Science for Humanitarian Emergencies and Resilience (SHEAR) scoping study:

Annex 5 - Workshop report, London 9 December 2013

G. Pearce

10 March 2014

About Evidence on Demand

The Evidence on Demand service is led by a HTSPE Limited and IMC Worldwide Limited Joint Venture. Both firms are established development consultancies with considerable experience in managing resource centres. The Joint Venture is backed by a consortium of specialist organisations. The consortium provides technical support for developing quality assured resources, answering helpdesk enquiries and supporting consultancy services. Please go to the Evidence on Demand website (www.evidenceondemand.info) for further details.

Disclaimer

HR Wallingford

This report has been produced by HR Wallingford Ltd for Evidence on Demand with the assistance of the UK Department for International Development (DFID) contracted through the Climate, Environment, Infrastructure and Livelihoods Professional Evidence and Applied Knowledge Services (CEIL PEAKS) programme, jointly managed by HTSPE Limited and IMC Worldwide Limited.

The views expressed in the report are entirely those of the authors and do not necessarily represent DFID's own views or policies, or those of Evidence on Demand. Comments and discussion on items related to content and opinion should be addressed to the authors, via enquiries@evidenceondemand.org

Your feedback helps us ensure the quality and usefulness of all knowledge products. Please email enquiries@evidenceondemand.org and let us know whether or not you have found this material useful; in what ways it has helped build your knowledge base and informed your work; or how it could be improved.

DOI: http://dx.doi.org/10.12774/eod_cr.june2014.pearce

First published June 2014

EVIDENCE ON DEMAND
CLIMATE & ENVIRONMENT
INFRASTRUCTURE | LIVELIHOODS

Contents

List of Tables

SECTION 1

Introduction

1.1 Background

One of the Department for International Development's (DFID) responsibilities is to provide humanitarian aid targeted at the most vulnerable people and promote effective disaster risk reduction and climate change adaptation (DFID, 2011). This links to the recommendations of the Science in Humanitarian Emergencies and Disasters (SHED) Report (GO-Science, 2012). The Science for Humanitarian Emergencies and Resilience (SHEAR) programme is a potential future programme that DFID is currently preparing with the aim of investing in research to bring forward the next generation of more systematic, transparent and comprehensive risk information and early warning systems for humanitarian and development purposes in the Africa, South Asia and Caribbean regions.

As part of the Scoping Study for the SHEAR Programme, a workshop was held on 9 December 2013 at the Wellcome Trust in London. The workshop was attended primarily by UK-based researchers working in the three regions. The workshop was based around group-based discussions on:

- Current relevant research, and identification of research gaps
- Identifying research needs related to the integration of risk assessments and early warning systems into decision-making in low income countries
- Recommendations for research priorities in the SHEAR programme

Forty experts participated in four mixed-groups. The stakeholder groups represented were academics, research institutes, private sector specialists, international Non-Governmental Organisations (NGOs) and staff from DFID; all of whom were represented by experts with direct interest in risk assessment and early warning systems in low income countries in the three regions. The discussions were run under the Chatham House rule.

1.2 Objectives

The objective of the workshop was to gain a better understanding of what opportunities exist to make a significant difference to the progress and uptake of research on risk assessment and early warning systems for weather-related hazards. The workshop achieved this by assessing perceived gaps, needs and priorities, against an awareness of the large amount of existing initiatives already underway.

This report provides a synthesis of the main ideas and suggestions put forward by the workshop participants. These ideas were fed into the findings of the study's final report.

SECTION 2

Promising research areas

2.1 Existing relevant research initiatives

The following represents a summary of the participants' ideas of areas of research and new tools that show promise in improving early warning systems and risk assessments for weather-related hazards in the three regions on which SHEAR is focused.

2.1.1 Data from new and existing satellites

There are a number of new satellites that have either recently been put into orbit or are planned to be put into orbit in the next two years that are of relevant to the SHEAR programme. Participants noted that many of these missions could provide useful information to improve risk assessments and early warning systems for weather-related hazards in the three regions.

A summary of the satellites that were mentioned by stakeholders is provided in Table 1. Two of these satellites, the Global Precipitation Measurement and Soil Moisture Active Passive could help to provide significant improvements in hydrology, climate science, drought prediction and flood forecasting for the three regions. In particular, it was noted that data, both raw and projected, will be made freely available by the National Aeronautics and Space Administration (NASA).

Satellite name	Background information
Global Precipitation Measurement (GPM)	National Aeronautics and Space Administration's (NASA) Global Precipitation Measurement mission will set new standards for precipitation measurements worldwide using a network of satellites united by the GPM Core Observatory This satellite will be launched in February 2014.
Soil Moisture Active Passive (SMAP)	NASA's Soil Moisture Active Passive satellite, which will be launched in November 2014, will monitor land surface soil moisture globally every two to three days on a 3 km by 3 km grid. SMAP data will be coupled with hydrological models to infer soil moisture conditions.
Advanced Earth Observing Satellite 2 (AEDOS II)	The AEDOS II satellite project measures near-surface wind velocity over all the world's oceans. It combines wind data with other measurements to understand mechanisms of global climate change and weather patterns.

Table 1 New and forthcoming satellites that are relevant to SHEAR

2.1.2 Severe Weather Forecasting Demonstration Project (SWFDP)

The World Meteorological Organisation's (WMO) Severe Weather Forecasting Demonstration Project (SWFDP) links National Meteorological and Hydrological Services in low-income countries to improved forecasts and warnings of severe weather. It uses a cascading forecasting process (i.e. global to regional, regional to national) to improve the lead-time and reliability for alerts about high-impact events such as heavy precipitation, severe winds and high waves. It has strengthened interaction with disaster management and civil protection agencies, local communities and media. SWFDP's present five day forecasts should be extended to longer time scales, and to other regions (subject to review of lessons so far learned).

2.1.3 High Impact Weather Prediction Project (HIWPP)

The aim of this project is to improve minutes-to-weeks prediction accuracies in the context of a changing climate. This project, planned by WMO, is an extension to The Observing-System Research and Predictability Experiment (THORPEX) programme and aims to improve resilience to high impact weather by improving decision-level information. The work is part of a seasonal forecasting initiative of the World Weather Research Program (WWRP) which is in its initial stages.

2.1.4 CLIM-WARN

The United Nations Environment Programme (UNEP) is developing a concept for a UN-wide (i.e. global) multi-hazard global early warning system for climate-related extreme weather events that will protect populations by providing them with timely and actionable warnings against extreme climate events such as heat waves, forest fires, floods and droughts, known as CLIM-WARN There are three case study countries: Kenya, Ghana, and Burkina Faso.

2.1.5 Probability, Uncertainty and Risk in the Environment (PURE)

Probability, Uncertainty and Risk in the Environment (PURE) is a new action that has been prioritised by the Natural Environment Research Council (NERC) to increase the impact of NERC natural hazards research and to take a national leadership role in changing the way in which uncertainty and risk are assessed and quantified across the natural hazards community. The PURE action has two elements:

- The PURE programme (the research programme)
- The PURE network (the research and knowledge exchange network)

The two high-level goals are:

- To improve the assessment and quantification of uncertainty and risk in natural hazards by developing new methods and demonstrating their applicability
- To stimulate good practice guidance and standardisation of the assessment and quantification of uncertainty and risk across the natural hazard community.

2.1.6 Integration of warning systems for different hazards

For a given location or region, the integration of data processing and risk analysis between primary, secondary and tertiary hazards can help in building resilience. Such an integrated approach can help to improve the understanding of the impacts of respective hazards on different communities. However, further work will be needed on assessing the economic and social effects on vulnerable communities. Integration is also assisting in understanding how decision-making to tackle one hazard may impact on another. The recent storms in the UK were a good-example of how forecasting, warning and response came together. Communities, and more importantly, responsible local authorities were able to understand the type of threat imminent to them (e.g. storm surge or the location of anticipated flood hydrographs) and react appropriately. This preparedness saved lives and helped to limit damage to infrastructure.

2.1.7 Use of modern communication technology

Linking into the world of smart phones could assist with effective dissemination of “big data” upload/download to communities at large. “Crowd sourcing” can be utilised to produce maps. The technology is in place; however, further work is there needed to show how it can be used effectively to reduce the risk to vulnerable communities in low-income countries.

2.1.8 Early warning systems at seasonal time-scales

Seasonal forecasting can greatly assist in managing drought risks in agriculture, particularly in risk-prone rain-fed environments, by providing planners and farmers with timely information, and allowing them to decide upon the most suitable coping strategies over short time scales. For example in the Horn of Africa and the Sahel, information on expected water shortfalls during a forthcoming cropping season are useful to planners responsible for implementing early action to avoid potential famines occurring. The increased emphasis on improving these systems is largely the result of the mounting impacts of drought, reflecting greater societal vulnerability.

2.2 Major gaps for research

The participants discussed gaps in the research relevant to the SHEAR study. These are summarised below:

- **Integration of early warning and risk models** integrating early warning and risk models (e.g. a drought forecast model with a crop failure models) was considered to be a notable gap at present. This would help to reduce the impacts of weather-related hazards on vulnerable communities.

- **Decision-making** There is a need for improved decision making under uncertainty, including better development of visualisation aids.

- **Cultural aspects** The cognitive aspect of disasters, and associated decision-making, will vary according to local cultural aspects. This variation needs to be better understood so that warning messages can be couched appropriately to the intended user audience. Furthermore, there needs to be better characterisation of what current risks locally communities are most concerned about.

- **Meteorological research gaps** There are number of gaps in this area that participants summarised as follows:
  - Suitable observation sets to initiate the use of numerical models
  - Better assimilation of satellite data
  - Capacity in different countries to use space-based information
  - Downscaling of data
  - Predicting the distribution of extreme events is reasonably good; however, predicting their intensity needs to be improved
  - There is a need for improved calibration of impacts models, as well as for satellite data models
  - Use of past climatological data and knowledge for reanalysis and risk assessment
  - There is a need for improving methods to combine uncertainty in models, this is often not done at present
  - Prediction using ocean surface monitoring

- Tropical cyclone tracking is presently carried out at short timescales to give warning, but analysis at seasonal timescales could potentially identify cyclone probability ahead of the season
    - Validation of early warning systems needs to be done
    - Improved causality linking predictions to impacts
    - Improved use of longer term projections
    - Interdisciplinary research i.e. turning meteorological data into crop predictions or impacts on livelihoods
    - Determining risk by combining information from different models
    - Even when forecasting is accurate there are still challenges to predict what separates a bad storm from a disastrous one

- **Resilience in least developed countries** There has only been limited research on how to create resilience in low-income countries. There is considerable research required developing appropriate measures to improve vulnerable communities' resilience to weather-related hazards.

- **Use of technology** There has been little research carried out in the use of Information Technology such as smart phones and visualisation technology. This visualisation capability is most important in disseminating information in a useful, useable form, e.g. with respect to decision-making and its associated uncertainties. There is a need to integrate technology and data to prioritise hazard response and build long-term resilience and thereby improve mitigation and preparedness within the beneficiary communities.

- **Communicating uncertainty** There is a need for research how the uncertainty can be communicated appropriately to relevant stakeholders both in early warning systems and risk assessments.

- **Local decision-making** There is research to be done on what "risk" means at a local level, and how that effects local risk planning. The active process of making decisions (e.g. probability thresholds and "trigger levels" for early action) need to be investigated so that it can be prioritised. Such decision-making is constrained by gaps in decision chains, and in the chains of information down to local level.

- **Social interventions** Research is required on how to persuade communities to avoid hazard risk problems posed by providing them with incentives not to move into vulnerable areas.

- **Multiple and cascading hazards** There is a need for focusing research on multiple and cascading hazards. For example, how assessments of multi-hazard risks can be carried out effectively for the most vulnerable communities in low income countries using relatively limited data

SECTION 3

New approaches for research and areas where research could add value

3.1 Research approaches that best meet users' needs

The participants discussed the approaches to research that could best meet users of information needs. These are briefly summarised below.

3.1.1 Encourage uptake and understanding the users' needs

Participants felt that science needs to "meet up" with the users. The need to encourage people to understand/use information and models, and to carry out research into decision-making under uncertainty was expressed. In inviting and responding to feedback from users of the information, researchers and suppliers of information should be ready to shape their available information to match the end-user need e.g. give crop forecast rather than weather forecast. This would necessarily involve two-way discussion with users, and also, importantly, two-way discussion *between* the users themselves. An example of this interaction would be to engage the users in collecting the data and also possibly in designing the warnings and the systems. This would assist in building the credibility of forecasts from early warning systems and add to local relevance. However, it might be necessary to split how outgoing information is divided (e.g. between different levels of users such as: Government, NGOs, community). Different countries have different warning systems so it will depend on their respective national infrastructures. Efforts should be made to understand key bodies where cooperation is likely to lead to success. This could be done via a fellowship system where after a disaster a scientist is embedded in a region (e.g. a "rent-a-scientist" scheme) so that their science could be better shaped to the issue.

3.1.2 Targeted climate research

Climate research should be targeted on particular areas of Africa and South Asia (e.g. some aspects of the prediction of the monsoon are still very poor). This leads on to a second aspect to the approach, that research should be looked at through the "lens" of a particular country. There needs to be ownership within the country but new science still needs to feed into this. National centres need to be involved in research e.g. hydrological research. At the same time, some forecasting systems around the world should be harmonized.

3.1.3 Linkage to users' needs

In terms of evolving areas where the quality and extent of meteorological data are getting better, these areas should be linked to the user needs. The information derived as a result of this work needs to be fit for purpose, and for the decisions being made. For instance the amount of uncertainty linked to a risk or warning that is conveyed to users should probably be adjusted to different situations, for instance by giving a crop forecast rather than a weather forecast.

3.1.4 Community level response

In order to prime peoples' awareness about risk assessment and early warning messages, key barriers to response at community level need to be addressed; in particular how do the messages filter through. In systems where there are gaps in the chain, improving the forecast will not help the response.

3.1.5 Participatory approach to research

There is a need for a "dialogues-based approach" at national level because there are political issues with data sharing. A participatory approach to research would include the communities (e.g. farmers) in the research approach. This could also help determine what specific additional decision support assistance would be needed for specific countries/regions, or for particular types of communities.

3.1.6 Multi-disciplinary approach

There is a clear need for the challenges of risk assessment and early warning to be addressed by multidisciplinary groups of people. Complexity of information has to be rationalised against the likely urgency of the risk event that is being watched out for. Given the complexity of the situation, it may not be possible to prioritise which particular approach should be used. However, it will be important to include mechanisms that bring in local knowledge.

3.1.7 Learning from previous events in high income countries

Research into risk assessments and early warning in countries where there has been success, will help identify what has worked. Given the nature of the technology utilised, this should look at high-income countries rather than low-income countries. It is also important to learn from failures. For example when a weather-related event causes significant damage it is important to investigate whether this was this due to failures in the forecasting process, engineering issues such as defects in the flood bunds, or because of the event's extreme nature. These will help determine the inherent vulnerabilities of different locations and situations. Learning from regions where the flow of information works well is a potential way to build up good practice (e.g. Japanese response to earthquakes).

3.2 Areas where the proposed research programme could add value

The participants discussed areas where they felt that the proposed SHEAR programme could add value. The areas discussed by the participants are summarised below.

3.2.1 Decision support systems

A decision support system needs to reflect the context in which the decision-making will be made. It needs to be able to assist in bridging between absorbing relevant information and achieving the desired response. Much research is being carried out without the involvement of potential users and intended beneficiaries. There is a strong need to involve the end users. There is also a need to examine why some decision support initiatives have not been successful, for instance whether more pragmatic, less academic approach is needed.

3.2.2 Encouraging multi-disciplinary approaches

Investigations into improving decision-making and how it is affected by cognitive limitations, will benefit from promotion of inter-disciplinarily, especially including cultural specific aspects with natural science analyses. There is an opportunity to design programme funding mechanisms so that understanding of varying hazards and their respective impacts can be integrated into "broad reach research".

3.2.3 Improving the understanding about the problems faced

For floods and tropical cyclone risk it is difficult to obtain digital terrain models that are good enough to improve risk calculation down to the local community level. With respect to exposure development, what information is available to assist in using this approach. There is scope to expand use of the "One health concept" (which focuses on human health, animal health and environmental health to centralise understanding about disease spread for example).

3.2.4 Closer links with users of the information

By knowing who the users of the information are, and identifying the range of particular problems that face them, researchers can better frame their analysis projects and their research and development initiatives to develop appropriate solutions.

3.2.5 Available information

It is important to make sure data is fit for purpose and that it is actually used. When downscaling information there are operational difficulties concerning where it is appropriate to use deterministic or probabilistic information, that need to be resolved. Furthermore there is researchable work to be done: on how the information cascades down, and on what indicators to use that will be most appropriate for users. There is a need to make proper use of high resolution information, for instance better pull-through to impact risk assessment and warning.

SECTION 4

Conclusions

In terms of research priorities the participants' suggested research priorities could be generally prioritized as follows:

1. **Improvements in intra-seasonal forecasting** Research into intra-seasonal risk should cover key gaps, i.e. intense rainfall, longer dry spells, extreme temperatures and their impacts. Approximately one-third of the world's population lives in countries influenced significantly by climate anomalies. Many of these are low-income countries have economies that are largely dependent upon their agricultural and fishery sectors were improvements. Research into this area could yield significant societal benefits for people living in these areas.

2. **Multi-hazard risk assessments and cascading risks** The objective of multi-hazard risk assessments is to establish a ranking and/or integration of the different types of risk taking into account possible cascade effects (i.e. the situation for which an adverse event triggers one or more sequential events) posed by weather-related hazards. There is a need to research how these techniques can be developed with users in low income countries.

3. **Decision making under uncertainty** Understanding the uncertainties is critical to characterising risks and developing approaches to decision-making. This is an area where participants felt that there was a need for further research.

4. **Monitoring and evaluation of the use of the effectiveness of early warning systems** There is a need to carry effective monitoring and evaluations of early warning systems to ensure that they are having the intended impact on beneficiaries in low income countries.

5. **Methods of communication for early warnings** At the community level, social interpretation of physical hazards can be significantly shaped by how risks are communicated. There is need to carry out further research into how to improve the communication of both early warnings and risk to vulnerable communities in low income countries and also how to set this information in a relevant context. This could include looking into appropriate visualization techniques.

6. **Vulnerability information** There is a need to research how information on the vulnerability of communities to weather-related hazards can be obtained and assessed using appropriate methods.

7. **Extensive risk** The past 20 years have seen an exponential increase in the number of local areas reporting losses, the number of houses damaged, the number of people affected, and the damage to health and educational facilities associated with extensive disasters (UNISDR, 2011). There is a need to carry out research into how extensive risk can be ameliorated because this is often closely related to the challenges low income countries face in addressing underlying risk drivers and increasing resilience to weather-related hazards.

8. **Resilience** In low income countries where resources are often limited, resilience is critical to a community's ability to reduce long recovery periods after a disaster.

Further research is need on methods via which vulnerable communities can enhance their resilience to weather related hazards.

9. **Use of Information and Communication Technology (ICT)** Effective disaster response demands rapid access to reliable and accurate data and the capacity to assess, analyse and integrate information from varied sources. Recent developments in low income countries and the penetration of mobile phones in the three regions means that there are many areas in which the use of Information and Communication Technology (ICT) both in improving risk assessments and early warning systems for weather related hazards needs to be explored further.

References

DFID, 2011 *Humanitarian Emergency Response Review: UK Government Response*
GO-Science, 2012, *The Use of Science Advice in Humanitarian Emergencies and Disasters, Special report, UK Government Office for Science* (SHED)

UNISDR, 2011, *Revealing risk, redefining development: The 2011 Global Assessment Report on Disaster Risk Reduction*, United Nations International Strategy for Disaster Reduction

UNISDR, 2013, *From Shared Risk to Shared Value: the Business Case for Disaster Risk Reduction: The 2013 Global Assessment Report on Disaster Risk Reduction*, United Nations International Strategy for Disaster Reduction