 2010)[43]. There is potential for similar cost-benefits to be realised through investing in improved climate monitoring and early warnings systems in developing countries. These benefits are expected to be proportional to: i) the population of the country; ii) level of climate-related risk; and iii) exposure to weather due to the state of infrastructure.

158. The total benefits are estimated to be between US$ 4 and US$ 36 billion per year. The cost of improving hydro-meteorological services and producing the required warnings is estimated to be lower than US$ 1 billion. The benefit-cost ratio is thus, on average for developing countries, between 4 and 36. The objective of the LDCF project is to strengthen climate monitoring capabilities through the installation of weather monitoring equipment to inform early warning systems, and for planning for adaptation to climate change. Various approaches could be adopted to achieve this objective. The proposed outputs and procurement purchases of the LDCF project were assessed, in collaboration with government stakeholders, for cost-effectiveness and sustainability of investments (based on available government support) and weighed against alternative approaches. In some instances, investments in technologically advanced equipment and techniques e.g. repairing and installing radar technologies, were considered too expensive to be implemented through the LDCF project.

The approach taken to ensure cost-effectiveness of the LDCF project's outcomes is detailed further below and in Table 8

[41]Tsirkunov, V. and Rogers, D. 2010.Costs and benefits of early warning systems. Global Assessment report on Disaster Risk Reduction. The World Bank.

[42]Healy, A. and Malhotra, N. 2009.Myopic Voters and Natural Disaster Policy. *The American Political Science Review* 103(3): 387-406.

[43]Tsirkunov, V. and Rogers, D. 2010.Costs and benefits of early warning systems. Global Assessment report on Disaster Risk Reduction. The World Bank.

Outcome 1. Enhanced capacity of the Department of Climate Change and Meteorological Services (DCCMS) and Department of Water Resources (DWR) to monitor and forecast extreme weather, hydrology and climate change.

159. LDCF project activities will build on existing networks, achievements and planned actions by DCCMS, DWR and DoDMA. This will allow institutional capacity to be built cost-effectively, ultimately assisting in planning and implementing the early warning system. This approach of complementing existing, related projects is more cost-effective than the implementation of a separate initiative, as it will allow the LDCF project to be managed within the existing institutional and management frameworks. Additionally this approach builds local capacity and maximizes the baseline EWS on which future investments can build. The LDCF project will also work closely with existing DCCMS, DWR and DoDMA projects to co-produce outputs. This will promote cost-sharing with these other projects, reducing overheads and enhancing cost-effectiveness. The LDCF project will also develop sustainable financing mechanisms to support the operation and maintenance of the improved hydro-meteorological network. In particular, there is potential for improved early warning services and tailored forecasts to generate revenue from the aviation and commercial agriculture sectors.

160. Equipment purchases and repairs to existing infrastructure were evaluated for cost-effectiveness. In order to maximise the geographic coverage of the hydro-meteorological network, a large proportion of existing infrastructure will be rehabilitated in addition to the procurement of new AWSs. Stakeholders within the DWR and DCCMS were consulted extensively on the likely extent of training that would be required for personnel to operate various equipment types in order to ensure that training as well as procurement was included in cost-effectiveness considerations.

Outcome 2. Efficient and effective use of hydro-meteorological and environmental information for making early warnings and long-term development plans.

161. Lessons learned from on-the-ground climate monitoring and early warning interventions will be captured and disseminated through inter alia: i) in-house training for meteorologists; ii) internships in national meteorological hydrological services; iii) monitoring/forecasting and general climate/early warning information platforms and databases; and iv) a toolbox that will include courses, handbooks and manuals. This integrated approach provides a cost-effective manner of informing and increasing the capacity of an extensive range of stakeholders, which include government technical staff, policy-makers, restoration practitioners, scientists, university students, school children and the general public.

162. This LDCF project is not a standalone project; it is part of a wider multi-country programme that will implement similar initiatives on climate information and Early Warning Systems in at least 10 countries in Africa (including Benin, Burkina Faso, Ethiopia, Liberia, Malawi, Sierra Leone, São Tomé & Príncipe, Tanzania, Uganda and Zambia). Synergies between these projects will be used to enhance the cost-effective hiring of specialized technical staff, coordination of data and information (including inter-country sharing where feasible), training (operations & maintenance of equipment; forecasting techniques; tailored advisories and warnings), and effective use of communications and standard operating procedures.

163. Surveying the technical support needs for each country a set of common specialized technical staff were identified, each with particular skills related to the development of hydroclimatic observing systems, the effective design and implementation of standard operating procedures and tailored warnings/advisories, as well as the communication of advisories/warnings. Hiring 3-4 full-time technical staff, which can provide the needed support for all countries, will be more cost effective than hiring the same staff as consultants for each country and all projects will benefit from the diverse technical support that will be provided. Further benefits include time saved on HR procurement procedures (e.g. for hiring, advertising etc.) and the ability to compare and standardize support across

countries where possible. UNDP will directly undertake the recruitment for all project staff who will support all countries in this multi-country programme.

164. A common priority identified in all project countries was the need to provide training and capacity building for operation and maintenance of the newly enhanced hydromet infrastructure and for modeling and forecasting (Outputs 1.1, 1.2 and 1.4). These training and capacity-building activities will be undertaken at a regional level. This approach of enhancing skills in all project countries simultaneously has several benefits in addition to enhancing cost-effectiveness. Bringing stakeholders from all project countries together will: i) encourage knowledge sharing and the development of collective skills; ii) promote the sharing of information and learning between countries, best practices and lessons learned etc.; and iii) increase the effective pool of skilled resources which each country can draw upon (increasing the potential for future trainings to be conducted by experts within the region). Regional training and capacity-building activities will be closely coordinated with other regional and international partners/centres e.g. WMO/GFCS, ACMAD, and ICPAC etc.

A multi-country approach will also help strengthen the development of standard operating procedures (both the procedures themselves and their legal basis), for the development, issuing and communication of warnings/advisories (Outputs 2.1, 2.2 and 2.3). This will allow all project countries to benefit from shared information, lessons learned and best-practices. For example, the training of junior and senior hydrologists and meteorologists to produce forecasts and develop tailored hydro-meteorological information can be undertaken through regional workshops, which will allow all project countries to share costs such as workshop facilities and accommodation, hiring technically skilled trainers and purchasing/developing appropriate training materials (for example, the provision of training in hazard and vulnerability mapping to staff members of the Department of Surveys, DoDMA, DCCMS, DWR and DCCMS).

165. By strengthening ties and collaboration between regional stakeholders, the individual projects will benefit from sharing relevant data and information packages (for example, in the case of shared watersheds and river systems). Stakeholders in Malawi who will benefit from participating in regionally-aligned training and workshops will include DoDMA/OPC, MoAFS, MoLGRD, private sector, civil society, development partners and communities in EWS pilot districts. Relevant national sector policies, strategies and plans which will be strengthened through regionally-aligned workshops and training activities will include the National Disaster Risk Management Policy as well as District Development Plans in priority drought and flood prone districts. The development of standardized processes for disseminating drought, flood and severe weather early warnings through DoDMA in Output 2.1 will be enhanced by the shared knowledge, experiences and best-practices of all project countries participating in regionally-aligned activities. In the case of this LDCF project, protocols and agreements for strengthening interactions and coordination between DCCMS, DWR, DoDMA, MoAFS and related institutions will be enhanced by including experiences from neighbouring countries.

166. All projects under this programme will develop a sustainable financing strategy for ongoing operation and maintenance of the newly enhanced hydrometeorological networks, which may include leveraging financing and logistic support from private sector companies and relevant sectors. In the instance of Malawi, specific sectors that the DCCMS aims to support and which could represent potential sources of revenue include transport (mainly aviation), agriculture, water resources, energy, building and construction, retail, legal, insurance, environmental, fisheries, sport and recreation, health, disaster preparedness, and banking. Where private sector engagement (Output 2.4) includes multi-national corporations, regional support will assist engaging head offices in multiple countries, increasing the total effective services being offered and hence bargaining position of each government. In the case of mobile (cellular) communications (which may be used for both disseminating alerts and the collection of data used to generate alerts), the regional support

programme will leverage collective negotiations for data services, as well as engaging with corporate social responsibility programmes to enhance services where possible.

167. A baseline self-capacity assessment was conducted during the project preparation phase in order to guide the identification and prioritisation of stakeholder needs. Equipment and capacity-building investments were selected based on identified priorities as well as the available budget and focal areas of the LDCF project. Proposed outputs and procurements were reviewed in a representative validation workshop and revised to reflect considerations of sustainability and cost-effectiveness. Proposed outputs are considered cost-effective relative to the alternative approaches considered to address project barriers, as shown in Table 8 below.
168.

Table 10. Alternatives considered for the project.

Output	Barrier Addressed	Alternatives Considered
Output 1.1 10 Automatic Hydrological Stations (AHSs) installed in 7 disaster prone districts, namely Karonga, Salima, Nkhota-kota, Rumphi, Nkhata-bay, Dedza and Phalombe and 50 hydrological monitoring stations rehabilitated in key rivers in catchment areas – excluding the districts covered by the SRBI.	Limited financial resources available for hydro-meteorological services and disaster risk management, which has resulted in obsolete and inadequate weather and climate observation network and reduced capacity of DCCMS, DoDMA and DWR to fulfil their core mandates.	**Alternative 1:** Expansion of the hydrological monitoring network through procurement of new Automatic and Manual Stations. However, the costs and technical challenges of maintaining a dramatically expanded automated monitoring system is unlikely to be sustainable given the limited availability of maintenance funding and suitable qualified technicians. Therefore an emphasis on rehabilitation of existing infrastructure, as well as procurement of new equipment and associated training, has been adopted. **Alternative 2:** Various sources of equipment could be used. However, budgets were developed based on existing models that are used in the country as well as endorsed by the relevant stakeholders. Local stakeholders indicated that they preferred to use particular models as they already have experience with these models. At times these models were more costly, however, stakeholders indicated that these were most suitable for the local context and easier to maintain. This is more cost-effective in the long-term Using different models would increase the training and maintenance costs.
Output 1.2 25 automatic, 18 manual and 53 rainfall logging stations rehabilitated and 20 Automatic Weather Stations (AWS) installed to cover blind spots in the existing observation network in the eastern parts of Malawi, Lake Malawi and lakeshore areas including drought and flood prone priority districts, namely Karonga, Salima, Nkhota-kota, Rumphi, Nkhata-bay, Dedza and Phalombe-excluding districts covered by the SRBMP and IFRM.	Limited financial resources available for hydro-meteorological services and disaster risk management, which has resulted in obsolete and inadequate weather and climate observation network and reduced capacity of DCCMS, DoDMA and DWR to fulfill their core mandates.	**Alternative 1:** Only use manual stations and incorporate SMS communication services, using the existing capacity to monitor and report data with familiar and user-friendly equipment. Automated data collection is necessary in order to generate timely alerts, particularly at night when manual stations will not be monitoring or reporting data. **Alternative 2:** Expansion of the meteorological monitoring network through procurement of new Automatic and Manual Stations. However, the costs and technical challenges of maintain a dramatically expanded automated monitoring system is unlikely to be sustainable given the limited availability of maintenance funding and suitable qualified technicians. Therefore an emphasis on rehabilitation of existing infrastructure, as well as procurement of new equipment, has been adopted. **Alternative 3:** Lighting detection systems. At present, there is considerable variability around the costing for lightning detection systems. Besides startup costs, which in some cases are a significant portion of the project budget, the costs of implementing new technologies, training and maintenance, as well the requirement for ground based observations (for calibration) and the untested nature of the technology in Africa were significant concerns. **Alternative 4:** The rehabilitation and installation of radar technologies has the

		potential to generate high-quality spatial data of various weather indices in near-real-time. However the high costs and extensive technical capacity requirements for operation and maintenance of these technologies suggest that investments in simpler, more fundamental skills and technologies would be more sustainable and appropriate to the local context.
Output 1.3 Weather and climate forecasting facilities upgraded, including building on current and planned upgrades to DCCMS and DWR's data and information management systems under the SRBMP and IFRMS and operationalizing collaboration arrangements and procedures for drought and severe weather monitoring and forecasting between DWR and DCCMS.	Limited technical and human capacity for monitoring and forecasting extreme weather and climate change. Limited protocols and agreements and related SOPs for DoDMA, DCCMS and DWR at regional, national and local levels with regards to weather, hydrological and climate data and information collection, exchange, analysis, interpretation and early warning dissemination.	**Alternative 1:** Ongoing and planned monitoring, forecasts and EWS initiatives will continue to operate independently. Moderate investments could be directed to restoring the functionality of existing facilities. However, this will not result in a modernization of the hydro-meteorological monitoring and forecasting system and there will be only a limited development of national capacity as a result of LDCF investments. Furthermore, if existing facilities are not appropriately modernized and data is not readily accessible to various stakeholders, it will be challenging to incorporate other user-agencies of weather, climate and hydrological information. **Alternative 2:** Forecasting and data management capacity is sourced offshore. However this is not popular with GoM as this places data (which is considered a national asset) offshore and does not build local human and technical capacities.
Output 1.4 Capacity developed for operating and maintaining observation networks and related infrastructure including training 7 meteorological and 6 hydrological technicians, 2 communications operators and system administrators, 25 weather observers and 25 gauge readers, raising local community awareness and developing an O&M toolbox including refresher courses.	Limited financial resources available for hydro-meteorological services and disaster risk management, which has resulted in obsolete and inadequate weather and climate observation network and reduced capacity of DCCMS, DoDMA and DWR to fulfill their core mandates.	**Alternative 1:** All operation and maintenance can be outsourced to a private company through a PPP (public private partnership) to enable the company time to train information production personnel over a longer period of time. However, local stakeholders are already experienced with the equipment that will be used in the rehabilitated monitoring network and can make use of previous experience in training personnel. **Alternative 2:** Technical capacity of personnel could be built through regional and international training centers. However this option may be less cost-effective because it does not capitalize on the existing internal forecasting and training expertise within DCCMS and DWR and will reduce the upscaling of technical capacity built through the LDCF project.
Output 1.5 Tailored drought, flood and severe weather forecasts and alerts produced – with a focus on agricultural stress and Mwera winds over Lake Malawi – by training 8 meteorological and 3 hydrological forecasters to build in-house capacity.	Limited technical and human capacity for monitoring and forecasting extreme weather and climate change. Limited protocols and agreements and related SOPs for DoDMA, DCCMS and DWR at regional, national and local levels with regards to weather, hydrological and climate data and information collection, exchange, analysis, interpretation and early warning	**Alternative 1:** Technical capacity of personnel could be built through regional and international training centers. However this option may be less cost-effective because it does not capitalize on the existing internal forecasting and training expertise within stakeholders. **Alternative 2:** Only regional and international products are used. This would reduce their applicability and usefulness within the districts and sectors targeted in Malawi.

	dissemination.	
Output 2.1 Weather and climate information and alerts – including drought, flood and severe weather warnings, integrated cost-benefit analyses and hazard and vulnerability maps – made accessible to decision makers in DoDMA/OPC, MoAFS, MoLGRD, private sector, civil society, development partners and communities.	Limited consolidation and linkages of effective governmental and non-governmental weather, hydrological and climate information dissemination channels (including physical mechanisms) and early warning systems.	**Alternative 1:** Allow decision-makers to receive their information independently through current sources. With this option, there is no central focal point for reporting information and to clarify disaster prevention strategies. Also, there would be no standards applied to the generation and packaging of information. Thus, information would not have consistency in terms of content and quality. This would lead to poor coordination of strategies and DRR activities, resulting in duplication of efforts and/or gaps in delivery of DRR services. **Alternative 2:** Rely on additional infrastructure (e.g. rehabilitated and newly installed weather stations) to improve information generation. However, while the additional infrastructure allows improvements in the gathering of information, without tailoring the information may be of limited value to decision-makers in the various sectors. The decision-maker will not have access to sector-specific information that would guide planning and budgeting. This will result in sub-optimal delivery of DRR and other services.
Output 2.2 Weather and climate information mainstreamed into the operationalization of relevant national sector policies, annual budgets and local development plans including the National Disaster Risk Management Policy and District Development Plans in priority drought and flood prone districts – excluding districts covered by SRBMP and IFRM.	Limited consolidation and linkages of effective governmental and non-governmental weather, hydrological and climate information dissemination channels (including physical mechanisms) and early warning systems. Limited capacity at a district level to effectively manage early warning systems and related disaster risk reduction efforts resulting in poor community preparedness and response.	**Alternative 1:** Allow national, district and local policy-making and planning to continue under present *modus operandi*. This would perpetuate the current reactive approach to climate change adaptation and disaster risk management planning. This would result in poor coordination of early warning-related planning and implementation across all levels, leading to duplication of efforts and/or gaps in delivery of services (especially in localized flood, drought and extreme weather management and relief efforts).
Output 2.3 Governmental and non-governmental communication channels and procedures for issuing forecasts and warnings are reviewed and strengthened – including standardising SOPs, alert dissemination systems using a range of successful dissemination approaches and developing a national weather and climate information and early warning system communication and coordination strategy – at a national and local level in 7 priority districts.	Limited protocols and agreements and related SOPs for DoDMA, DCCMS and DWR at regional, national and local levels with regards to weather, hydrological and climate data and information collection, exchange, analysis, interpretation and early warning dissemination. Limited consolidation and linkages of effective governmental and non-	**Alternative 1:** Continue using present communication channels and procedures for issuing alerts. This would result in a poor coordination of alerts being issued. Also, there would be no standards in terms of *inter alia* protocols, content, timing and modalities of alerts. Consequently, alerts may contain insufficient information, be of poor quality, not reach the proper recipients, and/or be transmitted/received too late. Have separate data portals for each agency to ensure security: however, this would prohibit the easy use of data across agencies and a potential means to share data internationally.

	governmental weather, hydrological and climate information dissemination channels (including physical mechanisms) and early warning systems. Limited capacity at a district level to effectively manage early warning systems and related disaster risk reduction efforts resulting in poor community preparedness and response.	
Output 2.4 Improved enabling environment for development of sustainable revenue streams for DCCMS through the provision of climate services and products.	Limited financial resources available for hydro-meteorological services and disaster risk management, which has resulted in obsolete and inadequate weather and climate observation network and reduced capacity of DCCMS, DoDMA and DWR to fulfill their core mandates.	**Alternative 1:** Operation and maintenance of upgraded hydro-meteorological network can be financed purely through allocation of public budgets. However this will reduce the participation of various socio-economic sectors in the development of tailored forecasting and EWS services i.e. reduce dialogue regarding most valuable services. Furthermore, the limited availability of funding from DCCMS and DWR budgets is likely to affect the efficacy and sustainability of the LDCF project's investments.

2.7 Sustainability

169. To sustain the LDCF project interventions beyond the project implementation period, ownership of the LDCF project by government structures (primarily DCCMS, DWR and DoDMA) is essential. Consequently, relevant government departments, as well as local communities, need to be involved in the design and implementation of project interventions. This participatory approach has been initiated through collaboration with national government departments in designing the LDCF project approach and interventions. Furthermore, the LDCF project is part of the over-arching support structure to DoDMA under the DRM PSD. Implementation of the project activities will include technical capacity building focused on appropriate government departments that will coordinate and/or support the implementation of the LDCF project. Furthermore, local communities will be consulted during the development of early warning systems in the 15 priority districts. Community needs will therefore be addressed by the LDCF project, which will instill community ownership of the project's activities. Government staff will be involved in these community capacity building exercises, and as a result the capacity of government staff working within the project to develop and implement climate information and early warning-related measures will be significantly strengthened, which will be beneficial for future projects within Malawi.

170. To further strengthen the sustainability of the LDCF project, interventions will be implemented in a phased approach. This applies to the development of human, technical capacity, as well as to installing hydro-meteorological equipment. Lessons learned as the equipment is installed will be used to inform future installations, and capacity developed in government staff will be used to build in-house capacity of fellow staff members through a 'train the trainers' approach. Additionally agreements will be established with individuals trained to ensure that they remain in the relevant government departments for the minimum period after receiving the training. All capacity that is developed will also be linked to a deliverable, such as the production of maps or assessments, which will contribute to the implementation of the LDCF project.

171. Budget allocations for Operation and Maintenance of installed hydro-meteorological equipment are an important part of sustainability of the LDCF project interventions. This is particularly relevant to DCCMS, DWR and DoDMA as there is uncertainty as to whether the minimum level of funding required for annual recurrent costs will be made available. As a result, the LDCF project will create for development of sustainable revenue streams for DCCMS through the provision of climate services and products. This will include proposing revisions and updating the DCCMS data policy, evaluating the marker potential for weather and climate products, developing a commercial strategy and developing weather and climate products with commercial potential.

172. Ultimately, the sustainability of the LDCF project will largely depend on the willingness of stakeholders to adopt interventions and continue to pursue them beyond the duration of the project. Suitable technical, legal and institutional capacity is necessary at both local and national level for sustainability to be achieved. This capacity will be strengthened by:

- improving institutional coordination within government;
- building awareness to climate change risks and the benefits of improved climate information and early warnings from local to national level;
- enhancing stakeholder capacity to use the climate information generated through the LDCF project; and
- developing an evidence base to stimulate greater levels of investments in climate information and early warning system projects, and to develop understanding of sector-specific needs and climate information priorities.

2.8 Replicability

173. The LDCF project will generate improved climate information at a national level, and activate communication channels and procedures for issuing alerts including advisories, watches and warnings at a national and local level. This will include the development of radio and mobile-based alert platforms in 15 priority districts. There is thus considerable scope for replication of activities in other districts of Malawi, using the improved climate information generated at a national level. To facilitate the effective replication of project activities, the lessons learned during the project implementation will be disseminated nationally through training programmes, the online platform and toolboxes including courses, handbooks and manuals.

174. The close involvement of government institutions and departments – principally DCCMS, DWR and DoDMA –in the LDCF project's development and implementation means there is considerable potential for future incorporation of the project's approaches into on-going planning and strategies. Additionally, it is expected that the strengthening of capacities among key government stakeholders will enable continued mainstreaming of the use of climate information and early warnings into sectoral planning and decision-making.

175. The position of this LDCF project in UNDP's PS DRM will provides the strongest mechanism for upscaling the activities undertaken. Furthermore, the extensive training and capacity building of local communities and technical staff regarding the application of climate information and the response to early warnings will ensure that future local level endeavors within Malawi are climate-resilient. As a result, LDCF project interventions are more likely to be replicated and/or up-scaled to other sub-regions in Malawi where similar benefits could be realised.

2.9 Stakeholder involvement plan

176. The lead institution for all project outputs is the DoDMA. The implementation strategy for the project is dependent on comprehensive stakeholder participation.

Table 11. Relevant partners and stakeholders identified for engagement by project outcome/output.

Outcome	Output	Lead Institution	Implementing Partners	Key Responsibilities
Outcome 1 Enhanced capacity of the Department of Climate Change and Meteorological Services (DCCMS) and Department of Water Resources (DWR) to monitor and forecast extreme weather, hydrology and climate change.	**Output 1.1** 10 Automatic Hydrological Stations (AHSs) installed in 7 disaster prone districts, namely Karonga, Salima, Nkhota-kota, Rumphi, Nkhata-bay, Dedza and Phalombe and 50 hydrological monitoring stations rehabilitated in key rivers in catchment areas – excluding the districts covered by the SRBI.	OPC (DoDMA)	**Main:** MoWDI (DWR) **Other:** MECCM (DCCMS)	Undertake systematic analysis. Procure and install automatic hydrological stations. Undertake repairs. Procure spare parts. Integrate automatic stations into existing DWR network.
	Output 1.2 25 automatic, 18 manual and 53 rainfall logging stations rehabilitated and 20 Automatic Weather Stations (AWS) installed to cover blind spots in the existing observation network in the eastern parts of Malawi, Lake	OPC (DoDMA)	**Main:**MoECCM (DCCMS) **Other:**MoWDI (DWR)	Undertake systematic analysis. Procure and install AWSs. Upgrade existing stations. Procure spare parts. Integrate AWSs into existing DCCMS network.

	Malawi and lakeshore areas including drought and flood prone priority districts, namely Karonga, Salima, Nkhota-kota, Rumphi, Nkhata-bay, Dedza and Phalombe ¬– excluding districts covered by the SRBMP and IFRM.			
	Output 1.3 Weather and climate forecasting facilities upgraded, including building on current and planned upgrades to DCCMS and DWR's data and information management systems under the SRBMP and IFRMS and operationalizing collaboration arrangements and procedures for drought and severe weather monitoring and forecasting between DWR and DCCMS.	OPC (DoDMA)	**Main:** MoECCM (DCCMS) **Other:** MoWDI (DWR)	Procure and install equipment. Upgrade and update the national DCCMS database and information management system. Undertake data rescue and digitisation. Develop and implement a protocol and agreement between DRW and DCCMS. Develop and establish a monitoring/forecasting platform and database
	Output 1.4 Capacity developed for operating and maintaining observation networks and related infrastructure including training 7 meteorological and 6 hydrological technicians, 2 communications operators and system administrators, 25 weather observers and 25 gauge readers, raising local community awareness and developing an O&M toolbox including refresher courses.	OPC (DoDMA)	**Main:** MoECCM (DCCMS) **Other:** MoWDI (DWR)	Develop an observation network quality control and maintenance toolbox. Develop and implement a management protocol between DRW and DCCMS. Train seven meteorological and six hydrological technicians. Conduct a refresher course for 25 weather observers and 25 gauge readers. Train 1 communications operator and 1 systems administrator. Establish operation and maintenance training facilities. Assist trained individuals to conduct awareness raising with local communities.
	Output 1.5 Tailored drought, flood and severe weather forecasts and alerts produced – with a focus on agricultural stress and Mwera winds over Lake Malawi – by training 8 meteorological and 3 hydrological forecasters to build in-house capacity.	OPC (DoDMA)	**Main:** MoECCM (DCCMS) **Other:** MoWDI, (DWR), Department of Surveys (DoS), MoAFS, MoLGRD,	Conduct training of 8 and 3 meteorological and hydrological forecasters to build in-house capacity. Develop training packages and toolkits. Undergo short-term hydro-meteorological internships. Develop tailored flood, drought and severe weather forecasts and information.
Outcome 2 Efficient and effective use of hydro-meteorological and environmental information for making early	**Output 2.1** Weather and climate information and alerts – including drought, flood and severe weather warnings, integrated cost-benefit analyses and hazard and	OPC (DoDMA)	MoECCM (DCCMS), MoWDI, (DWR), Department of Surveys (DoS), MoAFS, MoLGRD,	Undertake a comprehensive assessment of existing centralised and decentralised early warning systems. Develop and implement

warnings and long-term development plans.	vulnerability maps – made accessible to decision makers in DoDMA/OPC, MoAFS, MoLGRD, private sector, civil society, development partners and communities.			coordination protocols and agreements among DCCMS, DWR, DoDMA and other related institutions. Develop and promote a general climate/early warning system information platform and database. Training of for producing hazard and vulnerability maps. Develop information, communication and education materials.
	Output 2.2 Weather and climate information mainstreamed into the operationalization of relevant national sector policies, annual budgets and local development plans including the National Disaster Risk Management Policy and District Development Plans in priority drought and flood prone districts – excluding districts covered by SRBMP and IFRM.	OPC (DoDMA)	MoECCM (DCCMS), MoWDI, (DWR), Department of Surveys (DoS), MoAFS, MoLGRD,	Facilitate inter-sectoral sharing of weather and climate. Integrate weather and climate information into national policy. Integrate weather and climate information into District Development Plans. Operationalize revised policy and development plans.
	Output 2.3 Governmental and non-governmental communication channels and procedures for issuing forecasts and warnings are reviewed and strengthened – including standardising SOPs, alert dissemination systems using a range of successful dissemination approaches and developing a national weather and climate information and early warning system communication and coordination strategy – at a national and local level in 7 priority districts.	OPC (DoDMA)	MECCM (DCCMS), MoWDI, (DWR), Department of Surveys (DoS), MoAFS, MoLGRD, private sector	Develop a national weather, climate information and early warning system communication and coordination strategy. Standardize SOPs. Develop an early warning system dissemination national and local toolbox. Support the dissemination of weather and climate information and warnings. Support the dissemination of weather and climate information and warnings in 7 priority districts. Development an alert dissemination system.
	Output 2.4 Improved enabling environment for development of sustainable revenue streams for DCCMS through the provision of climate services and products.	OPC (DoDMA)	MECCM (DCCMS), MoWDI, (DWR), Department of Surveys (DoS), MoAFS, MoLGRD, private sector	Review DCCMS data policy. Evaluate the costs and benefits of accurate, timely and accessible weather and climate forecasts Evaluate market potential for weather and climate products in Malawi Development of commercial strategy. Develop 1-3 commercial weather and climate products.

3 PROJECT RESULTS FRAMEWORK

This project will contribute to achieving the following Country Programme Outcome as defined in CPAP or CPD: National policies, local and national institutions effectively support equitable and sustainable economic growth and food security by 2016.

Country Programme Outcome Indicators: 1.3.1 Environment, natural resources, climate change and disaster risk management mainstreamed in policies, development plans and programmes at national level and implemented in 14 disaster-prone districts; 1.3.2 Data and knowledge on the impact of climate change, environmental degradation and natural disasters collected and made accessible to decision makers and government, private sector and civil society; and 1.3.3 Coordination mechanisms and implementation arrangements for climate change, environment, natural resources, and disaster risk management established and used at national level and disaster-prone districts.

Primary applicable Key Environment and Sustainable Development Key Result Area: 3. Promote climate change adaptation

Applicable SOF (e.g. GEF) Strategic Objective and Program:
Climate Change Adaptation Objective 2 **"**Increase adaptive capacity to respond to the impact of climate change, including variability, at local, national, regional and global level"

Applicable SOF (e.g. GEF) Expected Outcomes:
Outcome 2.1: "Increased knowledge and understanding of climate variability and change-induced risks at country level and in targeted vulnerable areas; and
Outcome 2.2: "Strengthened adaptive capacity to reduce risks to climate-induced economic losses."

Applicable SOF (e.g. .GEF) Outcome Indicators:

- Relevant risk information disseminated to stakeholders;
- Type and scope of monitoring systems in place; and
- % of population covered by climate change risk reduction measures.

	Indicator	**Baseline**	**Targets End of Project**	**Source of verification**	**Risks and Assumptions**
Project Objective: To strengthen the weather, climate and hydrological monitoring capabilities, early warning systems and available information for responding to extreme weather and planning adaptation to climate change in Malawi.	1. Capacity as per capacity assessment scorecard (Annex 12). 2. Domestic finance committed to DoDMA, DCCMS and DWR to monitor extreme weather and climate change.	1. Average CCA capacity scorecard rating of **72** across men and women (Annex 12). 2. Annual budget of USD allocated to DoDMA, DCCMS and DWR[44].	1. CCA capacity scorecard rating is increased to an average of **121**for both men and women (Annex 12). 2.>**20%** increase in domestic financing committed to DoDMA, DCCMS and DWR to monitor extreme weather and climate change (including equipment operation and maintenance)[45].	1. Focus group interviews with climate monitoring and EWS-related stakeholders; consultant reports. 2. Review of DoDMA, DCCMS and DWR annual budgets.	Risk: Delayed implementation of baseline projects by the government and donors negatively affects LDCF project outcomes. Assumption: Baseline projects are implemented according to the timeline identified in the PPG phase of the LDCF project, and achieve the desired outcomes and objective. Risk: Installed hydro-meteorological equipment fails because it is vandalised or not maintained. Assumption: Communities living nearby installed hydro-meteorological equipment commit to taking active measures to prevent the equipment from being vandalised; and the equipment is adequately maintained by the responsible institution. Risk: Climate shocks occurring during the design and implementation phase of the LDCF project result in disruptions to installed equipment and severely affect communities, prior to the EWSs

[44]To be confirmed and finalized during the inception phase.
[45]To be confirmed and finalized during the inception phase.

					being established. Assumption: Any climate shocks occurring whilst the EWSs are being established will not be so severe as to result in a relocation of the communities where the effectiveness of the EWSs will be tested. Risk: Local information technology and telecommunications infrastructure restricts the transfer of data from installed equipment to necessary recipients, and restricts communication amongst key role players and end-users. Assumption: Information technologies and telecommunications systems implemented or used, where such suitable system already exists, by the LDCF project are best suited to the local context and do not restrict the transfer and communication of information. Risk: Procurement and installation of hydro-meteorological equipment, including hardware and software, is delayed because of complications with the release of funds and/or national procurement procedures. Assumption: UNDP CO and HQ will co-ordinate with the IP to ensure effective administrative planning, meaning that equipment is procured and installed in a timely manner.
Outcome 1: Capacity of the Department of Climate Change and Meteorological Services (DCCMS) and Ministry of Irrigation, Agriculture and Water Development	1. Percentage of national coverage of climate monitoring network (fully operational).	1. DCCMS[46]– 15**%** national coverage of operational manual (15%) and automatic (0%) weather stations (Annex 6[47]). 1. DWR[48]– **52%** national coverage	1. DCCMS[51]– **77%** national coverage of operational manual (71%) and automatic (84%)[52] weather stations (Annex 6)[53]. 1. DWR[54]– **69%** national coverage of operation	1. Field inspection of AWS sites; review of climate monitoring database.	Risk: Delayed implementation of baseline projects by the government and donors negatively affects LDCF project outcomes. Assumption: Baseline projects are implemented according to the timeline identified in the PPG phase of the LDCF project, and achieve the desired outcomes and objective. Risk: Installed hydro-meteorological equipment fails because it is vandalised or not maintained.

[46]There are currently 22 Synoptic Weather Stations in Malawi for which accurate locality data has been obtained, however, only four are fully functional. Based on these data, 4 out of 26 districts in Malawi are covered by the current monitoring network. There are also an additional 53 manual rainfall logging stations that require rehabilitation, however, no accurate locality data was obtained for these.

[47]**Manual:** 4 operational in 4 out of 26 districts, which equates to **15%**.**Automatic:** Currently **none** of the 26 automatic weather stations

[48]There are currently 158 operational manual hydrological monitoring stations in Malawi (*Directory of Hydrometric Stations in Malawi, 2012. Ministry of Irrigation and Water*

(MoIAWD) to monitor and forecast extreme weather and climate change enhanced.	2. Frequency and timeliness of climate-related data availability.	of operational surface manual (85%) and automatic (19%)[49] hydrological stations (Annex 6)[50]. 1. Number and Type (operational stations) Automatic weather stations: **6** Manual synoptic stations: **4** Manual river discharge and water level stations: **158** Rainfall logging stations actively transmitted through GPRS network: **0** 2. DCCMS: i) **4** times daily between 5am-5pm for manual synoptic stations; ii) **once** a day for	surface manual (100%) and automatic (39%) hydrological stations (Annex 6)[55]. 1. Number and Type (operational stations) Automatic weather stations: **45** Manual synoptic stations: **22** Surface manual hydrological stations: Manual river discharge and water level stations: **208** Rainfall logging stations actively transmitted through GPRS network: **53** 2. DCCMS: **hourly** for synoptic stations and **daily** for rainfall logging gauges.	2. Review of climate monitoring database.	Assumption: Communities living nearby installed hydro-meteorological equipment commit to taking active measures to prevent the equipment from being vandalised; and the equipment is adequately maintained by the responsible institution. Risk: Climate shocks occurring during the design and implementation phase of the LDCF project result in disruptions to installed equipment and severely affect communities, prior to the EWSs being established. Assumption: Any climate shocks occurring whilst the EWSs are being established will not be so severe as to result in a relocation of the communities where the effectiveness of the EWSs will be tested. Risk: Local information technology and telecommunications infrastructure restricts the transfer of data from installed equipment to necessary recipients, and restricts communication amongst key role players and end-users. Assumption: Information technologies and telecommunications systems implemented or used, where such suitable system already exists, by the LDCF project are best suited to the local context and do not restrict the transfer and communication of information. Risk: Procurement and installation of hydro-meteorological equipment, including hardware and

Development).Accurate locality data was obtained from the DWR for 79 of these of these operational hydrological monitoring stations (see Annex 6). Based on these data, 22 of 26 districts (85%) are covered by the current monitoring network.

[51]25 automatic, 18 manual and 53 rainfall logging stations rehabilitated and 20 Automatic Weather Stations (AWS) installed in priority districts

[52] There are currently 26 AWSs requiring rehabilitation in 20 of the 26 districts of Malawi. Through the rehabilitation of this network, as well as the installation of 20 additional AWSs in priority districts, the coverage in Malawi will increase to a minimum of 22 of 26 districts.

[53]**Manual:** Synoptic weather stations operational in 17 of 26 districts, which equates to **71% .Automatic:** Operational in 22 out of 26 districts, which equates to **84%**.

[54]50 manual hydrological monitoring stations rehabilitated, and 10 automatic hydrological monitoring stations installed in priority districts.

[49]There are six hydrological monitoring stations with automatic Data Collection Platforms (DCPs), which were installed in the late 1990s under the SADC Hydrological Cycle Observing System (HYCOS) Phase 1 Project. These stations are located in five of the 26 districts in Malawi, namely: Karonga, Nkhata Bay, Mangochi, Machinga and Mulanje. This equates to ~19% coverage.

[50]**Manual:** 158 operational in 22 out of 26 districts, which equates to **85%**.**Automatic:**6 operational in 5 out of 26 districts, which equates to **19%.**

[55]**Manual:** Operational in all 26 districts (**100%**).**Automatic:** Operational in 10 out of 26 districts, which equates to **39%**.

		AWSs; iii) **once a month** for rainfall logging gauges. 2. DWR: **daily** to **monthly** basis	2. DWR: **6** hourly and **2-4** hourly for flood prone areas.		software, is delayed because of complications with the release of funds and/or national procurement procedures. Assumption: UNDP CO and HQ will co-ordinate with the IP to ensure effective administrative planning, meaning that equipment is procured and installed in a timely manner. Risk: Alerts and warnings required by communities are not feasible to produce due to scientific or technological barriers. Assumption: The most up to date technology and scientific approaches and advances are feasible and appropriate for meeting the LDCF project needs. The level of error for forecasting is within the minimum thresholds appropriate for the LDCF project activities.
Outcome 2 Hydro-meteorological and environmental information for early warnings and long-term development plans efficiently and effectively used.	1. Percentage of population with access to improved climate information and flood, drought and Mwera wind warnings (disaggregated by gender). 2. Policies, annual budgets and development plans that integrate climate information (type and level).	1. 10% of men and 10% women with access to improved climate information and flood, drought and Mwera wind warnings (*to be confirmed during project inception)*. Male: 628,620 Female: 663,136[56] 2. Currently **0** policies and development plans	1. 17% of men and 17% women with access to improved climate information and flood, drought and Mwera wind warnings (*to be confirmed during project inception)*. Male: 1,093,242 Female: 1,154,912[57] 2. **7** District Development Plans and 1 National DRM Policy	1. Gender-sensitive field surveys undertaken within the 7 priority districts, representative the f the local population; consultant reports 2. Review of District Development Plans and the NDRM Policy.	Risk: Lack of commitment from communities where EWSs are established undermines the effectiveness of the LDCF project demonstrations. Assumption: Awareness raising activities, and the demonstration of the advantages of responding to the information provided through the established EWS, will ensure the commitment of the communities to participating in the LDCF project. Risk: Local information technology and telecommunications infrastructure restricts the transfer of data from installed equipment to necessary recipients, and restricts communication amongst key role players and end-users. Assumption: Information technologies and telecommunications systems implemented or used, where such suitable system already exists, by the LDCF project are best suited to the local context and do not restrict the transfer and communication of information.

[56] Based on baseline estimates of 43% of male and female populations in districts covered by the Enhanced Community Resilience Programme (Kasungu, Machinga, Mwanza, Thyolo, Mulanje) that receive weather and climate information.

[57] Based on 43% of the male and female population that receive weather and climate information in 7 priority districts (Karonga, Salima, Nkhota-kota, Rumphi, Nkhata-bay, Dedza and Phalombe) which will benefit from improved climate information and warnings for flood, drought, and Mwera wind warnings and mainstreaming of climate information and EWS into local development plans.

					Risk: Alerts and warnings required by communities are not feasible to produce due to scientific or technological barriers. Assumption: The most up to date technology and scientific approaches and advances are feasible and appropriate for meeting the LDCF project needs. The level of error for forecasting is within the minimum thresholds appropriate for the LDCF project activities.

4 TOTAL BUDGET AND WORKPLAN

Award ID:	00074326	Project ID(s):	00086781
Award Title:	Strengthening EWS-GEF		
Business Unit:	MWI10		
Project Title:	Strengthening climate information and early warning systems in Malawi for climate resilient development and adaptation to climate change		
PIMS no.	5092		
Implementing Partner (Executing Agency)	DoDMA		

SOF (e.g. GEF) Outcome/Atlas Activity	Responsible Party/ Implementing Agent	Fund ID	Donor Name	Atlas Budgetary Account Code	ATLAS Budget Description	Amount Year 1 (USD)	Amount Year 2 (USD)	Amount Year 3 (USD)	Amount Year 4 (USD)	Total (USD)	See Budget Note:
OUTCOME 1:	**DoDMA**	**62160**	**GEF LDCF**	71400	Contractual Services	26 250	45 950	40 700	3 500	116 400	a
				71300	Local Consultants	27 500	26 440	25 000	0	78 940	b
				74200	Audio Visual & Print Production Costs	31 000	56 000	185000	20000	292000	c
				72300	Materials and Goods	50 000	842 900	632 900	10 000	1 535 800	d
				75700	Training, Workshops and Conferences	151300	200 000	56 000	16 000	423 300	e
					Total Outcome 1	**286050**	**1 171 290**	**939600**	**49500**	**2 446 440**	
OUTCOME 2:	**DoDMA**	**62160**	**GEF LDCF**	71400	Contractual Services	12050	11550	8000	17550	49150	f
				71300	Local Consultants	10 500	20 600	14 500	21500	67100	g
				74200	Audio Visual & Print Production Costs	42 000	14 000	35030	116 500	207 530	h
				72300	Materials and Goods	45 000	10 000	0	185 000	240 000	i
				75700	Training, Workshops and Conferences	22 500	67 000	179 280	141 000	409 780	j
					Total Outcome 2	**132050**	**123150**	**236810**	**481550**	**973560**	
PROJECT MANAGEME	**DoDMA**	**62160**	**GEF LDCF**	71300	Local Consultants	18 000	18 000	18 000	18 000	72 000	k
				71600	Travel	3 500	3 500	3 500	3 500	14 000	l

NT COSTS/UNIT				74500	Miscellaneous Expenses	26 000	26 000	26 000	16 000	94 000	m
						47 500	**47 500**	**47 500**	**37 500**	**180 000**	
					PROJECT TOTAL	**465600**	**1341940**	**1223910**	**568550**	**3600000**	

Summary of Funds:[58]

	Amount (USD) Year 1	Amount (USD) Year 2	Amount (USD) Year 3	Amount (USD) Year 4	**Total**
LDCF	465,600	1,341,940	1,223,910	568,550	**3600000**
UNDP	1,525,000	1,525,000	1,525,000	1,525,000	**6,100,000**
DFID	250,000	606,607	250,000	250,000	**1,356,607**
Government	959,575	959,575	959,575	959,575	**3,838,300**
TOTAL	3,200,175	4,433,122	3,958,485	3,303,125	14,894,907

Budget Note	**Description of cost item**
a	M&E expert (16 days @ $550/day +1 flight @ $2,000 +5days DSA @ $200/day). Costs of data collection and/or VRA for informing the generation of forecasts and alerts for integration into existing early warning systems in the 7 priority districts. Cost of 4audits @ $3000each prorated at the Outcome level @$6000 (i.e. total for LDCF project: $12000). Cost of an Independent Mid-term evaluation@ $30000 prorated at the Outcome level @ $15000. Cost of an Independent Terminal evaluation @ $45000 prorated at the Outcome level @ $22500.
b	2 National trainers and workshop facilitators (a climate change modeller/risk and vulnerability assessment and mapping expert; and an adaptation, early warning system and disaster management specialist) (30 days each @ $250/day). 2 National trainers and workshop facilitators (hydro/meteorology specialist) (86 days each @ $250/day). Communications and ICT specialist (82 days @ $250/day) + Contingency. $ 78,940 budgeted.

[58] *Summary table should include all financing of all kinds: GEF financing, cofinancing, cash, in-kind, etc...*

c	Cost to strengthen existing and/or develop, host and maintain online platforms including websites and databases related to EWS/CI for Malawi (including costs of an information management systems (including equipment required). Cost to strengthen existing and/or develop, implement and maintain coordination protocols and agreements between DWR and DCCMS. Develop tailored weather and climate alerts including advisories, watches and warnings by integrating and customizing standard forecasts. Edit, print and publish protocols, handbooks, and/or guidelines for DCCMS and DWR including manuals for AWSs, AWLSs and manual stations as well as other remotely accessible resources regarding the observation network quality control and maintenance toolbox developed.
d	Procuring and installing 20 Automatic Weather Stations @$14000 each. Procuring and installing of civil works (including weather fencing @ $3500) for 20 AWSs @$5500 each. Procuring and installing 10 Automatic Hydrological Stations @$15000 each. Procuring and installing civil works for 10 Automatic Hydrological Stations @$6000 each. Rehabilitate 50 manual Hydrological stations including procurement and replacement of gauge plates, installation and civil works @$3000 each. Purchase 53 licenses and GPRS receivers for existing rainfall-logging stations @$3400 each. Procuring AWLSs spare parts and equipment. Purchase telecommunications infrastructure including computers, computer servers and software, radiotelephones, portable telephones, GSM/GPRSGSM/GPRS modems and other equipment for internet access. Upgrade 18 manual stations - including thermometers (maximum, minimum and soil), manual wind and solar sensors with digital sensors and barometers, and calibrate thermometers and barometers @$5000 each. Upgrade 25 AWSs - replace sensors on units @$1500 each. Upgrade 2 AWSs - replace data loggers on units @$800 each. Stabilize power at 5 AWSs through the provision of dry cells, upgrading solar panels, batteries or 2.5mm armoured cable as required @$2300each. Calibration and installation costs for 25 AWS upgrades including fieldtrips to sites @$3000each. Procure and install modern forecasting facilities/workstations (computers, storage and software) to support main stations at Blantyre and at the Chief Hydrological office in Lilongwe, including internet modems and access. Perform data rescue and digitization processes from DCCMS and DWRM archives building on Shire River Basin Initiative activities. Purchase and install licenses for HYDSTRA for the DWRM. Procure vehicles for technical hydro-meteorological staff for field visits and other project activities related to ensuring the effective operation and maintenance of all equipment installed.
e	In-country national technical hydro-meteorological operation and maintenance training for 7 meteorologists and 6 hydrologists. Supply operational and maintenance refresher training courses, conducted by individuals trained at a national level, for 25 weather observers and 25 gauge readers. Provide national training to 8 meteorologists and 3 hydrologists on state-of-the-art region-specific weather and climate forecasting and in-house capacity building. Develop and implement a community awareness and training campaign in 15 priority districts. Provide 2 NMHS internships (6 months) @$45000each. The cost of an Inception workshop prorated at the Outcome level @$5000.

	Equip training facilities at Blantyre and Lilongwe with reference quality sensors and demonstration equipment. Develop training packages and toolkits for assisting trained meteorologists and hydrologists to build in-house forecasting capacity and enhance collaboration between the DWR and DCCMS. Develop and promote 'toolboxes', protocols, handbooks, policy and information briefs and/or guidelines on climate change adaptation, hydro-meteorological data and early warning systems.
f	Economist (27 days @ $550/day +1 flight @ $2,000 +5days DSA @ $200/day). M&E expert (13 days @ $550/day +1 flight @ $2,000 +5days DSA @ $200/day). Data collection (cost of enumerators, travel related to surveying) for informing the generation of forecasts and alerts for integration into early warning systems in the 7 priority districts. Surveys include the economic benefits of warnings/advisories and the decision frameworks and pathways for using climate information. Study on the costs and benefits of accurate, timely and accessible weather and climate forecasts (including tailored forecasts and alerts). Study on the design of tailored products based on climate information required by users. Cost of 4audits @ $3000each prorated at the Outcome level @$6000 (i.e. total for LDCF project: $12000). Cost of an Independent Mid-term evaluation@ $30000 prorated at the Outcome level @ $15000. Cost of an Independent Terminal evaluation @ $45000 prorated at the Outcome level @ $22500.
g	2 National trainers and workshop facilitators (a climate change modeller/risk and vulnerability assessment and mapping expert; and an adaptation, early warning system and disaster management specialist) (105 days each @ $250/day). 2 National trainers and workshop facilitators (hydro/meteorology specialist) (5 days each @ $250/day). A National Communications and ICT specialist (35 days @ $250/day) + Contingencies. $ 67,100 budgeted.
h	Promote commercial operations related to hydro-meteorological services including costs of reviewing of reviewing policies, developing and implementing a commercial strategy. Develop a national weather and climate information and early warning system communication and coordination strategy. Develop, host and maintain online platforms including websites and databases. Implement a two-way SMS-based alert and feedback system for local farmers and vulnerable communities in 7 priority districts.This will cover the costs of building on baseline projects and promoting the importance of cooperative responsibility of service providers; and include meetings, planning, establishing relationships and agreements, travel, and other costs needed including additional equipment and consultants not covered under materials and goods and contractual services budget codes respectively – see budget notes g, h and j). Develop and implement protocols for integrating weather and climate information into disaster policy at a national and local level in 7 priority districts. Edit, print and publish protocols, handbooks, policy and information briefs, and/or guidelines on climate change adaptation, hydro-meteorological data and early warning systems.
i	Procure 2 Satellite phones @$2500 each. Establish hotlines/call centres @$1250 each Procure 30 cell phones for DDCMs and/or community champions @$1250each. These will be integrated into the two-way SMS-based alert and feedback system for floods, droughts, severe weather and by building on baseline projects in particular the alert system being implement by ECRP and UNDP. Buy materials for colour-coded signs for alerts - advisories, watches and warnings.

	Procure Communication Facility Radio Transceiver and supporting two way radios. Purchase airtime, TV, radio spot messages. Procure vehicles for technical hydro-meteorological staff and disaster management offices for field visits, and costs of other project activities related to ensuring the effective operation and maintenance of all installed equipment. Procure computer workstations/laptops (including internet connection).
j	Develop and implement a community awareness campaign in15 priority districts. Train DoDMA, DWR, DCCMS and Department of Surveys personnel to produce climate risk and vulnerability sector-specific maps. Train National Disaster Preparedness and Relief Committee. Train DoDMA - VCPCs and DCPCs to integrate weather and climate information into annual workplans. Develop the capacity of VCPCs and DCPC's through workshops and meetings in the Karonga, Salima, Nkhota-kota, Rumphi, Nkhata-bay, Mangochi, Dedza, Ntcheu, Balaka, Zomba, Phalombe, Machinga, Blantyre Chikhwawa and Nsanje districts to integrate weather and climate information into district development plans and to further translate it into policies and workplans. The cost of an Inception workshop prorated at the Outcome level @$5000. Develop and promote 'toolboxes', protocols, handbooks, policy and information briefs and/or guidelines on climate change adaptation, hydro-meteorological data and early warning systems.
k	Financial/administrative support.
l	Travel expenses to support project implementation.
m	Administrative costs for desktop officers. Insurance, bank charges and other sundries for project coordinating unit.

5 MANAGEMENT ARRANGEMENTS

177. The LDCF financed project will be implemented over a four year period. DoDMA will function as the Implementing Partner for this project. DoDMA, as the IP, will be responsible and held accountable for managing the LDCF project on a day-to-day basis as per UNDP's NIM procedures and compliant with GEF policies. Please see management arrangements in Figure 4 and further details on this below.

178. The Management arrangements of this LDCF financed project are in alignment with arrangements already in place for the UNDP's Programme Support Document to Disaster Risk Management. Governance of the Project will be supported through annual work planning as well as reporting and monitoring the delivery of results and impact on the basis of LDCF project results framework (which is also aligned with the results framework for the PS DRM).

Figure 4 below shows the management structure of the project.

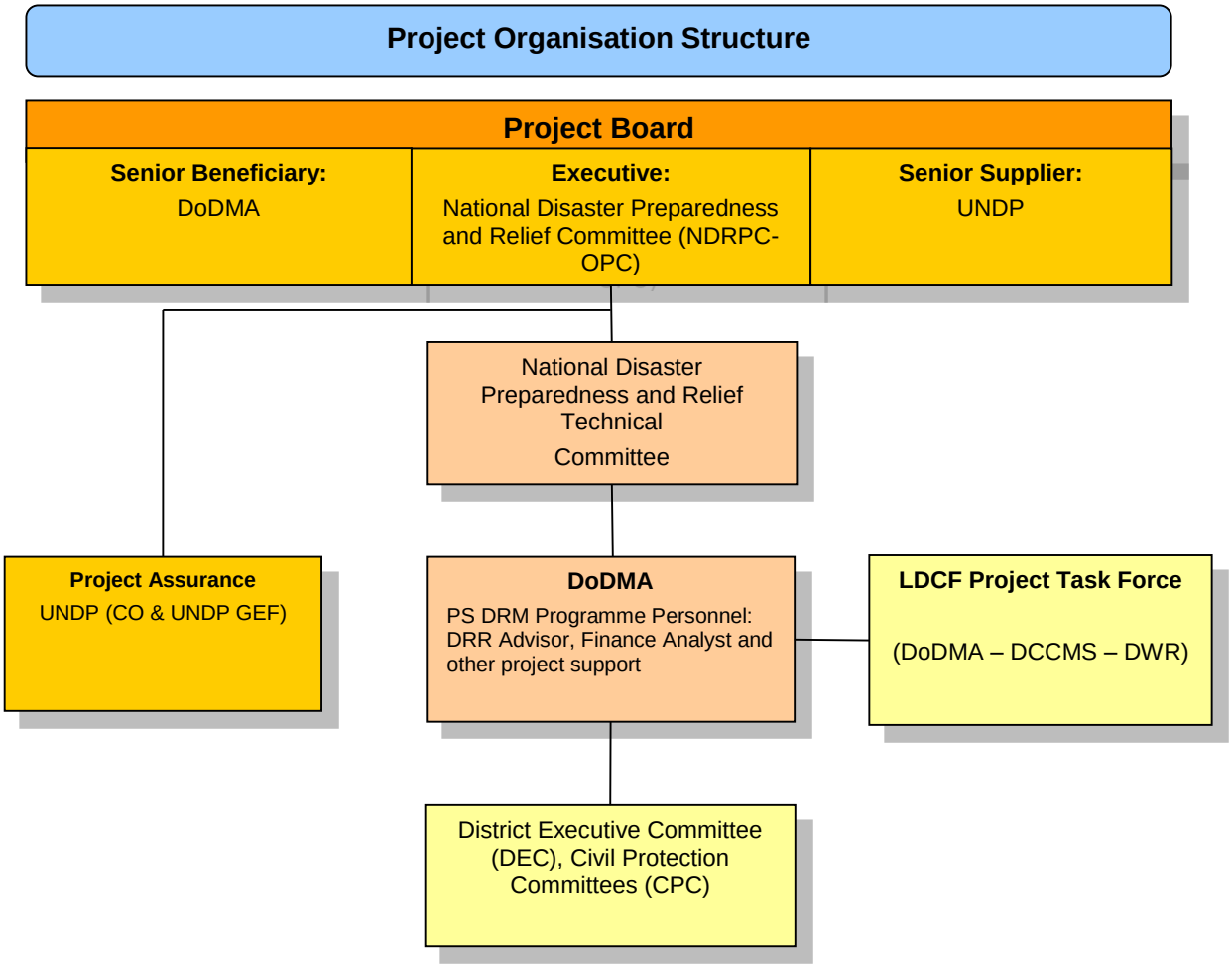

Figure 4. UNDP LDCF Project Organization Structure

179. The Project Board for this LDCF project is the group of executives responsible for making on a consensus basis management decisions for the PS DRM programme and its projects. The project board will provide policy guidance to DoDMA and PS DRM personnel entrusted with responsibility to achieve the LDCF project outcomes and outputs. Project reviews by this group are made at designated decision points

during the running of a project, or as necessary when raised by DoDMA and PS DRM personnel who are entrusted to deliver on the LDCF financed project outcomes and outputs.

The project board is comprised of:

1. An Executive (role represented by National Implementing Partner) that holds the project ownership. The Executive will be the NDRPC which is chaired by the Chief Secretary in the Office of the President and Cabinet (OPC).
2. Senior Supplier provides guidance regarding the technical feasibility of the project, compliance with donor requirements and rules pertaining to use of project resources. This role will be fulfilled by UNDP in its capacity as GEF IA
3. Senior Beneficiary (role represented by DoDMA) that ensures the realization of project benefits from the perspective of project beneficiaries.

180. Other potential members of the Project Board are reviewed and recommended for approval during the Local Programme Advisory Committee (LPAC) meeting. The Project Board holds its sessions once every six months upon the initiative of the National Project Director. The Project Board can also decide on the participation of civil society organisations including their role in board meeting deliberations.

181. As the Implementing Partner for the LDCF financed project, implementation responsibility will be with DoDMA– namely the Director of DoDMA – and PS DRM programme personnel, with oversight provided by UNDP in line with its role as a GEF IA. The annual work plans of this LDCF project as well as progress reporting (on both substantive and financial matters) will be the responsibility of DoDMA and PS DRM personnel and will be approved by National Project Director in close consultation with UNDP. This will create an enabling environment for participatory decisions reached in the process of preparing the work plans to be implemented effectively and efficiently. The LDCF project work plan will be implemented upon its endorsement by the Project Board, by DoDMA and other project personnel. The endorsed work plan will serve as an authorization to the Programme Manager at UNDP to disburse funds and project implementation, subject to fulfillment of NIM requirements by the Implementing Partner.

182. In line with UNDP NIM policies, the project will be implemented in a manner that ensures Government ownership and active participation in project activities, leaving the staff paid for by the project resources with the function of rendering expert support, but not substitution of the national structures/mechanisms.

183. The LDCF Project implementation will be guided through a Task Force comprising the following government departments: i) DoDMA in the OPC whose main role will be to ensure proper coordination and participation of all key stakeholders in the project; ii) DCCMS in the Ministry of Environment and Climate Change Management (MoECCM) which will take the leading role in implementation of all weather and meteorology related activities; and iii) DWR in the Ministry of Irrigation and Water Development (MoWDI) which will take the leading role in implementation of hydrological activities. Complementing DoDMA's role as the Implementing Partner, MoECCM and MoWDI will therefore constitute the key Responsible Parties (RPs) for the day-to-day implementation of the project.

184. As per discussions with the GEF Secretariat, this initiative is part of a multi-country set of NIM projects supported by UNDP-GEF. In response to LDCF/SCCF Council requirement that a regional component would be included to enhance coordination, increase cost effectiveness and, most importantly, benefit from a regional network of technologies, a cohort of technical advisors and a project manager will be recruited to support each of the national level project teams. In particular they will support countries to develop robust adaptation plans and provide technical advice, training and support for accessing, processing and disseminating data for early warning and national/sectoral planning related purposes on a systematic

basis. The cost of these project staff has been prorated across all country project budgets and recruitment of these posts will be undertaken by UNDP-GEF (HQ) in coordination with all UNDP Country Offices.

185. The Director in DoDMA will be the key responsible person for the overall management of the LDCF project including reporting to UNDP on project implementation. Support will be provided to the Director in DoDMA from the PS DRM personnel. However, since the LDCF project will be implemented through a Task Force including the DCCMS and DWR, a Desk Officer from each of the three departments (DoDMA, DCCMS and DWR) will be designated for the LDCF project.

186. The NPD, together with LDCF Project Task Force members, will ensure sound linkage of all decisions and experience of the project with building the internal capacity of the Implementing Partner and Responsible Parties. Together, the NPD and UNDP Programme Manager will ensure participatory consultations with DoDMA staff to ensure the integration of project decisions and experience into national and local policies. The Task Force will involve other RPs as necessary in the implementation of project activities. Further RPs will include Ministry of Agriculture and Food Security (MoAFS-Early Warning Section), Department of Surveys, and Ministry of Local Government and Rural Development (MoRLGD) (see Table 7, Section 2.9).

187. Project Assurance is the responsibility of UNDP as a GEF IA. The Project Assurance role supports the Project Board by carrying out objective and independent project oversight and monitoring functions. This role ensures appropriate project management milestones are managed and completed. Project assurance is provided by the UNDP CO and UNDP-GEF (at HQ and Regional level).

The project organizational structure will be as follows:

Overall Management

The management of the project will be carried out by the Project team in Lilongwe under direct supervision of the National Project Director. UNDP also closely cooperates with national authorities and local authorities in the project micro units and respective communities. UNDP's role in activities financed by LDCF resources will be according to its role as a GEF IA.

The project stakeholders

The stakeholders will consist of the UNDP as the GEF IA, the DoDMA at national level and local government with local offices in the districts, DCCMS, DWR, the community members being empowered in risk reduction practices, the civil society and other local and international NGOs working in disaster risk management and reduction in particular, and the Government of Malawi.

Audit arrangements

Audits will be conducted in accordance with UNDP financial rules and regulations and applicable audit policies on NIM/NGO projects.

188. The IPs is required to provide appropriate management responses to all audit recommendations. All action plans emanating from the audit recommendations and findings must be implemented in the provided time period. Based on the current audit policies, if the IP has qualified audits for two consecutive years or rated higher than Significant Risk by HACT assurance activities, UNDP will suspend Direct Cash Transfers. This case will also warrant a HACT special audit to provide adequate assurances to UNDP in terms of financial accounting. This arrangement would remain into force until UNDP is satisfied that necessary steps have been taken to ensure that the implementing partner has re-gained adequate accountability and internal controls for the receipt, recording and disbursement of cash transfers, proven by HACT assurance activities or

Micro-assessment. UNDP reserves the right to conduct HACT special audits when in-depth analysis on financial accountability is required.

189. The 2010 macro-assessment of the public financial management system pointed to limited capacity of the National Audit Office (NAO). Therefore, as per current UNDP audit policy, audits of UNDP-funded projects will be conducted by pre-qualified private audit firms until there is adequate capacity in NAO to carry out the audits. The NAO will be consulted in engaging the private audit firms and will be invited to sit on committees assessing proposals from audit firms to conduct scheduled audits and special audits. Audit reports shall be shared with NAO for their records and to ensure that they meet the required national/international standards. Should UNDP audit policy change during the period of implementation, the prevailing audit policy at the time will be followed.

190. *Agreement on intellectual property rights and use of logo on the project's deliverables*

Ownership of equipment, supplies and other properties financed from the contribution shall vest in UNDP. Matters relating to the transfer of ownership by UNDP shall be determined in accordance with the relevant policies and procedures of UNDP and the GEF.

191. *Roles and Responsibilities*

There are four main institutions that will be heavily involved in the implementing the project namely; UNDP Malawi (GEF IA), DoDMA (IP), DCCMS and DWR (key RPs). The roles of these institutions are as follows:

192. UNDP Malawi will be responsible for all functions in line with its role as a GEF IA:

- Facilitating the development and approval of annual work plans (AWPs)
- Making timely disbursements of quarterly advances to the implementing partners (Department of Disaster Management Affairs and other agencies that will be involved in the implementation with direct funding);
- Checking accuracy of financial reports and reviewing requests for advances jointly with DoDMA.
- Ensuring quality control in project implementation including meeting technical and financial reporting requirements of all implementing partners in the project
- Providing overall technical advice
- Support Government in mobilizing more resources for the project
- Organizing project audits as required.
- Monitoring progress in implementation of Annual Work Plans

193. Government (DoDMA) will be responsible for all functions in line with its role as the IP:

- Developing annual work plans together with the District Councils of the 15 target districts;
- Ensuring overall coordination of the project following the agreed annual work plan including joint supervision with UNDP of activities implemented through NGOs;
- Supervision of the activities coordinated by the District Councils of the 15 target districts;
- Appropriate use of funds which will be advanced to DoDMA on a quarterly basis in line with the approved budget and annual work plan;
- Accurate accounting and timely reporting of the use of project funds;
- Monitoring the achievement of results and providing timely progress reports as indicated in the project document.

194. Government (DCCMS) will be responsible for:

- developing annual work plans together with the District Councils of the 15 target districts;
- procurement and installation of Automated Weather Stations and other related equipment;
- collect, analyse and disseminate EW related data within its mandate;

- accurate accounting and timely reporting of the use of project funds that are directly disbursed to it; and
- monitoring the achievement of results and providing timely progress reports as indicated in the project document.

195. Government (DoWRM) will be responsible for:

- Developing annual work plans together with the District Councils of the 15 target districts;
- Procurement and installation of data loggers including rehabilitation and maintenance of equipment;
- Collect, analyse and disseminate EW related data within its mandate;
- Supervision of the activities coordinated by the District Councils of the 15 target districts;
- Accurate accounting and timely reporting of the use of project funds directly disbursed to the department;
- Monitoring the achievement of results and providing timely progress reports as indicated in the project document.

196. *Steering Committee (Project Board)*

The National Disaster Preparedness and Relief Committee (NDPRC) will serve as the Steering Committee (SC) for the Programme. The NDPRC will also serve as the national platform. The SC will provide overall and strategic guidance during project implementation. This committee consists of Principal Secretaries (PS) of key ministries of Economic Planning and Development (MoEPD); Agriculture and Food Security (MoAFS)[59]; Local Government and Rural Development (MoLGRD), Environment and Climate Change Management (ECCM); Health (MoH); Lands, Housing and Urban Development (MoLHUD); Education, Science and Technology (MoEST); and Office of the President and Cabinet (OPC); United Nations Development Programme (Environment Cluster Manager); and Civil Society Organizations (CSO) will be represented by Malawi Red Cross Society (MRCS) and Concern Universal and Christian Aid. Other UN agencies and donor agencies will be called upon to attend the Steering Committee meetings as required. The SC is chaired by the Chief Secretary of the Civil Service in the Office of the President and Cabinet.

197. *Technical Committee*

The Technical Committee (TC), whose membership includes Directors from the ministries represented in the SC; Department of Climate Change and Meteorological Services (DCCMS); Department of Water Resources (DWR); UNDP (DRM Programme Analyst and UNDP DRM Technical Advisor); other UN agencies (mainly UNICEF, WFP, UNFPA and FAO), non-governmental actors[60] and donors shall meet as necessary – maximum is once quarterly. The TC will be responsible for providing technical guidance to the implementing partner and the LDCF Project Task Force in the preparation of Annual Work Plans and in the implementation of project activities. The TC will also constitute thematic technical teams for overall monitoring of progress and to approve significant changes to the work plan and budget. The Technical Committee will be chaired by the Secretary and Commissioner for Disasters in the Department of Disaster Management Affairs.

198. *District level Coordination*

District level coordination of project activities will be done through the Directorate of District Planning which is headed by the Director of Planning and Development (DPD). The DPD will be the overall coordinator of the LDCF project at the district level. The executive body will be the District Civil Protection Committee (DCPC), chaired by the DPD and the Assistant District Disaster Risk Management Officer (ADDRMO) will serve as the secretary to the DCPC. The ADDRMO will in particular work in close

[59]All the Principal Secretaries in the ministry will be represented in the Steering Committee

[60]The representation could be broadened to include other NGOs and Civil Society Networks

collaboration with district level staff from DWR and DCCMS as a reflection of central government level management arrangement. Thus, ADDRMO with support from the two departments will also provide the necessary guidance to the DCPC to ensure that LDCF project outputs are adequately mainstreamed into the district development planning process. The DCPC will prepare and present quarterly project progress reports to the District Executive Committee (DEC), which will also be shared with DoDMA and UNDP.

199. *Payment modality*

Based on approved Annual Work Plans (AWPs), UNDP will make cash transfers according to the National Implementation (NIM) modality and following the procedures of the UN Harmonised Approach to Cash Transfers (HACT).

Cash transfers for activities in AWPs can be made by UNDP using the following modalities:

a) Direct cash transfers whereby cash is transferred directly to the Implementing Partner (DoDMA) prior to the start of activities based on agreed cost estimates;
b) Reimbursements whereby the Implementing Partner is reimbursed for expenditures agreed prior to the costs being incurred; and
c) Direct payments to vendors or third parties for obligations incurred by the Implementing Partners on the basis of requests signed by the designated official of the Implementing Partner.

200. Direct cash transfers shall be requested and released for programme implementation periods not exceeding three months. The Implementing Partner will be responsible for preparing and submitting monthly financial reports and requests for quarterly advance of funds to UNDP. The financial reports and requests are to be submitted according to the *Funding Authorisation and Certificate of Expenditures* (FACE) standard format due on the **10th** day of the subsequent month. Delays in submission may negatively impact the access to future advances. No new direct cash transfers will be made until at least 80% of prior advances have been satisfactorily reported against. If the implementing partner does not fully liquidate any advances within 5 months from date of transfer, UNDP will suspend any further Direct Cash Transfer until the Implementing Partner clears all outstanding Direct Cash Transfer.

201. Reimbursements of previously authorized expenditures shall be requested and released quarterly or after the completion of activities. UNDP shall not be obligated to reimburse expenditures made by the implementing partner over and above the authorized amounts. Following the completion of any activity, any balance of funds shall be reprogrammed by mutual agreement between the implementing partner and UNDP, or refunded.

202. As per HACT procedures, UNDP will conduct HACT assurance activities including spot checks and onsite reviews on a regular basis based on the findings of HACT micro-assessments.

203. DoDMA will be responsible for the management of a project specific bank account where the advance of basket funds will be deposited by UNDP on a quarterly basis. Based on the quarterly work plan prepared by DoDMA, UNDP will review the request for advance and disburse the appropriate amount. The National Project Coordinator will be accountable for the use of funds advanced to the project according to agreed upon work plans. DoDMA will be expected to maintain books of accounts in accordance with UNDP's NIM accounting and reporting guidelines.

204. In terms of the rates applied for Daily Subsistence Allowances (DSA), the harmonised DSA guidelines as stipulated in the guidance note effective 21stOctober, 2011 will be strictly applied. UNDP will make sure that the correct rates are applied and inform DoDMA accordingly whenever the rates are adjusted.

205. *UNDP Support Services*

Upon request by Government, UNDP may provide direct project services in the following areas:

- Assistance with and/or recruitment of long-term or short-term technical personnel in accordance with UNDP rules and regulations.
- Procurement of specific goods and services for the project in cases where UNDP has a competitive advantage, e.g. import of specific goods or services from abroad. However, in general procurement will be done using national procurement systems and procedures where possible as long as key principles of competitiveness, accountability and transparency are followed.
- Identification and facilitation of training activities.

206. The above are considered services, which are beyond UNDP's role as a GEF IA. Direct Project Costs (DPCs) are costs incurred by UNDP when providing Direct Project Services (DPS). In accordance with UNDP policies and GEF Council requirements, the cost of any anticipated DPS to be incurred by UNDP need to be clearly identified and estimated in the project document. The costs should be calculated on the basis of estimated actual costs or transaction-based costs, using the UPL (for standard service transactions) or Local Price List template (for non-standard service transactions), as a reference point. DPCs must not be charged as a flat percent, as this would not equate to actual or transaction-based costs. DPCs should be charged to the separate account code: "74599-UNDP cost recovery charges-Bills", until such further notice is given. The costs of direct project services, if they are incurred, need to be fully recovered. That being said, however, they are never mandatory. They are only provided upon the request of and in agreement with the implementing partner. These arrangements should be documented in a Letter of Agreement (LOA), as UNDP will be acting as a 'Responsible Party'. DPCs need to be funded from within the 'Project Management Cost (PMC)' allocation provided by GEF to the Implementing Partner. DPCs charged by a UNDP Country Office cannot exceed the total PMC allocation. In the case of this LDCF project, the need for direct Project costs will be determined during the inception phase of the project.

6 MONITORING FRAMEWORK AND EVALUATION

207. The project will be monitored through the following M& E activities. The M&E budget is provided in the table below. The M&E framework set out in the Project Results Framework in Part III of this project document is aligned with the AMAT and UNDP M&E frameworks.

208. **Project start**: A Project Inception Workshop will be held within the first 2 months of project start with those with assigned roles in the project organization structure, UNDP country office and where appropriate/feasible regional technical policy and program advisors as well as other stakeholders. The Inception Workshop is crucial to building ownership for the project results and to plan the first year annual work plan.

209. The **Inception Workshop** should address a number of key issues including:
- Assist all partners to fully understand and take ownership of the project. Detail the roles, support services and complementary responsibilities of UNDP CO and RCU staff vis-à-vis the project team. Discuss the roles, functions, and responsibilities within the project's decision-making structures, including reporting and communication lines, and conflict resolution mechanisms. The Terms of Reference for project staff will be discussed again as needed.
- Based on the project results framework and the LDCF related AMAT set out in the Project Results Framework in Section III of this project document, and finalize the first annual work plan. Review and agree on the indicators, targets and their means of verification, and recheck assumptions and risks.
- Provide a detailed overview of reporting, monitoring and evaluation (M&E) requirements. The Monitoring and Evaluation work plan and budget should be agreed and scheduled.
- Discuss financial reporting procedures and obligations, and arrangements for annual audit.

- Plan and schedule PB meetings. Roles and responsibilities of all project organisation structures should be clarified and meetings planned. The first PB meeting should be held within the first 12 months following the inception workshop.

210. An **Inception Workshop report** is a key reference document and must be prepared and shared with participants to formalize various agreements and plans decided during the meeting.

Quarterly:
- Progress made shall be monitored in the UNDP Enhanced Results Based Management Platform.
- Based on the initial risk analysis submitted, the risk log shall be regularly updated in ATLAS. Risks become critical when the impact and probability are high. Note that for UNDP/GEF projects, all financial risks associated with financial instruments such as revolving funds, microfinance schemes, or capitalization of ESCOs are automatically classified as critical on the basis of their innovative nature (high impact and uncertainty due to no previous experience justifies classification as critical).
- Based on the information recorded in Atlas, a Project Progress Reports (PPR) can be generated in the Executive Snapshot.
- Other ATLAS logs will be used to monitor issues, lessons learned. The use of these functions is a key indicator in the UNDP Executive Balanced Scorecard.

211. Annually: Annual Project Review/Project Implementation Reports (APR/PIR): This key report is prepared to monitor progress made since project start and in particular for the previous reporting period (30 June to 1 July). The APR/PIR combines both UNDP and GEF reporting requirements.

212. The APR/PIR includes, but is not limited to, reporting on the following:
- Progress made toward project objective and project outcomes - each with indicators, baseline data and end-of-project targets (cumulative)
- Project outputs delivered per project outcome (annual).
- Lesson learned/good practice.
- AWP and other expenditure reports
- Risk and adaptive management
- ATLAS QPR

213. **Periodic Monitoring** through site visits: UNDP CO and the UNDP-GEF region-based staff will conduct visits to project sites based on the agreed schedule in the project's Inception Report/Annual Work Plan to assess first hand project progress. Other members of the Project Board may also join these visits. A Field Visit Report/BTOR will be prepared by the CO and UNDP RCU and will be circulated no less than one month after the visit to the project team and Project Board members.

214. **Mid-term of project cycle**: The project will undergo an independent Mid-Term Review at the mid-point of project implementation. The Mid-Term Review will determine progress being made toward the achievement of outcomes and will identify course correction if needed. It will focus on the effectiveness, efficiency and timeliness of project implementation; will highlight issues requiring decisions and actions; and will present initial lessons learned about project design, implementation and management. Findings of this review will be incorporated as recommendations for enhanced implementation during the final half of the project's term. The organization, terms of reference and timing of the mid-term review will be decided after consultation between the parties to the project document. The Terms of Reference for this Mid-term review will be prepared by the UNDP CO based on guidance from the Regional Coordinating Unit and UNDP-GEF. The LDFC/SCCF AMAT as set out in the Project Results Framework in Section III of this project document) will also be completed during the mid-term evaluation cycle.

215. **End of Project**: An independent Terminal Evaluation will take place three months prior to the final PB meeting and will be undertaken in accordance with UNDP-GEF guidance. The terminal evaluation will focus on the delivery of the project's results as initially planned (and as corrected after the mid-term review, if any such correction took place). The terminal evaluation will look at impact and sustainability of results, including the contribution to capacity development and the achievement of global environmental benefits/goals. The Terms of Reference for this evaluation will be prepared by the UNDP CO based on guidance from the Regional Coordinating Unit and UNDP-GEF. The LDFC/SCCF AMAT as set out in the Project Results Framework in Section III of this project document) will also be completed during the terminal evaluation cycle. The Terminal Evaluation should also provide recommendations for follow-up activities and requires a management response, which should be uploaded to PIMS and to the UNDP Evaluation Office Evaluation Resource Center (ERC).

216. **Learning and knowledge sharing**: Results from the project will be disseminated within and beyond the project intervention zone through existing information sharing networks and forums. The project will identify and participate, as relevant and appropriate, in scientific, policy-based and/or any other networks, which may be of benefit to project implementation though lessons learned. The project will identify, analyze, and share lessons learned that might be beneficial in the design and implementation of similar future projects.

217. There will be a two-way flow of information between this project and other projects of a similar focus.

218. Audit: Project will be audited in accordance with UNDP Financial Regulations and Rules and applicable audit policies.

Table 5. Project Monitoring and Evaluation

Type of M&E activity	Responsible Parties	Budget US$ *Excluding project team staff time*	Time frame
Inception Workshop and Report	▪ DoDMA Director and PS DRM personnel ▪ PIU ▪ UNDP CO, UNDP GEF	Indicative cost: 10,000	Within first two months of project start up
Measurement of Means of Verification of project results.	▪ UNDP GEF RTA/DoDMA Director and PS DRM personnel will oversee the hiring of specific studies and institutions, and delegate responsibilities to relevant team members. ▪ PIU, esp. M&E expert	To be finalized in Inception Phase and Workshop.	Start, mid and end of project (during evaluation cycle) and annually when required.
Measurement of Means of Verification for Project Progress on *output and implementation*	▪ Oversight by DoDMA Director and PS DRM personnel ▪ PIU, esp. M&E expert ▪ Implementation teams	To be determined as part of the Annual Work Plan's preparation. Indicative cost is 20,000	Annually prior to ARR/PIR and to the definition of annual work plans
ARR/PIR	▪ DoDMA Director and PS DRM personnel ▪ PIU ▪ UNDP CO ▪ UNDP RTA ▪ UNDP EEG	None	Annually

Type of M&E activity	Responsible Parties	Budget US$ *Excluding project team staff time*	Time frame
Periodic status/ progress reports	▪ DoDMA Director and PS DRM personnel and team	None	Quarterly
Mid-term Review	▪ DoDMA Director and PS DRM personnel ▪ PIU ▪ UNDP CO ▪ UNDP RCU ▪ External Consultants (i.e. evaluation team)	Indicative cost: 30,000	At the mid-point of project implementation.
Terminal Evaluation	▪ DoDMA Director and PS DRM personnel ▪ PIU ▪ UNDP CO ▪ UNDP RCU ▪ External Consultants (i.e. evaluation team)	Indicative cost : 45,000	At least three months before the end of project implementation
Audit	▪ UNDP CO ▪ DoDMA Director and PS DRM personnel ▪ PIU	Indicative cost per year: 3,000 (12,000 total)	Yearly
Visits to field sites	▪ UNDP CO ▪ UNDP RCU (as appropriate) ▪ Government representatives	For GEF supported projects, paid from IA fees and operational budget	Yearly for UNDP CO, as required by UNDP RCU
TOTAL indicative COST Excluding project team staff time and UNDP staff and travel expenses		US$ 117,000	

7 LEGAL CONTEXT

219. This document together with the UNDAF Action Plan signed by the Government and UNDP which is incorporated by reference constitute together a Project Document as referred to in the SBAA and all UNDAF Action Plan provisions apply to this document.

220. Consistent with the Article III of the Standard Basic Assistance Agreement, the responsibility for the safety and security of the implementing partner and its personnel and property, and of UNDP's property in the implementing partner's custody, rests with the implementing partner.

The implementing partner shall:

a) put in place an appropriate security plan and maintain the security plan, taking into account the security situation in the country where the project is being carried;
b) assume all risks and liabilities related to the implementing partner's security, and the full implementation of the security plan.

221. UNDP reserves the right to verify whether such a plan is in place, and to suggest modifications to the plan when necessary. Failure to maintain and implement an appropriate security plan as required hereunder shall be deemed a breach of this agreement.

222. The implementing partner agrees to undertake all reasonable efforts to ensure that none of the UNDP funds received pursuant to the Project Document are used to provide support to individuals or entities associated with terrorism and that the recipients of any amounts provided by UNDP hereunder do not appear on the list maintained by the Security Council Committee established pursuant to resolution 1267 (1999). The list can be accessed via http://www.un.org/Docs/sc/committees/1267/1267ListEng.htm. This provision must be included in all sub-contracts or sub-agreements entered into under this Project Document.

8 ANNEXES

See attached document for annexes