THE SUDD INSTITUTE
RESEARCH FOR A PEACEFUL, JUST AND PROSPEROUS SOUTH SUDAN

P. O. Box 34, Juba, South Sudan • Tel: +211 (0)956 305 780
Email: thesudd.institute@gmail.com • www.suddinstitute.org

Special Report

November 27, 2018

Climate Services Model for South Sudan's Rural Farmers and Agro-pastoralists

Nhial Tiitmamer
Augustino Ting Mayai

Summary

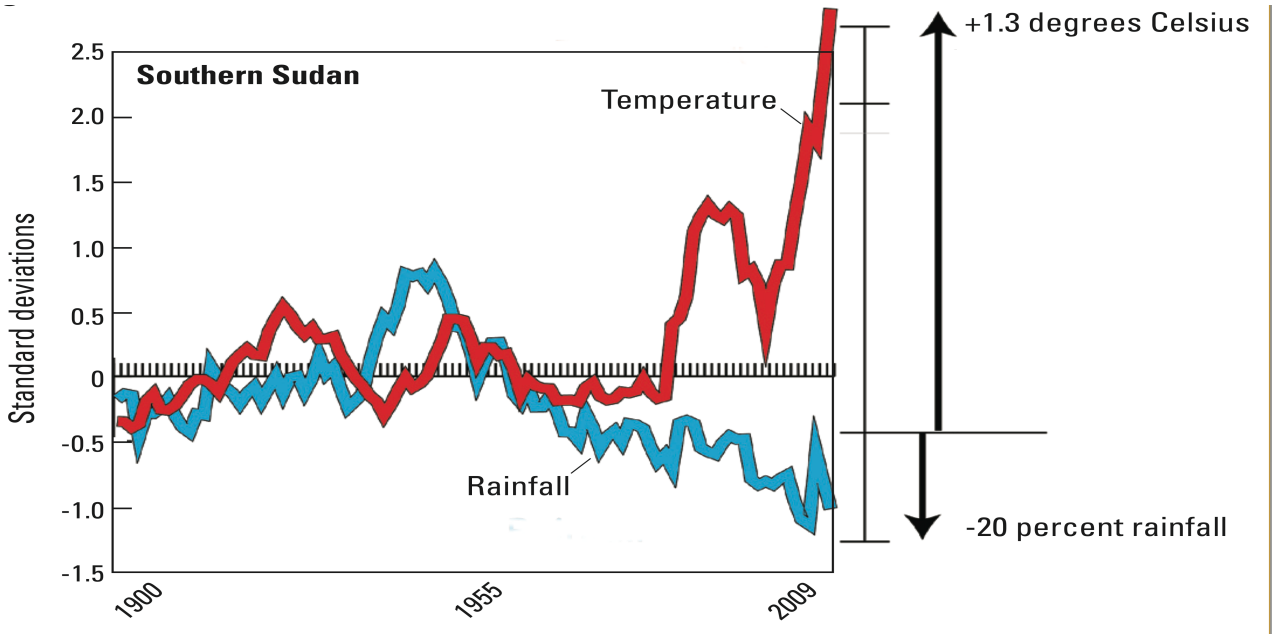
Using experimental data from a pilot project administered in rural Tonj South, Aweil West, and Aweil North, this paper studies climate services reception and application in South Sudan. The pilot climate service was first of its kind directly delivered to farmers and agro-pastoralists in the country. The results are encouraging: a vast majority of the project beneficiaries received climate conditions advice, used it, trusted it, and are now interested to make use of such services in the future. This positive reception implies a growing interest by agro-pastoralists and farmers to use weather forecasts to make informed farming decisions. We recommend a number of policies to strengthen this interest, with the objective of improving livelihoods for the rural population. First, there is need to establish a permanent national technical working group on climate services to coordinate, review, translate and disseminate climate information to key end users (e.g., agro-pastoralists, farmers, health professionals, airlines, etc). Support for this group could be drawn from the Global Environment Facility. Second, a financial and meteorological strategy for long-term climate services in South Sudan is desired. Third, the stakeholders should institute a climate data sharing agreement for more informed coordination and decision-making. These data would need generating using equipment that meets the World Meteorological Organization's (WMO) standards. Fourth, more studies to increase understanding of the role of traditional rainmakers and Traditional Ecological Knowledge (TEK), creating an integrated climate services model to inform livelihoods and policies, are suggested. Finally, the stakeholders should mobilize resources to improve national capacity on climate information by strengthening South Sudan Meteorological Department through equipment acquisition, training and exchange visits with global forecasting centers, such NOAA's Africa Training Desk.

1. Introduction

Climate change is making it difficult for farmers to produce food globally (IPPC, 2014, 2007). Since 1900, South Sudan has witnessed about 20% decrease in rainfalls and 1.3 degree Celsius increase in temperatures (Funk et al., 2011, see figure 1). In addition, the country's rainy season, which begins in March/April and continues until November, has increasingly become unpredictable (Funk et al., 2011). Besides, rainfalls have become erratic. Sometimes they are less than expected, resulting in drought, and other times, they are heavy, resulting in flood, which leads to losses in food production. According to South Sudan's National

Bureau of Statistic (NBS) (2009), droughts and floods are among the top causes of vulnerability in South Sudan, with about 56% of the population surveyed reporting to be vulnerable to both drought and flood shocks. This has had huge implications for food security, as unpredictable climate patterns, coupled with violent conflicts, have inhibited the ability to produce enough food. In other words, communities, as a result, struggle to attain food security due to unpredictable rainfalls and shifting seasonality. As the rains and seasonality become more eratic and unpredictable, interventions such as climate services become a necessary response.

Figure 1: Rainfall and temperature trend in South Sudan, 1900 -2009 (Source: Funk et al., 2011)



Climate services are defined as "Climate information prepared and delivered to meet users' needs" (WMO, 2011). Based on Global Framework on Climate Services' guidelines, climate "services require appropriate engagement along with an effective access mechanism and must respond to user needs" (WMO, 2018). Users of climate services include farmers, agro-pastoralists, pastoralists, agriculture inputs suppliers and vetennairy drug suppliers, among others. Climate services enable farmers to plant crops that are well suited to the prevailing seasonal weather conditions. The benefits include less uncertainty about seasonal weather conditions and effectiveness in selecting the right crops and planting at the right time (Meza at el., 2008). Many imperical studies suggest that "improved climate information and forecasts can reduce the risk of economic losses, increase profits, and improve short- and long-term farm management decisions " (Meza et al., 2008).

This important knowledge is missing in South Sudan. The country currently faces a myriad of challenges with regards to meteorological infrastructure. Run by South Sudan Meteorological Department (SSMD), there are currently 5 synoptic stations spread across the country's vast territory, which is the size of Rwanda, Kenya and Uganda combined. Only three of these are functioning as the two were destroyed during the war in 2013. There are other automatic stations in several of the former

10 states' capitals. However, they are in bad shape, have not been functioning regularly and therefore need repair and constant maintenance. In short, critical barriers to climate information in South Sudan include: (1) Limited synoptic weather stations, (2) Inadequate weather instruments (3) Insufficient computers, (4) Inadequate office space and equipment (e.g. internet, phones, printing, scanning and photocopying machnines, etc), (5) Lack of website, (6) Inadequate trained staff, (7) Low priority of meteorology services, and (8) Inadequate funding (SSMD, 2018, Tiitmamer, 2015). Information produced by IGAD Climate Prediction and Application Center (ICPAC), a regional climate change body of IGAD, based in Nairobi, Kenya and other relevant institutions such as Famine Early Warning Networks, is difficult to share with farmers in South Sudan due to some of the above barriers. This necessitates the need for a better climate services model that can serve the rural people that are vulnerable to climate change.

To contribute towards this endeavor, we used regional climate services model to pilot a Climate Services Model for agro-pastoralists and farmers in Aweil West, Aweil North, and Tonj South, South Sudan, with the objective of replicating the same in the future across the country. The pilot targeted the agro-pastoralists who were participating in Agro-pastoralist Farmer Field Schools under the Programme on Building Resilience and Adaptation to Climate and Disasters (BRACED), known in South Sudan as Improving Resilience in South Sudan (IRISS). The pilot, which was first of its kind to directly deliver climate services in rural setting in South Sudan, provided the participants with access to a user-friendly seasonal weather information to help make informed decisions with regards to farming activities. Decisions targeted included the timing of planting, type of crops to plant, where to plant (low grounds or high grounds) and when and where to move livestock (mostly cattle, goats and sheep). The pilot model serves both practical and knowledge generation purposes. The practical aspect is with regards to informing cropping decisions in the related IRISS BRACED project areas, while the research component helps document and share lessons learned from the pilot model design and implementation for improving national climate services. The findings and lessons could help inform policymakers and partners on next steps, including capacity building of the South Sudan Meteorological Department and other stakeholders.

2. Approach

2.1. The Ugandan Experience

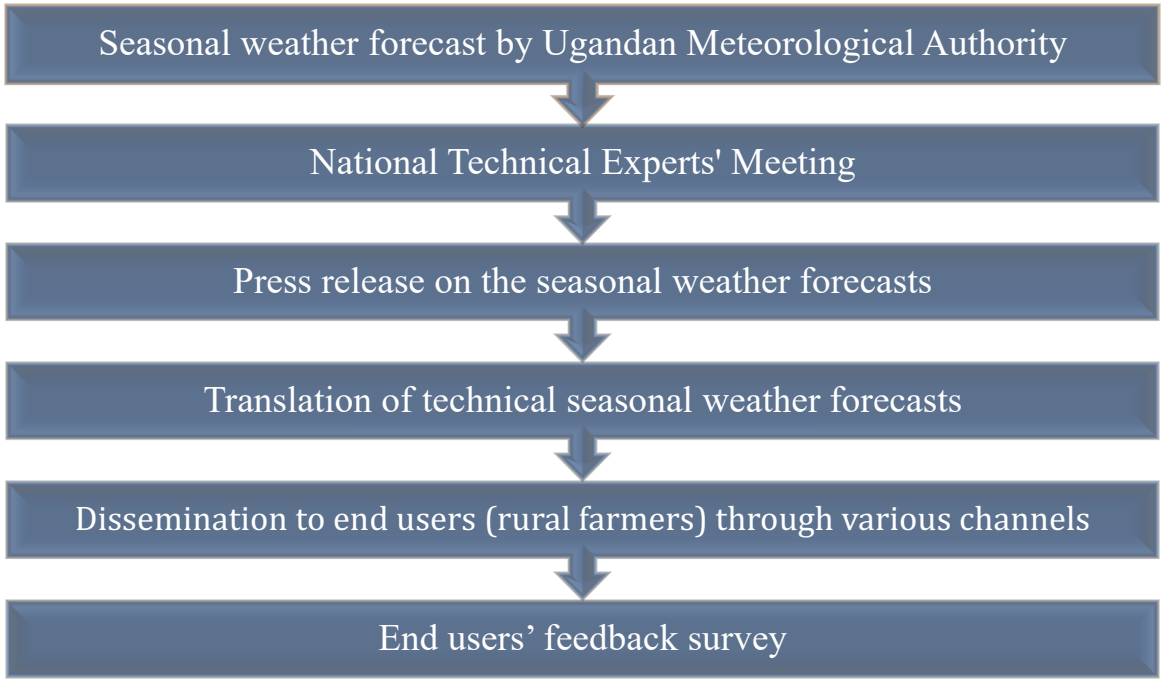
To develop an effective scientific climate services model for rural farmers and agro-pastoralists in Aweil and Tonj, we reviewed literature about similar climate services models in Africa to inform a possible design of similar model in South Sudan. We chose the Ugandan climate information forecast model. Uganda is closer to South Sudan and therefore, its context was deemed appropriate to inform similar seasonal climate services model.

Uganda designed a climate information mechanism to address the problems of increases in floods and droughts frequency, which negatively affects agriculture, on which 4 out of 5 Ugandans depend (Uganda Meteorological Authority (UMA), 2013). The climate services model was designed because forecasts from UMA were

too technical for the farmers to easily understand. In addition, forecasts have only been shared with government institutions through email, narrowing access. This limited access makes farmers rely on unreliable traditional knowledge.

The Ugandan seasonal weather forecast model comprises several steps and actions to disseminate user friendly information to the farmers (see figure 2). First, UNMA produces seasonal weather forecasts, which are highly technical and could not be easily understood by farmers. Most of these forecasts are drawn from the IGAD's Climate Prediction and Application Center (ICPAC), which are then scaled down to the local levels.

Figure 2: The Ugandan Seasonal Weather Forecast Model



After producing the technical forecasts, a meeting of national technical experts is convened to review, simplify the language, and translate information into local languages. The technical expert meeting draws from Agriculture, Health, Disaster Management, Water, Environment, Energy, Wildlife, civil society organizations and research and academic institutions.

After the technical expert meeting, the Ugandan Ministry of Enviroment and Water issues a press release about the forecasts. Written in a simplified language for the lay members of the public to understand, the press release is carried in the Ugandan government newspaper, The New Vision.

Following the press release, the forecasts are translated into local languages. Translated information answers questions on the (1) start and end of rains, (2) total estimated amount of rain for the season, and (3) types of crops to grow based on the predicted rainfall amount (Mahoo and Mpeta, 2011). Knowledge of the start and end of rains helps with activities planning (e.g. timing of clearing of fields and harvesting, etc).

After the translation, the forecasts are disseminated to the farmers by government institutions and civil society organizations through internet, FM radios, churches, mosques, markets, community meetings, schools, print media and mobile phones. The channels of delivery vary with audience. For example, internet messaging targets government institutions and those with access, the FM radios target those who own radios, particularly men, church meetings target mostly women. The format in which the message is delivered includes email, pre-recorded CDs, printed materials, and village message board.

2.2. Climate Services Model

To design a climate information dissemination model for South Sudan, we analyzed and identified a number of aspects to be included in the model. Some of these include (1) actors/stakeholders and their responsibilities, (2) types of information to be shared, (3) channels and formats through which the information would be shared, (4) decisions to be made using the information, and (5) end users or beneficiaries of the information (see tables 1 and 2). The model was designed with the goal of having the previous experience informing future processes/activities. As illustrated in figure 3, the whole model process includes:

- Conducting stakeholder and beneficiary analysis and identifying the stakeholders and beneficiaries about the information they need and decisions they need to make in response;
- Obtaining seasonal forecasts from IGAD Climate Prediction and Application Center (ICPAC) and South Sudan Meteorological Department (SSMD);
- Holding technical working group meetings to analyze and discuss the seasonal forecasts;
- Writing up the seasonal forecasts in a simple language
- Training field officers and community forecasters to disseminate the seasonal forecasts;
- Disseminating the seasonal forecasts to end users in Aweil West, Aweil North and Tonj; and
- Carrying out end user feedback survey to assess the utilization of the information and its impacts on agricultural production to inform policy and planning.

Figure 3: South Sudan's Pilot Climate Services Model

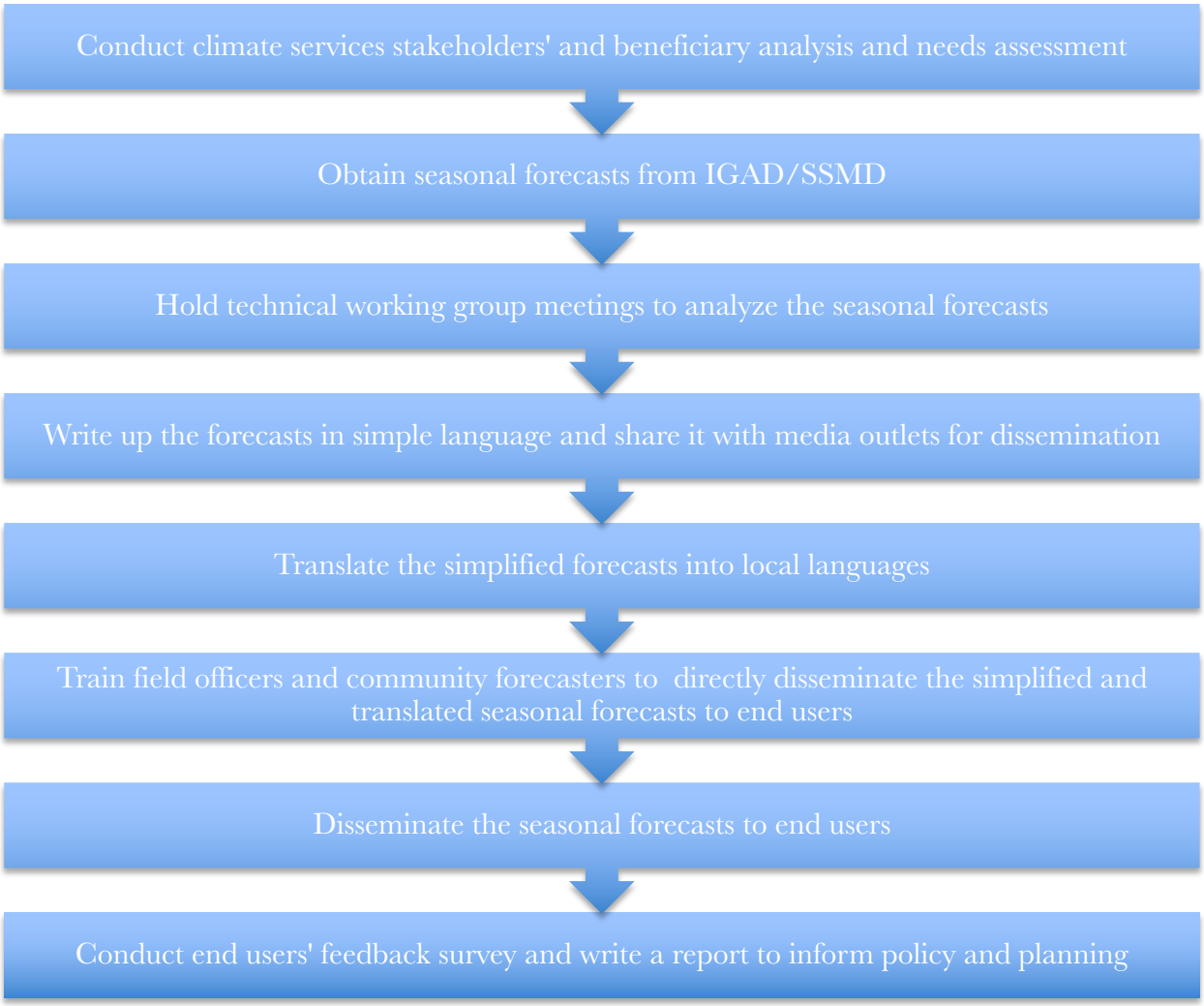


Table 1: Climate Services Model: Climate information, delivery channels, beneficiaries and decisions

Climate Information	Format and delivery channels	Beneficiaries/ end users	Decisions to be made by end users
• Rainy season start date & end date, • Seasonal dry spell, • Seasonal rainfall amounts, • Extreme climate and	• Climate services information charts delivered by field officers and members of community resilience planning committees at meetings of agro-	• Farmers and agro-pastoralists	• Timing of planting, • Type of crops to plant, • Where to plant (lowland or highland), • Where to move the livestock, whether in the river valley/low lying greener areas suitable in dry spell or

weather events, • Temperature, and • Wind	pastoralist farmer field schools.[1]	highland to escape flood, etc

Table 2: Climate Services Model: Actors/stakeholders and their responsibilities

Actors/stakeholders	Responsibilities
Concern Worldwide	• Supervises the process, • Organizes end users • Trains the forecasters (field officers), and • Disseminates the forecasts
The Sudd Institute	• Writes the concept note, • Coordinates the process, • Convenes national technical working group (NTWG) meetings, • Obtains forecasts from ICPAC and SSMD and presents them for analysis at the NTWG meetings, • Writes up the forecasts in simple language, • Carries out end users' feedback survey, and • Writes and presents the report.
ACTED	• Organizes end users • Trains the forecasters (field officers), and • Disseminates the forecasts
Ministry of Environment and Forestry (MoEF)	• Coordinates and brings on board other government stakeholders and line ministries
Ministry of Agriculture and Food Security	• Provides insights from its climate information unit
South Sudan Meteorological Department (SSMD)	• Provides technical seasonal climate forecasts in collaboration with MoEF's Climate and Meteorological Directorate
Food and Agriculture Organization (FAO)	• Provides linkage with FAO (AFISS) weather forecast modeling in close coordination with the Concern Worldwide and The Sudd Institute.
SNV	• Communicates forecasts to schools through environmental clubs

[1] Future delivery channels will include radios, text messages, e-mails, community meetings, church congregations, mosques and women groups.

Ministry of Humanitarian Affairs and Disaster Management (MHADM)	• Provides insights from its disaster early warning unit to inform the process

We first analyzed and identified relevant institutions and their roles. Carried out through a meeting of technical working group made up of Concern Worldwide, ACTED, FAO, SNV, UNEP, and the Sudd Institute, the analysis and identification of the stakeholders were based on interest and power. In other words, the technical working group identified which institutions have high interest in climate information and which institutions have mandated power to participate in the design and implementation of climate services model. Stakeholders with high power and interest were chosen to participate while the ones with low interest and power were excluded.

Using this approach, the technical working group identified the Ministry of Environment and Forestry (MoEF), Ministry of Agriculture and Food Security, Ministry of Humanitarian Affairs and Disaster Management (MHADM) and South Sudan Meteorological Department (SSMD). Roles were assigned. First, MoEF was assigned to mobilize and coordinate participation of other relevant government institutions identified above. Second, Agriculture and Food Security Ministry was assigned to provide technical expertise using its experience from its early warning and climate information unit, as well as advising on relevance of the information to a particular agriculture activity. Third, SSMD was given the role of providing technical forecasts from IGAD and MHADM agreed to provide insights using experience from its early warning unit. Fourth, BRACED Consortium Coordination (CCU) and the Sudd Institute collaborated with the South Sudan Meteorological Department and MoEF. At the field levels, ACTED and Concern Worldwide identified beneficiaries, recruited, and oriented community forecasters. The Sudd Institute documented the whole process – beginning with the concept note and the design of the model, facilitated the stakeholder meetings and the implementation of the model, and conducted user feedback survey. FAO worked with forecasts institutions to help provide technical insights into the forecasts and the model.

The identified stakeholders were invited for the first meeting on April 7, 2017 where they sent representatives from their climate information and early warning units to participate. The agenda items included (1) presentation of Climate Services Model Concept Note by the Sudd Institute, (2) Presentation of Technical Seasonal Forecasts for March, April and May by Concern Worldwide, (3) Presentation of Simplified Seasonal Forecasts for March, April and May by South Sudan Meteorological Department and (4) discussions and agreement on the mode of dissemination of the forecasts. The gathering helped bridge climate information gaps. The meeting found out that most of the participants were engaged in some climate information and early warning work but these efforts were not coordinated at the national level. Therefore, the model was embraced as the one that would connect the climate information producers and climate information end users.

Channels and formats of delivery were chosen for this pilot to be community forecasters/field officers and Community Resilience Planning Committees (CRPCs). However, radios, text messages, e-mails, community meetings, church congregations,

mosques and women groups can be used in the future as channels of delivery. As this pilot is the first of its kind, the consortium decided to use a small group as a test so that the communities do not lose faith in the formal climate information if the information delivered was not accurate given there is little local climate information infrastructure. Therefore, APFS were identified as beneficiaries. They were asked to set aside portions of their plots to use for climate information which was delivered to them. The reason of allocating a portion of the plot was so the selected households did not lose in food producton in case the information was not accurate. This due diligence was required in order to minimize any future risks.

Information shared with APFS' participants includes start of the rainy season, dry spells, seasonal rainfall amount (whether it would be normal, above normal or below normal). These pieces of information were used to advise the participants on the types of crops to plant, when to start planting and where to plant and make decision on the movement of livestock. Forecasts for March, April and May was reviewed in the meeting convened on 7 April 2017. These forecasts were used for the stakeholders to familiarize themselves with the process. Forecasts for June, July, August and September (JJAS) were reviewed and charts for Tonj, Nyamlel, and Gok Machar were developed and sent to Concern and ACTED BRACED Project Managers to disseminate (see figure 4). JJAS' forecasts for South Sudan were categorized into *near normal* and *above normal* rainfalls and *above normal* temperatures (see figure 5). Based on these, participants were advised according to the charts to plant crops on high grounds to avoid potential floods and to prepare to irrigate if the dry spell hit. While seasonal forecasts may not be the best predictors of flood (de Perez et al., 2017), they are quite useful, especially in the absence of other more informative means.

The 2nd technical working group meeting was held in September 2017 to discuss the possibility of establishing a permanent national working group that would take over from this pilot group. The meeting also reviewed the progress of the pilot model, and the end user survey questionnaire with regard to application, reliability, and usefulness of the information shared in June. The pilot was completed with the end user feedback survey conducted from October 9 – 16, 2017.

Figure 4: JJAS 2017 Seasonal Rainfall Forecast for Tonj South, Aweil North and West, South Sudan (Source: ICPAC's Greater Horn of Africa Consensus rainfall Outlook for JJAS's season 2017, compiled by the authors)

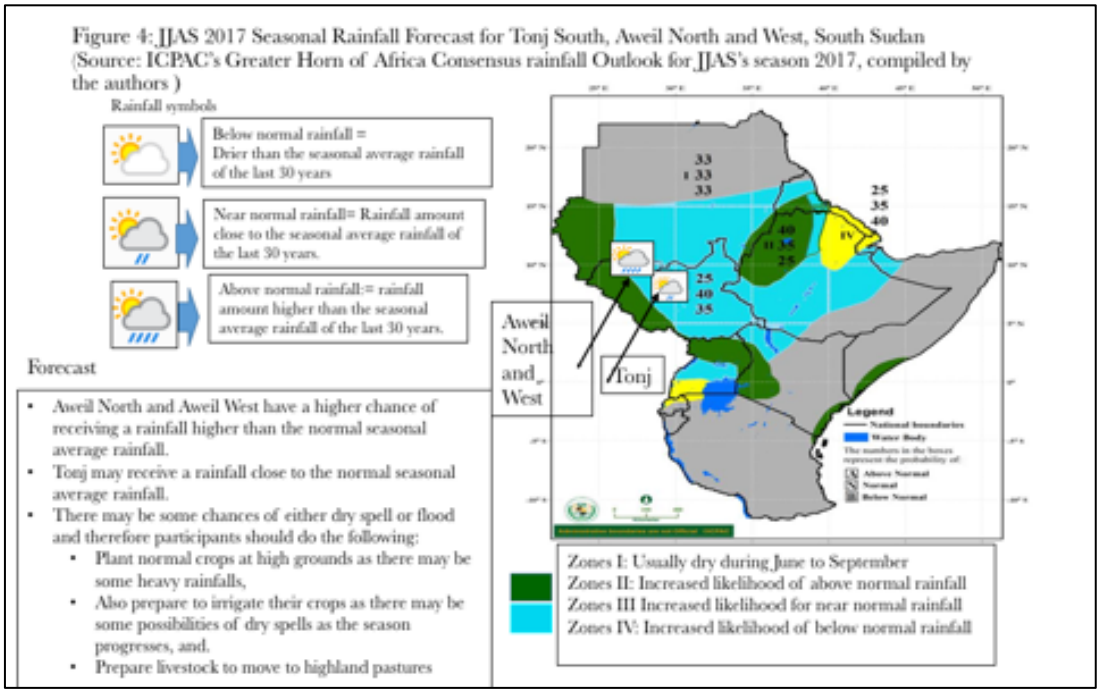
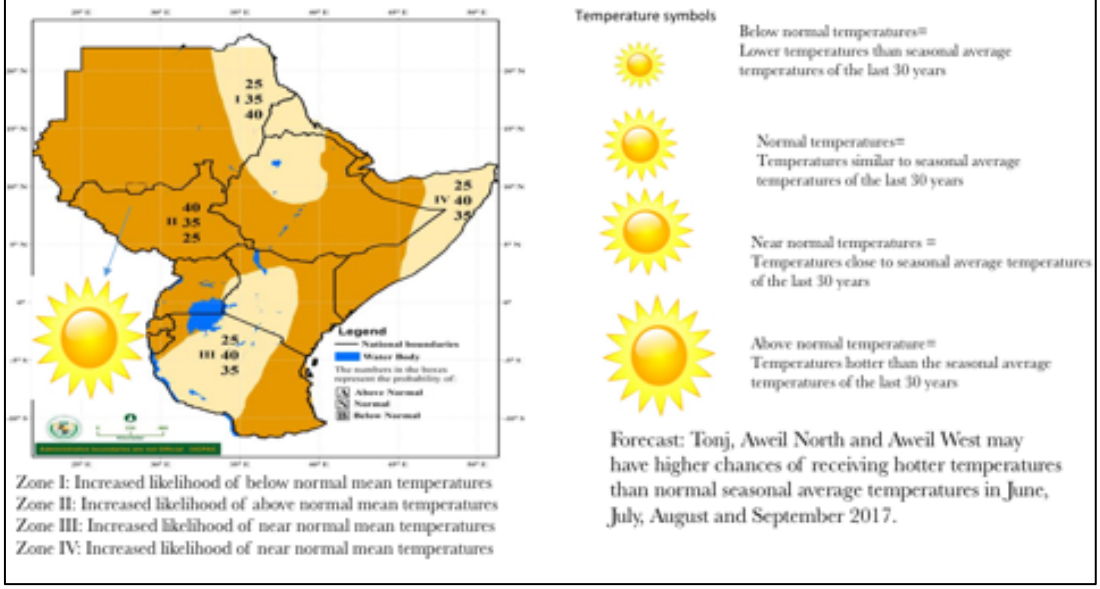


Figure 5: JJAS 2017 Seasonal Temperature Forecast for Tonj South, Aweil North and Aweil West, South Sudan (Source: ICPAC's Greater Horn of Africa Consensus Mean Temperature Outlook for JJAS's season 2017, compiled by the authors)



3. End User Feedback

3.1. Method

This pilot was carried out in three phases, namely conception, dissemination, and end user feedback survey. For the first phase, we developed a concept note detailing what the model should look like, including the stakeholders to be involved, information to be forecasted, decisions to be made using the information and the end user feedback survey to be carried out. The second phase includes holding

meetings to obtain the seasonal forecast, and discussing and simplifying it into a language the end users understand.

The first and second phase involves the inputs of the stakeholders in the development of the pilot study. Key among the stakeholders, as mentioned previously, include the Ministry of Environment & Forestry, Ministry of Agriculture & Food Security, Ministry of Humanitarian Affairs & Disaster Management and South Sudan Meteorological Department. Each of these institutions had an input into the process. Of critical input was the supply of seasonal weather forecast from IGAD, which was discussed and modified into a simple language through the technical working group. The simplified language was meant for field officers who eventually translated the more locally tailored version into local languages, mainly Bongo, Dinka, and Luo. The field officers were trained before they disseminated the information among the participants. We used the participants of Agro-pastarolist and farmers fields schools as the target group. We supplied this group with seasonal weather forecast for JJAS to inform their farming decisions.

The forecasts were above normal in Aweil West and Aweil North and near normal in Tonj South. The participants were advised to prepare to plant crops on higher grounds and also be prepared for some chances of dry spells (See figure 4). Even though we gave the same advice to participants in all of the locations, the forecasts pointed to the possibility of dry spells in Tonj and floods in Nyamlel and Gok Machar.

The third phase involves conducting an end user feedback survey to examine whether the groups have received the information, whether they used it, trusted it, and whether the information was accurate, as well as seeking beneficiaries' preference on seasonal weather information source. The end user feedback survey was conducted in October 2017 in the BRACED IRISS project areas.

The seasonal forecasts were given to participating agro-pastoralists and farmers field schools (APFS) in BRACED IRISS project areas. There were 1200 APFS participants in Aweil West and Aweil North and 1620 participants in Tonj South, making a total of 2820 APFS participants for the three locations. For the study, we selected 338 participants as a sample. Since the target population was known, we used Kretchie and Morgan (1970) sampling technique.

3.2. Results and Discussions

Demographic

We interviewed a total of 353 (Aweil = 159; Tonj = 194) participants (63.10% female and 36.90% male). In terms of education, 76.97% never went to school, 18.08% attended primary school, and 4.96% obtained secondary education or higher.

There are two main messages to be gleaned from the demographic information. First, that the majority of the respondents are females reflects the fact that the BRACED IRISS programme has been designed to target the vulnerable members of the community, namely women and children. Second, high rates of illiteracy show that the majority of women in South Sudan have an inadequate access to education.

What does this mean for climate change resilience? It suggests that most women in the project areas can't be expected to read weather information and that any future weather information should be oral and preferably in local languages.

Reception, application and usefulness

As mentioned earlier, one of the objectives of this study is to examine whether the participants had received and applied the weather forecasts . We find that over two-thirds (68.27%) of the respondents received the forecasts. When we summarize the sample by state, we find that 60.58% of the respondents from Tonj received the information, compared to 39.42% from Lol (Aweil West and North).

Of those who received the weather information, 62% used the information and 23.23% did not use the information. How useful were the forecasts? The respondents used such information to start planting crops (39%), plant crops on higher ground to avoid flood (13%), plant seeds that do well in flood (4%), move cattle to escape flood (2%), plant on low ground to minimize drought (2%), and irrigate crops (1%).

To verify if the right forecasts were delivered, we also asked the respondents which forecasts they received, categorized as: above normal, near normal or below normal. Of the sample, 50.99% received above normal, and 11.33% near normal. The question did not apply to 32.29% of the sample. When we break down the use of forecasts by state, Tonj gets a relatively higher share: 64.25%, compared to 35.75% in Lol state.

Two messages can be gleaned from the above findings. First, availability and distribution of weather information improve knowledge among farmers. Second, the level of reception attained under this pilot project shows that the farmers are ready to use modern approaches to farming.

Accuracy and trust

The other important variable we tested was the trust and accuracy of the forecasts. To verify if the forecasts were accurate or if the weather conditions manifested as predicted, we asked if the rainfalls were more than the normal rainfalls, meaning above normal. In response, 90.12% of the participants said the rainfalls were more than the normal rainfalls. We asked the same question for the temperature and 71.39% said the temperature was very high in the JJAS season. We also asked the respondents if they trusted the forecasts; 71.47% said they did. This finding has a positive implication going forward because transitioning from the traditional weather information method to the modern one requires trust in the latter.

If the forecasts were inaccurate, it would be hard to convince the participants to use climate services in the future, given that this is the first time formal climate services have been accessed in these locations. Now that the forecasts were accurate, they would expect them to be often accurate in the future. But the forecasts could go wrong in the future, potentially causing farmers' distrust in the climate services. To overcome this, the participants have been made aware of the inherent uncertainty in the climate services. Therefore, part of providing the climate services is to also educate the beneficiaries about such uncertainty and the need to improve ways of predicting to reduce uncertainties and associated risks.

Traditional ecological knowledge and rainmaking

Traditional Ecological Knowledge (TEK) is strong among the communities. For example, people are able to predict rain and dry spell if the wind blows from or to a certain direction. They count the number of years and predict whether there would be a drought or flood. Tradional rainmakers, those who offer sacrifices to God to bring rainfalls, are still very common. Of those we surveyed, 52.76% suggested having traditional weather predictors. Interestingly, 52.49% of the respondents do not trust the rainmakers. TEK and traditional rainmakers are often confused to mean the same. They do not. TEK is scientific in nature as it uses scientific variables while rainmaking uses religious offerings.

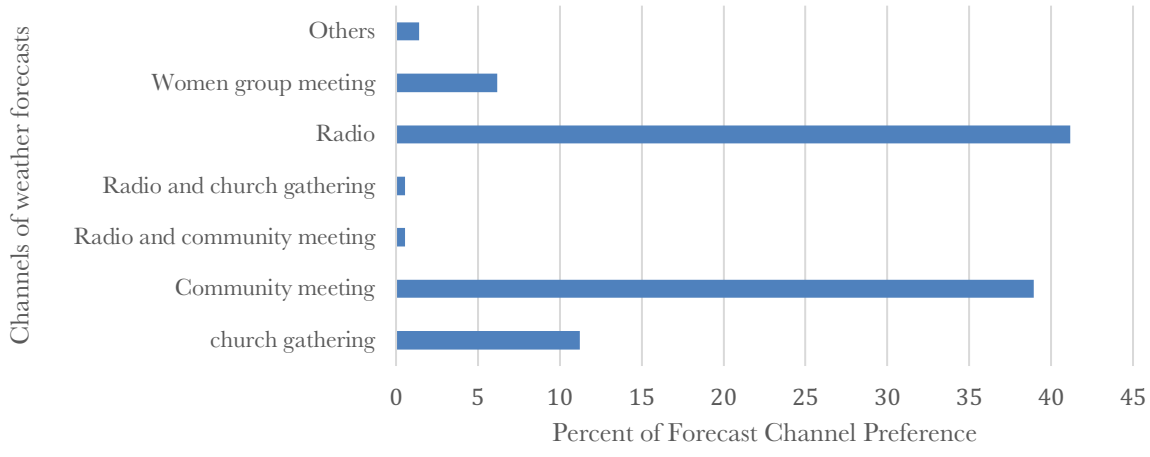
Inadequate coordination among climate information stakeholders

Several institutions are creating climate related data, albeit lack of adequate coordination. Therefore, key climate information does not reach end users, such as pastoralists and farmers. We establish this fact during the stakeholder and beneficiaries analysis. The Ministry of Agriculture and Food Security, Ministry of Humanitarian Affairs and Disaster Management, FAO, FEWSNET, and WFP all engage in activities related to climate information but do not coordinate in order to bring services to the end users in a nationally coordinated and comprehensive manner.

Prefered forecasts channels

We asked the participants to state their choice of weather information distribution model. Of those interviewed, 41.2% prefer to receive weather forecasts through radio, 38.94% desire community meeting, 11.2% favor church gathering, and 6.2% prefer women group meetings. Some want a combination of radio and community meeting (0.6%) and church gathering and radio (0.6%) (see figure 6 for details).

Figure 6: Choice of channels to receive weather forecasts



4. Conclusion

We administered a pilot Climate Services project for South Sudan's small scale farmers and agro-pastoralists. The pilot established whether the agro-pastoralist and farmers received, trusted, and used climate information to make informed farming decisions. The results show a substantial level of reception, application, and trust. This suggests the readiness of agro-pastoralists and farmers in South Sudan to use weather forecasts to make decisions. Similarly, the use of traditional rainmaking and traditional ecological knowledge of weather forecasting are still very strong among these communities, albeit a growing distrust. Besides, some of the climate service stakeholders engage in climate service but they do not coordinate to ensure the information get effectively to the end users. Thus, we suggest a number of policies as follows:

- Establish a permanent national technical working group on climate services to coordinate, review, translate and disseminate climate information to key end users (e.g agro-pastoralists, farmers, health professionals, airlines, etc). The Global Environment Facility should support the establishment of this permament, technical national working group by focusing on key stakeholders and partners.
- Develop a financial and meteorology strategy for long term climate services in South Sudan.
- Institute a climate information data sharing or cooperation agreement among stakeholders.
- Conduct more studies to increase understanding of the role of traditional rainmakers and Traditional Ecological Knowledge (TEK) to create an integrated climate services model to inform livelihoods and policies.
- Build and increase national capacity on climate information by strengthening South Sudan Meteorological Department through acquisition of equipment, training and exchange visits with global forecasting centres, such NOAA's Africa Training Desk. The weather measurement equipment ought to meet the WMO standards.

References

De Perez, E. C., Stephens, E., Bischiniotis, K., van Aalst, M., van den Hurk, B., Mason, S., Nissan, H. and Pappenberger, F. 2017. Should seasonal rainfall forecasts be used for flood preparedness? Hydrology and Earth System Sciences.

Funk, C., Eilerts, G., Verdin, J., Rowland, J. & Marshall, M. 2011. A climate trend analysis of Sudan. US Geological Survey.

Mahoo, H. and Mpeta, E. (2011). Combining indigenous and scientific weather forecasting knowledge in Climate Risk Management in Semi-arid Areas of Tanzania. Presentation at Workshop on Achieving Benefits of Enhanced Service Delivery by National Meteorological Services in Eastern and Southern Africa.

Meza, F. J., J. W. Hansen, and D. Osgood, 2008: Economic value of seasonal climate forecasts for agriculture: Review of ex-ante assessments and

recommendations for future research. J. Appl. Meteor. Climatol., 47, 1269–1286.
NBS 2009. National Baseline Household Survey. South Sudan National Bureau of Statistics.
World Meteorological Organization. (2018). Step-by-step guidelines for establishing National Framework for Climate Services.
SSMD. (2018). Strategic Plan 2018 -2023. Juba, South Sudan.
Tiitmamer, N. (2015). *Assessment of Policy and Institutional Responses to Climate Change and Environmental Disaster Risks in South Sudan* (Special report). The Sudd Institute1.
UMA (2014). The Climate Forecast Model. A report published by UMA.

Acknowledgement

We thank the UK's Department for International Development (DFID) for its generous financial support through Building Resilience and Adaptation to Climate Extremes and Disasters (BRACED)/Improving Resilience in South Sudan (IRISS) Project. Besides, we thank BRACED- IRISS consortium members, namely Concern Worldwide, ACTED, FAO and UNEP for their unwavering support and productive partnership. We also thank our external reviewers for helpful reviews. However, the views expressed here neither reflect DFID's views nor that of the consortium members.

About The Sudd Institute

The Sudd Institute is an independent research organization that conducts and facilitates policy relevant research and training to inform public policy and practice, to create opportunities for discussion and debate, and to improve analytical capacity in South Sudan. The Sudd Institute's intention is to significantly improve the quality, impact, and accountability of local, national, and international policy- and decision-making in South Sudan in order to promote a more peaceful, just and prosperous society.

About the Authors

Nhial Tiitmamer is Programme Manager for environmental, energy and natural resources research and as well the Institute's Focal Point on Building Resilience and Adaptation to Climate Extremes and Disasters (BRACED), a climate change resilience programme being implemented in South Sudan by a consortium composed of The Sudd Institute and other international organizations. Nhial holds a Bachelor of Arts Degree and a Master of Science in Environmental Studies and Sustainable Energy from the Universities of Alberta and Calgary in Canada where he spent stints as an environmental consultant and research associate in environmental studies. Nhial is the co-founder of the NewSudanVision.com and has extensively commented and written on issues about South Sudan.

Augustino Ting Mayai is the Director of Research at the Sudd Institute and an Assistant Professor at the University of Juba's School of Public Service. He holds a PhD in Sociology, with concentrations on demography and development from the

University of Wisconsin-Madison. He currently studies how state effectiveness affects child health outcomes in South Sudan and Ethiopia. Dr. Mayai has written extensively on South Sudan's current affairs.

Appendices

Appendix 1

Questionnaire

IRISS BRACED

Weather Forecast Model (WFM)

Weather Forecast Information End User Feedback and Capacity Survey

Aweil North, Aweil West and Tonj South

October 9 - 14, 2017.

Introduction

This survey tool assesses the application, reliability and usefulness of seasonal weather forecast information disseminated in June 2017 to farmers and agro-pastoralists participating in Agro-pastoralists and Farmers' Fields Schools (APFS) in IRISS BRACED project areas in Gok Machar & Nyamlell in Lol State and Tonj South in Tonj State in South Sudan. The information was channeled through the project focal points using short bulletins and delivered directly to the participants through IRISS BRACED project community forecasters (project officers). The survey targets the APFS participants who received the seasonal weather information in June 2017.

Instructions

Please mark with a tick, circle or write the answer clearly where applicable.

Section A: Demographic information

State: ----------. County: ----------. Boma: ----------

Gender: Male ☐ Female ☐

Age: _____

Education: None: ☐ Primary Educ. ☐

Secondary Educ. ☐ Tertiary Educ. ☐ Others (specify): ☐

Ethnicity:_____

Section B: Reception and Application

B1. **Did you receive the seasonal weather forecasts for June, July, August and September (JJAS)?**

Yes: ☐

No: ☐

B2**. If yes, what information did the forecasts convey to you?**
a) Rainfall would be more than enough and there could be some chances of floods in JJAS (above normal rainfall)

b) Rainfall would be almost enough but there could be either some dry periods or some flash flood periods (near normal rainfall)

c) Rainfall would not be enough and there could be high chances of dry periods or droughts (below normal rainfall)

B3. Did you use the forecast information?

Yes: ☐

No: ☐

B4. If yes, what did you use the forecasts information for? (please tick all that applies)
a) I used it to start planting
b) I used it to plant my crops on a higher ground to avoid floods
c) I used it to plant my crops in low land to avoid droughts
d) I used it to plant seeds that can do well in flood
e) I used it to plant seeds that can do well in drought
f) I used it to move my cattle to escape flood or drought
g) I used it to plan to irrigate my crops
h) Other: ----------

Section C: Adequacy, Reliability and Accuracy

C1. Was the rainfall more than enough in the JJAS season this year?

Yes: ☐

No: ☐

C2. Was the temperature very high in the JJAS season?

Yes: ☐

No:

C3. Did you trust the forecast information?

Yes: ☐

No: ☐

Section D: Usefulness

D1. If weather forecast information was useful to you, in which way(s) was it? (Please tick all that apply)

a) The information enabled me to get good yields because I planted early to avoid floods.
b) The information gave me certainty that the rainfall would be good this year.
c) The information allowed me to plant the right crops for the forecast rainfall
d) Other: ----------
e) Not useful.

Section E: Weather information capacity

E1. Before BRACED, who did you use to get weather information from?

Government extension workers: ☐ NGO workers: ☐

Traditional rainmakers: ☐ Others (Specify): _____

E2. Which one of the following communication channels will be suitable to receive weather information through?

Radio: ☐ Community meetings: ☐ Church gatherings: ☐

Women group meetings: ☐ Other (Specify): _____

E3. Do you currently have rain gauges in your community or nearby town?

E4. What are the signs that show it will rain in your community?

E5. How do you traditionally know there would be drought?

E6. How do you traditionally know there would be flood?

E7. Are there people who predict weather condition in your community?

Yes: ☐

No: ☐

E8. If yes, do you trust the information they deliver?

Yes: ☐

No: ☐

E9. If yes, why do you trust the information they provide?

E10. Which wind direction brings rainfall in your area?

E11. Which wind direction brings drought or dry period in your area?

E. 12. What support do you get from the government with regards to weather information?

E13. What support do you get from non-governmental organizations with regards to weather information?

E14. What temperature level can bring rainfalls?

E15. Which direction does its cloud bring rainfalls?

Appendix 2

Acknowledgement

This report is part of a series of reports produced through Building Resilience and Adaptation to Climate Extremes and Disasters (BRACED)/Improving Resilience in South Sudan (IRISS) Project. We thank BRACED- IRISS consortium members, namely Concern Worldwide, ACTED, FAO and UNEP for their unwavering support and productive partnership. The funding came from UK government; however, the views expressed here neither represent the UK government policies nor those of BRACED-IRISS consortium members.

About The Sudd Institute

The Sudd Institute is an independent research organization that conducts and facilitates policy relevant research and training to inform public policy and practice, to create opportunities for discussion and debate, and to improve analytical capacity in South Sudan. The Sudd Institute's intention is to significantly improve the quality, impact, and accountability of local, national, and international policy- and decision-

making in South Sudan in order to promote a more peaceful, just and prosperous society.

About the Authors

Nhial Tiitmamer is lead Researcher and Program Manager for environmental, energy and natural resources at The Sudd Institute and the Institute's Focal Point on Building Resilience and Adaptation to Climate Extremes and Disasters (BRACED), a climate change resilience programme being implemented in South Sudan by a consortium composed of The Sudd Institute and five international organizations. Nhial received his undergraduate and graduate education in Environmental Studies and Sustainable Energy in Canada where he spent stints as an environmental consultant and research associate in environmental studies. Nhial is the co- founder of the NewSudanVision.com and has extensively commented and written on issues about South Sudan.

Augustino Ting Mayai is the Director of Research at the Sudd Institute and an Assistant Professor at the University of Juba's School of Public Service. He holds a Ph.D. in Sociology, with concentrations on demography and development from the University of Wisconsin-Madison. He currently studies how state effectiveness affects child health outcomes in South Sudan and Ethiopia. Dr. Mayai has written extensively on South Sudan's current affairs.