Draft concept note for a technical workshop on analyzing the socio-economic utility of weather and climate information services for different development sectors in Africa

Background

Extreme climate events such as droughts, heat waves, floods have huge impacts on society and ecosystems and their trends are thought to be correlated with global climate change (EICC, 2009). Particularly in vulnerable countries and communities in Africa, the combination of increasing temperatures and shifting rainfall amounts and patterns will have severe impacts on agriculture systems and food security with huge consequences of loss of life and livelihoods (UNFCCC, 2006). In addition to its impact on agriculture and food security, extreme climate events affect water resources management in the region. These include flooding, drought, sea-level rise in estuaries, drying up of rivers, precipitation and water vapor pattern distortions, snow and land ice mal-distribution, and changes in both ground and surface water supply for domestic, agricultural and industrial uses, including irrigation, hydropower generation, navigation and fishing (Walter et al., 2004; Milly et al., 2005; Bates et al., 2008; IPCC, 2008). These effects when compounded together have devastating impacts on ecosystems and communities, ranging from economic and social impacts to health impact, all of which threaten the continued existence of many regions in Africa (Urama & Ozor, 2010).

The utility of timely and accurate weather and climate information is vital to the day to day decision making of African people whose livelihood are highly dependent on weather and climate information. The aim of weather and climate services is to provide people and organizations with timely, tailored climate-related knowledge and information that they can use to reduce climate-related losses and enhance benefits, including the protection of lives, livelihoods, and property (Vaughan and Dessai, 2014). Making weather and climate information accessible, timely and relevant can help these communities to build their own resilience to future climate change and take advantage of opportunities provided by favorable climatic conditions to reduce poverty and enhance sustainable economic growth (Jones et al., 2015). Studies indicate that weather and climate services improve smallholders' livelihoods in Africa (e.g. Patt et al., 2005) and as a result there is a high demand for these services among subsistence farmers. For example, a survey conducted by CGIAR/CCAFS to examine the need for climate products and services among smallholder farmers in East and West Africa confirmed that there is so much demand for such products and services since the available information is not adequate to help smallholders to bring the kind of climate smart development required (Kadi et al., 2011a; Kadi et al., 2011b).

However, a substantial body of the literature indicate that relatively little is known about the performance of these products and services (e.g. Hartmann et al., 2002; Cash et al., 2006; Lavers et al., 2009). That is, there is a gap in evidence which remain an obstacle to the level of investment needed to build the resilience of smallholder agriculture and create an enabling environment for climate-smart agriculture at scale. As a result, it is difficult to assess the extent to which individual climate services or weather and climate services in general live up to the promise of benefiting the society at large. This leaves weather and climate service providers and funding agencies with very little information about the quality and relative value of weather and climate services (Vaughan and Dessai, 2014). Therefore, the aim of this work is to assess the value for money of these services in order to provide evidence for the providers of these services to determine whether to invest in, or continue investing in the provision of weather and climate information services to improve or perhaps even maintain these services (Anaman, 1995; Freebairn & Zillman, 2002). Demonstrating the socio-economic benefit of these services can also help potential users of the services to understand the use and benefits of forecasts so that they know how and why they could use weather and climate information, it also help them in involving and supporting service providers and help to understand user needs and values to prioritize the types of information to generate and determine how best to disseminate that information (Zillman, 2007; Lazo et al., 2009). According to Perrels et al. (2013), the societal value of, and benefits from, weather and climate information services can be greatly enhanced by establishing a much closer dialogue and sense of partnership between the provider and user communities at all levels. Hence, this work will be jointly implemented by AGRHYMET, ICPAC and will draw on UNECA's unique expertise in macro-economic and social development policy work.

Scope of activities

The work will begin with a scoping study on existing usage of weather and climate information in policy and decision making in Africa, including a review of methodologies and models used to assess socio-economic performance in relation to climate information. A series of hands-on training sessions on economic assessments of weather and climate forecast and their applications to decision making in different sectors will be provided to the user community, regional climate centers (RCCs) and national meteorological and hydrological services (NMHS). A community of practice on economic utility of weather and climate forecasts in Africa will be established. Preliminary work on a framework for economic utility of weather and climate forecasts will also be established.

Methodology

One of the main goals of this work is the creation of a framework for the proper estimation of the investments required, resulting avoided costs and added benefits brought about by the increased availability and dissemination of weather information.

Examining through the literature, the estimation of the socio-economic benefit of weather and climate information services can be found primarily in the developed world (e.g. Anaman et al., 1995; Rollins & Shaykewich, 2003; Frei, 2009; Clements et al., 2013; WMO, 2015), whereas, in Africa there are only a couple of studies that estimate the socio-economic benefit of weather and climate services (Hansen et al., 2009; Sultan et al., 2010; Roudier et al., 2016) mainly applying a market based approach. This demonstrates the existence of limited evidence in the estimation of benefit. In order to overcome the current knowledge gap in the quantitative evidence in the estimation of the socio economic benefit of weather and climate services in Africa, an in depth review of the literature for the identification of gap in methods and data would be an important first step.

The challenge is to develop a framework that captures required investments, resulting avoided costs as well as added benefits. *Investments* represent the cost of intervention, across various economic actors. As a result, investments include capital costs, which can be shared across economic actors through the use of incentives (provided by the government) and co-financing (provided by the private sector and households). The estimation of investments should also include operation and management costs (i.e. running costs) as well as the cost of financing, in case loans have to be contracted to implement the project. Investments are normally expressed in monetary terms. *Avoided costs* include those investment or policy-induced outcomes that reduce costs that would have been accrued in the baseline scenario. For instance, if the use of weather information leads to a reduction in yield loss, the avoided cost is the amount of revenue that would be accrued on top and above the loss that would have been projected in the baseline scenario. Further, avoided costs also apply to infrastructure. As an example, if a road was secured as a result of the availability of weather information (e.g. expectations for a high rainfall event), road maintenance would result to be lower than in the baseline scenario. Avoided costs are to be measured in social (e.g. avoided injuries and loss of life), economic and environmental terms. *Added benefits* include those new opportunities that emerge thanks to the implementation of a given policy or investment. For instance, if, in result of expectations for longer drought periods, different types of crops are planted, more revenues may be accrued and more jobs may be created (on top and above what would be forecasted in the baseline scenario). Added benefits are to be measured in social, economic and environmental terms.

As a result, this framework allows assessing whether an opportunity would be missed if decisions only aim at mitigating costs and passively adapt to climate change. If a more active approach were taken, new opportunities would emerge, and avoided costs could be reinvested in more resilient economic activities.

This framework is designed so that decision makers are well informed to design and implement policies that simultaneously (1) reduce the impact of climate change, and (2) create new opportunities for resilient and inclusive growth. The main aim is to adapt effectively, reduce the vulnerability of socio-economic systems in the face of adverse weather events and generate new opportunities for the growth and expansion of sectors and activities that would thrive even under the realm of projected climatic changes. All of this can be achieved through the improved collection, dissemination and use of weather information, and its integration into the decision-making process.

This framework targets three main types of analysis: (a) identification of systemic vulnerability, (b) improvement of preparedness, (c) anticipation of weaknesses (side effects) and emerging opportunities. The effective implementation of this methodology would allow for improved planning and budgetary allocation for timely and effective recovery.

The sequence of activities for the implementation of the project will be as follows:

1. Identification and selection of technical team and target sectors;
2. Literature review of relevant documents, methods and data;
3. Inception meeting to validate/review concept note and project documents and mapping out strategy for implementation;
4. First hands-on training workshop on socio economic utility of weather and climate forecasts;
5. Design, deployment and analysis of survey on core areas of current and expected operations and their effectiveness;
6. Field visits to selected RCCs and countries for data collection;

7. Second hands-on workshop on socio economic utility of weather and climate forecasts, analysis and presentation of survey data;
8. Stakeholder meeting to validate results and write up report; and,
9. Submission of report and outlook for further work.

Target institutions - RCCs and countries

The selection of RCCs and countries are done to have geographical representation and special needs that reflects ACPC priorities and focus areas. More importantly, the number and scope will be determined by financial and time constraints.

The target RCCs include the following:

- ACMAD
- ICPAC
- SADC-CSC
- AGRHYMET

The target countries will be derived from the following regional groupings and SIDS:

- SIDS: **Cape Verde**, **Mauritius**, **Seychelles**, **Guinea-Bissau**, **Sao Tome and Principe, Comoros** and **Madagascar** as a special case.
- East Africa/IGAD: Rwanda**, Ethiopia**, Djibouti, Tanzania, Uganda, Burundi and Kenya
- West Africa: Gambia, **Senegal**, Liberia, **Ghana, Nigeria, Burkina Faso** and Benin
- Central Africa: **Congo Brazzaville**, Congo, Angola, Gabon, **Cameroun** and Equatorial Guinea
- Southern Africa**: Zimbabwe**, Southern Africa, **Malawi**, Botswana, **Mozambique**, Lesotho
- North Africa: **Egypt**, Morocco, Algeria and Tunisia

The table below shows the proposed sectors and countries where the studies will be undertaken.
Table 1. Sectors, countries and actions for implementation

Sector	**Countries**	**Actions**
Agriculture and Food Security	Nigeria, Guinea-Bissau, Ethiopia, Senegal, Malawi, Zimbabwe, Ghana, Madagascar	• Establish national and regional teams; • Identify data, tools, methods and related resources • Provide training on data collection and analysis; • Identify/allocate funds and resources for activities; • Coordinate implementation of activities
Energy	Ghana, Seychelles, Congo Brazzaville, Cape Verde	
Health	Nigeria, Cameroon, Madagascar	
DRR	Mozambique, Madagascar, Mauritius, Comoros	

All the RCCs and countries above will benefit from the training activities and could be extended to more countries, depending on availability of funds. However, the countries where economic analysis of weather and climate forecasts will be undertaken for selected sectors are marked in bold. These countries are also selected to overlap with WISER project output 1.2 activities on the technical needs assessment of NMHSs.

Potential implementing Partners

The proposed implementing partners will be selected from the following:

- WMO Regional Offices in Western, Central, Northern, Eastern and Southern Africa
- UNECA Regional Offices in Western, Central, Northern, Eastern and Southern Africa
- GFCS
- AMCOMET
- RAI
- AU/MESA
- WISER East Africa Project
- ACMAD
- ICPAC
- AGRHYMET
- SADC-CSC
- UNFCCC
- UNDP
- NEPAD

Expected results

The main results include:

- Established framework, tools, methods, data and infrastructure for the operationalization of the assessment of the economic utility of weather and climate forecasts for decision making in selected sectors,
- Established community of practice on economic utility of weather and climate forecasts in decision making; and,
- A comprehensive report detailing activities undertaken, recommendations for scaling up results in other sectors and countries across Africa.

Reference

Anaman, K.A., Thampapillai, D.J., Henderson-Sellers, A., Noar, P.F. & Sullivan, P.J. (1995). Methods for assessing the benefits of meteorological services in Australia. Meteorological Applications 2: 17-29.

Bates, B.C., Kundzewicz, Z.W., Wu, S., and Palutikof, J.P. (eds) (2008) Climate Change and Water. Technical Paper of the Intergovernmental Panel on Climate Change. IPCC Secretariat, Geneva: 210pp.

Bateman, I.J., Carson, R.T., Day, B., Hanemann, W.M., Hanley, N., Hett, T., Jones-Lee, M., Loomes, G., Mourato, S., Özdemiroˇglu, E., Pearce, D.W., Sugden, R. & Swanson, J. (2002). Economic valuation with stated preference techniques: a manual. Edward Elgar Publishing, Cheltenham.

Cash, D.W., Borck, J.C. & Patt, A.C. (2006). Countering the loading-dock approach to linking science and decision making: comparative analysis of El Nino/Southern Oscillation (ENSO) forecasting systems. Science Technology and Human Values 31:465–494.

Champ, P.A., Boyel, K.J. & Brown, T.C. (2003). A primer on nonmarket valuation. Springer Science+Bussines Media, New York.

Clements, J., Ray, A. & Anderson, G. (2013). The value of climate services across economic and public sectors: a review of relevant literature. Technical report. U.S. Agency for International Development. Washington, DC.

Ecological Impacts of Climate Change, EICC (2009). The National Academies. Advisers to the Nation Science, Engineering, and Medicine.

Freebairn, J.W. & Zillman, J.W. (2002). Funding meteorological services. Meteorological Applications 9: 45-54.

Frei, T. (2009). Economic and social benefits of meteorology and climatology in Switzerland. Meteorological Application. DOI: 10.1002/met.156.

Hansen et al. (2009). Potential value of GCM-based seasonal rainfall forecasts for maize management in semi-arid Kenya. Agricultural Systems 101: 80–90

Hartmann, H.C, Pagano T.C., Sorooshian S. & Bales, R. (2002). Confidence builders: evaluating seasonal climate forecasts from user perspectives. Bulletin of the American Meteorological Societies 83:683–698.

Intergovernmental Panel on Climate Change, IPCC (2008) Climate Change and Water. IPCC Working Group II Technical Support.

Jones, L., Elizabeth, E., Roux, J-P & Tanner, T. (2015). Promoting the use of climate information to achieve long-term development objectives in sub-Saharan Africa: results from the Future Climate for Africa scoping phase.

Kadi, M., Njau, L.N., Mwikya, J. & Kamga, A. (2011a). The State of Climate Information Services for Agriculture and Food Security in West African Countries. CCAFS Working Paper No. 4. Copenhagen, Denmark.

Kadi, M., Njau, L.N., Mwikya, J. & Kamga, A. (2011b). The State of Climate Information Services for Agriculture and Food Security in West African Countries. CCAFS Working Paper No. 5. Copenhagen, Denmark.

Lavers, D., Luo, L. & Wood, E.F. (2009). A multiple model assessment of seasonal climate forecast skill for applications. Geographical Research Letter 36: 1-6. L23711.

Lazo, J.K., Raucher, R.S., Teisberg, T.J., Wagner, C.J. & Weiher, R.F. (2009). Primer on Economics for National Meteorological and Hydrological Services. Boulder, University Corporation for Atmospheric Research.

Milly, P.C.D., Dunne, K.A. and Vecchia, A.V. (2005) Global pattern of trends in stream flow and water availability in a changing climate. Nature 438(7066): 347-350

Patt, A., Suarez, P. & Gwata, C. (2005). Effects of seasonal climate forecasts and participatory workshops among subsistence farmers in Zimbabwe. The National Academy of Sciences of the USA 102:12623–12628.

Perrels, A., Th. Frei, Th., Espejo, F., Jamin, L. & Thomalla, A. (2013). Socio-economic benefits of weather and climate services in Europe. Advances in Science and Research 1: 1-6.

Rollins, K.S. & Shaykewich, J. (2003). Using willingness-to-pay to assess the economic value of weather forecasts for multiple commercial sectors. Metrological Application. 10, 31–38.

Roudier et al. (2016). Assessing the benefits of weather and seasonal forecasts to millet growers in Niger. Agricultural and Forest Meteorology 223: 168–180.

Sultan et al. (2010). Estimating the potential economic value of seasonal forecasts in West Africa: a long-term ex-ante assessment in Senegal. *Weather Climate and Society* DOI: 10.1175/2009WCAS1022.1

TEEB (2010). The economics of valuing ecosystem services and biodiversity. The Ecological and Economic Foundations.

United Nations Framework Convention on Climate Change, UNFCCC (2006). Climate Change: Impacts, vulnerabilities and adaptation in developing countries. Workshop report held in Africa, Asia and Latin America and one expert meeting held in Small Island developing States during 2006 – 2007.

Urama, K.C. & Ozor, N. (2010). Impact of climate change on water resources in Africa: the role of adaptation. African Technology Policy Studies Network (ATPS).

Vaughan, C. & Dessai, S. (2014). Climate services for society: origins, institutional arrangements, and design elements for an evaluation framework. WIREs Climate Change 5:587–603.

Walter, M.T., D.S. Wilks, J.Y. Parlange and B.L. Schneider (2004) Increasing evapotranspiration from the conterminous United States. J. Hydrometeorol. 5: 405-408.

WMO (2015). Valuing Weather and Climate: Economic Assessment of Meteorological and Hydrological Services. WMO – No. 1153. CH-1211 Geneva 2, Switzerland.

Zillman, J.W. (2007). Economic Aspects of Meteorological Services. Presented at the Bureau of Meteorology-WMO Workshop on Public Weather Services, Melbourne. September 10–14.