Health and food security are closely intertwined. Malnutrition increases vulnerability to disease and many of the mortalities during famines result from epidemic diseases such as measles. Consequently a health component is usually an integral part of a disaster response. However, we are gaining a growing appreciation that many epidemics are directly triggered by climatic anomalies such as drought, flood, temperature or humidity changes, rather than being the result of malnutrition.

This knowledge offers important new opportunities for forecasting and early warning of epidemics. Health professionals have taken a lead in exploring these health-climate interactions and this information has not yet been widely disseminated amongst the food security and disaster management communities. This issue of the Greater Horn of Africa Food Security Update reviews the health-climate linkages, assesses the on-going initiatives to provide improved early warning of epidemics and considers the opportunities for, and potential benefits of, greater interaction between health and food security professionals in this area.

Health-Climate Interactions

Temperature and weather changes can directly affect health, for example through exposure to thermal extremes. However, the most significant health effects occur as a result of disturbances to the ecological systems. In particular the geographic range and incidence of vector and waterborne diseases can be altered, either increasing or, less commonly, decreasing disease rates.

Figure 1: Monthly admissions for malaria treatment compared to rainfall, 1996 – 1998, Wajir Town, Kenya

In sub-Saharan Africa many major diseases are transmitted by a climate sensitive vector:

- Malaria is arguably the most important of these, given the morbidity attributed to the disease and the strong linkages to climate (see Figure 1 and Box 1). In Kenya in 1999 malaria accounted for 32% of total morbidity, with similar morbidity rates in other Greater Horn countries.

- There is a strong relationship between Rift Valley Fever (RVF) outbreaks in East Africa and heavy rains, notably during the 1997/98 El Nino event. The consequent livestock export ban by the Gulf States undermined food security in a large swathe of the Horn – to a much greater extent than the direct effects of the disease on livestock productivity.
Both Dengue Fever and Yellow Fever (sharing the Aedes aegypti vector) have transmission peaks associated with high rainfall and humidity. The spread of the vector, the biting frequency and virus development are all affected by the temperature. However, non-climatic factors appear to be the major trigger for epidemics.

Box 1: Using Climate Information to Forecast Malaria Epidemics

Transmission of malaria is linked with several climatic factors. While surface water is required for mosquito breeding, different vectors have different tastes and the relationship between rainfall and disease incidence is complex. High humidity and temperature increases adult mosquito survival; higher temperatures also decrease the mosquito feeding interval and the incubation period of the Plasmodium parasite.

The most predictable and dramatic upsurges in malaria are seen where malaria is normally regarded as non-endemic - at the fringes of the areas of climatic suitability for transmission (see Figure 2) - during periods of abnormally wet and/or warm conditions. For example, extensive epidemics occurred in both the Kenya lowlands and highlands following the heavy 1997/98 rains.

Combining this information with a population ‘layer’ allows us to identify populations at risk of epidemic (as opposed to endemic) malaria.

The Highland Malaria Project (HIMAL) developed such a model for the highland areas of Africa. This analysis indicates large populations at risk from malarial epidemics in Ethiopia, Kenya, Rwanda and Burundi with smaller populations at risk in Tanzania and Uganda. Populations in these epidemic prone areas are especially vulnerable as they typically have low levels of immunity and local malarial control programmes are often poorly resourced. This model can be used to prioritize the location and establishment of prediction and monitoring systems.

Water related diseases are also strongly influenced by climatic factors. Shortages of water during drought are associated with increased diarrhoeal diseases through the increased concentration of pathogens, poor hygiene and use of unsuitable water sources.

- High temperatures increase the survival of bacteria, viruses and protozoa that cause diarrhoea. A +5°C water temperature deviation during the 1982/83 El Nino event caused a huge cholera epidemic in the Indian Ocean coast and around Lake Victoria.
Flooding can contaminate water sources. The 1997/98 El Nino floods in Eastern Africa were acknowledged as the cause of major cholera outbreaks.

The array of possible climate-health interactions is vast. However, it should obviously be borne in mind that the relationships are complex and epidemics are equally often associated with non-climate factors such as land use change.

The Status of Epidemic Early Warning Systems

While the research on disease and climate is extensive, the establishment of operational epidemic early warning systems lags behind. There are few examples, and mostly experimental projects, which are not yet linked to early response mechanisms.

Box 2: Forecasting, Early Warning and Early Detection

“These strategies differ in approach, specificity and the lead times they provide. The following definitions were agreed: Epidemic forecasting consists of predicting that such conditions are likely to appear at some place and time in the future, and will normally depend on medium-range weather forecasts. Early warning, on the other hand, consists of monitoring these environmental risk factors directly and locally, in order to detect when conditions suitable for an epidemic have appeared at a given time and place. Early detection is the monitoring of epidemiological data in order to detect the actual occurrence of an epidemic as soon as it begins.

Each of these functions has an important role in an integrated strategy. Epidemic forecasting provides the longest lead times, but is likely to be the least specific and reliable. It will allow heightened surveillance and some initial precautionary measures in the danger areas. Early warning should provide greater reliability and local specificity, and therefore a lower frequency of false alarms, but will allow less time to prepare a response. Early detection will be even more reliable and geographically specific, but at the cost of much reduced lead times.”

The climatic triggers of other diseases are also being modeled. The seasonal extent of the meningitis belt into Ethiopia is significantly increased by high temperatures and low humidity in the dry season. Consequently the Ethiopian Ministry of Health factors in climate information into decisions on the timing and extent of (very expensive) vaccination campaigns.

The incidence of RVF in East Africa is being predicted by anomalies in vegetative cover. In both cases the systems are still rudimentary.

However, from these innovative projects several important generic lessons are emerging. The HIMAL project, at a meeting in March 1999, developed a “three flag” system for forecasting, early warning and early detection (see Box 2). This provides a useful framework for developing other early warning systems for a variety of health threats.

The KEMRI/KMD malaria project identified a further important consideration. The increased temperatures and modified rainfall patterns observed in the region over the last decade, which have been attributed to global warming, could modify the endemic ranges of vectors and diseases. This
suggests that our forecasts should not only consider seasonal variations but should consider the possible impacts of climatic shifts and make appropriate policy recommendations.

**Policy Implications of Linking Health and Food Security**

There are a number of potential benefits in bringing together the health and food security communities in the design and operation of the nascent health early warning systems.

⇒ Firstly, there is the obvious concern to protect human and animal health as a component of broad food security programmes. Disease can directly reduce productivity – for example when people become unable to labour on farms or through a reduction in livestock productivity. It may restrict the ability to access food through markets, for example the case of RVF. Health care costs may diminish scarce resources and assets, which in turn further reduce productivity. The food security community needs to proactively maintain good health and cross-sectoral support to, and nurturing of, health early warning systems is appropriate.

⇒ Secondly, many of the same monitoring indicators are needed by both health and food security professionals. Therefore, the monitoring systems can be harmonized, rather than replicated, to increase efficiency and reduce costs.

⇒ Thirdly, the health professionals have generated an interesting model for the organization of prediction services; in particular drawing distinctions between forecasting, early warning and early detection activities. A similar model could be usefully applied in the food security sector.

⇒ Lastly, one of the most important lessons gleaned over time by the food security early warning systems, is that good information does not necessarily lead automatically to an appropriate early response. The health sector can benefit enormously by examining the successful approaches adopted to bridge this gap. An obvious starting point is participation in the collaborative institutional arrangements, established under the food security sector, to link information providers with the ‘response’ community.

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**Box 3: Resources and Contacts**

- For details on MARA please visit [www.mara.org.za](http://www.mara.org.za)
- For information on HIMAL contact Dr Jonathan Cox ([jonathan.cox@lshtm.ac.uk](mailto:jonathan.cox@lshtm.ac.uk)), DfID Malaria Programme, London School of Hygiene and Tropical Medicine.
- Rift Valley Fever monitoring is available at [www.geis.osd.mil/Documents/rvf/Walter_Reed_Project/rift_valley_fever_monitor.html](http://www.geis.osd.mil/Documents/rvf/Walter_Reed_Project/rift_valley_fever_monitor.html)

This report is based on the presentations and discussions at the "Pre-Climate Outlook Forum Users Workshop", Jinja 27th - 28th November, organized by the Nairobi Drought Monitoring Centre ([www.dmcn.org](http://www.dmcn.org)). In particular this report draws on the presentation of Dr Jonathan Cox.
Consensus Rainfall Forecast for September to December 2001

The 8th GHACOF (Greater Horn of Africa Climate Outlook Forecast) meeting was held in Jinja, Uganda, between the 29th and 30th August 2001. During the GHACOF a consensus seasonal forecast for September to December was developed with inputs from representatives of the Meteorological Services from ten GHA countries, the Drought Monitoring Centre Nairobi (DMCN), the International Research Institute for climate prediction (IRI) and the UK Meteorological Office.

The rainfall outlook for each zone within this sub-region is given in Figure 3 (for a more detailed explanation of a probability forecast please consult the IRI site http://iripred.ldgo.columbia.edu/). The forecast is for an increased likelihood of near-normal rainfall over most of the Greater Horn of Africa sub-region for the period September - December 2001. However, probabilities favour above-normal rainfall over southern Sudan, northwestern Uganda and western Ethiopia and below normal rainfall over eastern Eritrea, extreme southern Ethiopia, north eastern Uganda, much of Kenya, southwestern Somalia and central and much of northern Tanzania.

Weather patterns in the Greater Horn are heavily influenced by Seas Surface Temperatures (SSTs) in the Pacific and Indian oceans. The Forum concluded that the 1998-2000 La Niña episode (below average SSTs in the Pacific ocean) has decayed and SSTs over the Pacific Ocean are now near normal. According to most models, SSTs are expected to remain near normal for the next few months. While the Pacific ocean is showing signs of warming, a new El Niño event is unlikely to develop in this forecast period.
In order to help in the interpretation of a forecast, a simple ‘road map’ was presented to the ‘user’ community at the GHACOF. This is summarized in Figure 4 below:

**Figure 4: FORECAST INTERPRETATION**

<table>
<thead>
<tr>
<th>Set the Forecast in Context</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. What is the ‘normal’ rainfall during the forecast period?</td>
</tr>
<tr>
<td>(Does the forecast period correspond to the dry season, major rains, minor rains? Bear in mind that this may vary within a country).</td>
</tr>
<tr>
<td>2. What are the conditions preceding the forecast period?</td>
</tr>
<tr>
<td>(Which populations are food secure and which are food insecure? What is the potential significance of this season to worsen/improve the food security of these groups?)</td>
</tr>
<tr>
<td>3. Evaluate the “lessons learnt” from the previous forecast cycle.</td>
</tr>
<tr>
<td>(Was the forecast effectively disseminated to the right people, what were the positive and negative experiences?)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mitigation Planning</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Consider a variety of possible rainfall patterns; “best case”, “worst case” and “most probable case”.</td>
</tr>
<tr>
<td>(Remember, forecasts are probabilistic not deterministic. They can help identify the most probable outcome, but a variety of outcomes are always possible)</td>
</tr>
<tr>
<td>2. Translate possible rainfall patterns into food security outcomes or scenarios; “best case”, “worst case” and “most probable case”.</td>
</tr>
<tr>
<td>(Estimate consequences of rainfall on agricultural production, factor in other information on current food security status, market access and civil insecurity)</td>
</tr>
<tr>
<td>3. Develop mitigation plans on the basis of the “most probable” scenario.</td>
</tr>
<tr>
<td>(Concentre planning and preliminary resource allocations on this outcome)</td>
</tr>
<tr>
<td>4. Include contingency plans to accommodate the best or worst case outcomes.</td>
</tr>
<tr>
<td>(Insure that plans remain flexible enough to respond to a “less probable” event)</td>
</tr>
</tbody>
</table>

September to December constitutes an important rainfall season over the Greater Horn of Africa sub-region. However, the dry season begins after September in northern Sudan, northern Ethiopia and parts of Eritrea. This forecast could be especially significant for highly food insecure populations in southern Somalia, southern Ethiopia and Kenya, who have yet to recover from preceding droughts. Intensified monitoring and contingency planning is justified given the enhanced probability of below average rainfall.

**Sudan Update: Outlook Brighter in Some Areas Update**

The current situation in Sudan is mixed, but with good rainfall in some of the drought-affected areas of Northern Sudan, the short-term prospects are improving in many places. In particular, most areas of Kordofan Region reported good rains: most of the surface water catchment systems have been
replenished; a reasonably good harvest is expected beginning in October, and most markets report declining food grain prices and improving terms of trade between livestock and food grains. While local infestations of pests have been reported, and there were some shortfalls in the emergency response, overall the situation looks set to improve for the rest of the year. The situation has improved somewhat in Darfur, though not as dramatically. While some areas have received adequate rains this year, many other areas particularly in North Darfur did not, and will not have any harvest in late 2001, compounding already serious local food crises. An already-existing shortfall in food assistance pledges is likely to worsen unless surpluses from elsewhere can be purchased and transported to areas still affected by the drought.

**Figure 5 Administrative areas of Sudan**

There was a serious threat of flooding, particularly along the Blue Nile where water levels reached near-record highs in mid August following heavy rains in the Ethiopian highlands. However, barring further extreme weather conditions in Ethiopia, the threat of widespread flooding, and in particular the threat of floods to the city of Khartoum. Some short-term relief efforts are under way in areas that were flooded, but these are of a relatively minor scale. Some 97,000 people are adversely affected by floods and in urgent need of assistance. Most severely affected States are River Nile, Kassala, South Darfur and Sennar.

Heavy rains have made many roads impassable, forcing WFP to expand its food airlift operations to new areas to reach some 200,000 people cut off from help. Through September, WFP airlift operation will deliver relief food to areas previously reachable by road in drought-ridden Darfur such as El Genina, and includes locations in government-controlled southern Sudan like Bentiu. The WFP emergency food aid operation, valued at $108 million, and targeting 2.9 million vulnerable people nation-wide, is 80% funded for 2001.

There is little change to report in the Government held transitional areas since the June GHA Food Security Update. Very high rates of malnutrition continue to prevail in parts of Northern and Western Bahr el Ghazal. A nutritional survey in Aweil South County indicated global malnutrition rates of 30 percent global acute malnutrition and 6 percent severe acute malnutrition in children under the age of three. A July survey in Unity State showed a prevalence of acute global acute malnutrition of 38 percent in Rubkona and 25 percent in Bentiu—the two main towns harboring people displaced by fighting around Sudan's oilfields.

### News & Resources

- A meeting to discuss “Early Warning and Early Response in the Pastoral areas of the Greater Horn” is scheduled to be held between 13th to 15th November in Mombasa. This event will exchange information on current best practices and identify opportunities for improvement at the national and regional levels. Further details are available from Nick Maunder nmaunder@fews.net

- “Soup Kitchens or Solidarity” Workshop on principled approaches to food distribution in conflict situations, jointly sponsored by Overseas Development Institute and CARE, is now rescheduled for Tuesday, December 11th in Nairobi. For information contact Dan Maxwell: Maxwell@care.org

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CARE is an international NGO working in relief and development in nine East African Countries

See www.fews.net or contact nmaunder@fews.net for details

For more info please contact maxwell@care.org