DECISION-INFORMED FORECAST DESIGN

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PROBLEM STATEMENT

• Climate change
  • East African climate paradox (droughts long rains SST)

• Bimodal rains - Rains do not always come
  • (Nov-Jan, Feb-May)
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• Available grazing land decreasing
  • Land privatization
  • Agricultural (and urban) expansion
  • Conservation
• More severe droughts predicted (climate change)
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What if people in Sinya know a drought is coming? Will that help them to better prepare and decrease losses?
Can weather information contribute to the drought management strategies of the Maasai communities in Sinya, Tanzania?
DROUGHT DEFINITIONS

- **Meteorological**: “a lack of precipitation over a region for a period of time”
- **Agricultural**: “a period with declining soil moisture and consequent crop failure without any reference to surface water resources”
- **Hydrological**: “related to a period with inadequate surface and subsurface water resources for established water uses of a given water resources management system”
- **Socio-economic**: “associated with failure of water resources systems to meet water demands and thus associating droughts with supply of and demand for an economic good (water). Socio-economic drought occurs when the demand for an economic good exceeds supply as a result of a weather-related shortfall in water supply.”

Source: (Mishra and Singh, 2010, p. 206)
What is the current situation in Sinya?

- Experience, strategies, available info/knowledge

What weather outlook (system) is currently available?

- What info, skill, scale, lead-time, communication

What are recommendations for improvement?

- What (unavailable) weather info can contribute?
- Is that achievable with the current weather models?
- With what skill?
**FIELDWORK: WHAT DID I DO?**

<table>
<thead>
<tr>
<th>Focus groups (3 sessions)</th>
<th>Key interviews</th>
<th>Family Portraits</th>
</tr>
</thead>
</table>
| • 2x women, 2x elders, 2x morans  
  • Drought in Sinya & strategies  
  • Design outlook system  
  • Seasonal Outlook Game | • Leader Sinya  
  • Traditional leaders (2x) incl. ‘weather man’  
  • Ward executive | • Drought management strategies  
  • Revisit in May/August |
### Do People in Sinya Predict the Weather?

Yes, they look at signs:

- Stars
- The way cows sleep
- Whether cows excrete faeces at night
- Scorpions
- Frogs
- Presence of elephants
- Whether cows give birth

However, no drought predictions…
IS WEATHER INFO RECEIVED IN SINYA?

Most people don’t receive any info

Some receive through:
- TV
- Radio
- Newspaper
- Relatives in cities

One of the leaders claims to consult elders on weather predictions
WHAT IS CURRENT WEATHER INFORMATION? (BY TMA)

**Technical**

- Rain/Sun/clouds, temperature
- Scale? One prediction for 400-500 km²
- Skill? Not good enough for people to have faith in the predictions

**Communication**

- Predictions are out once the period has started
  - over a period of 10 days, a month, or the season (3 months)
- TMA communicates through Internet, radio, tv
- Reach Sinya? – Only those with tv/radio/newspaper, which is very few.
WHAT ACTIONS ARE TAKEN TO MANAGE DROUGHTS BY PASTORALISTS IN SINYA?

Moving
Selling Livestock
Storing food/money
### WHICH INFO IS REQUIRED, WHEN, HOW COMMUNICATED, OF WHAT AREAS?

<table>
<thead>
<tr>
<th>What:</th>
<th>When</th>
<th>How</th>
</tr>
</thead>
<tbody>
<tr>
<td>• When rain</td>
<td>• Mobility = few days/ few weeks</td>
<td>• Meeting</td>
</tr>
<tr>
<td>• Where rain</td>
<td>• Selling = 1 week /few weeks</td>
<td>• Phone call system</td>
</tr>
<tr>
<td>• How much (enough for grass?)</td>
<td>• Storing food = 1 week /few weeks</td>
<td></td>
</tr>
<tr>
<td>• How long it won’t rain</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Districts in which Herders from Sinya Graze their Cattle
CAN WEATHER INFO CONTRIBUTE TO DROUGHT MANAGEMENT IN SINYA?

HOW?

Yes. But the quality of the forecasts has to increase.

How: Selling, storing money on bank/food

For migration only useful where it rained/grass regrew (Afriscout), not likely to move earlier. However...
HOWEVER, IF...

Livestock still at home

Grasses decreased

March

Decide

• Leave
• Wait for rains

Info required:

• Will it rain (enough) the coming 2 weeks
DROUGHT ➔ ALAMEI

Alamei
Jenny: "the time of suffering, lack of food"
"dead time"
FACTORS INFLUENCING ALAMEI – SHORT TERM
(GRASS/WATER)

• Rainfall
• Evaporation
• Wildlife
• Livestock migration into the area
• Grass growth limitation (e.g. vehicles)
WHAT’S NEXT?

Can the threshold exceedance of precipitation in these particular alamei periods be forecasted with high enough skill for Sinya?
1. **Determine Window-period**

2. **Determine Threshold**

3. **Analyse ERA5-reanalysis data to see if such a dry period occurred**

4. **Compare forecast with reanalysis to determine skill**
**APPROACH**

1. **Window-period**
   - Find when NDVI decreases to ‘very-little grass’ condition
   - Compare NDVI with this year [to get an idea what these values approximately represent]
   - Compare NDVI to data from field on grass seasonality, occurrence of *alamei sapo* and when there was a lot of grass [to see whether NDVI can be used as grass-indicator]

2. **Threshold**

3. **Analyse ERA5-reanalysis data to see if such a dry period occurred**

4. **Compare forecast with reanalysis to determine skill**
1. **Window-period**

2. **Threshold**
   - Compare total precipitation – evaporation reanalysis with NDVI
   - Estimate threshold based on:
     - Nr. of rainfall days
     - Cumulative rainfall
     - Nr. of dry days

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4. **Compare forecast with reanalysis to determine skill**
1. **Window-period**

2. **Threshold**

3. **Analyse ERA5-reanalysis data to see if such a dry period occurred**
   - Only for identified window periods

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1. **Window-period**

2. **Threshold**

3. **Analyse ERA5-reanalysis data to see if such a dry period occurred**

4. **Compare forecast with reanalysis to determine skill**
   - Determine what percentage of ensemble members has to pass the threshold for it to be a hit
   - Hits/misses/false alarm/correct negatives
   - Create a ROC diagram
LIMITATIONS

- No access to TMA data/models → ECMWF
- Only theoretical skill of model
  - Limited weather stations around study area
- Global weather model
  - Scale & Skill
CONCLUSIONS

• Initial ideas challenged
• Combining knowledges versus top-down system
• Only one part of alamei prediction and management
  • Local knowledge still vital
• Importance of clear communication
Study Area
NDVI & Total Precipitation
2001 - 2018
THE ROLE OF SATELLITE TECHNOLOGY IN “DEVELOPMENT”

- Evidence-based advocacy
  - Empowerment
  - Info of marginalized (limited data) areas
  - Open-source
- Challenges
  - Unequal access to knowledge
  - Adverse impacts
    - Misinterpretation
    - Misrepresentation
THANK YOU
ECMWF MODEL

- Resolution = 0.25°
- 51 ensemble members for forecast
- 10 ensemble members for reanalysis
- Use ocean analysis & global coupled ocean-atmospheric global circulation model
- Observation inputs: Satellite data (90 products), weather stations, buoys, ships, & aircraft observations