The Multiple Roles of Satellite Data in Livelihood-Based Famine Early Warning for Decision Makers

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Summary

For nearly two decades, the United States' Agency for International Development's Famine Early Warning Systems Network (FEWS NET) has advised local, national and international partners on African food security issues. During the past four years, this program has expanded to two more regions and will soon be available to those countries worldwide who request the program. A founding partner of the program, NASA has contributed real time satellite data for rangeland health, cropped area and rainfall estimation.

FEWS NET has implemented a new approach to quantifying food security that incorporates food prices, wealth ranking and levels of vulnerability with agricultural production information in a decision support system. The livelihoods-based food security early warning system is an analytical framework designed to help decision-makers understand the effects of different 'shocks' on household-level livelihood options and focuses on areas that are highly sensitive to biophysical hazards such as drought. The livelihoods analysis is used in a broader early warning system that organizes information about people living in rural and urban households and, when necessary, connects it to decision makers providing different types of assistance in support of their lives. The quantitative representation of the different food and cash income options available to different types of households in a particular geographic area is typically presented in a baseline report and a food economy spreadsheet designed to facilitate food security outcome analysis.

Satellite data can be used in each level of the food security analysis once the baseline study on food economy has been conducted. Satellite derived products contribute to estimates of the area of food crops planted in a particular year (LandSAT data), monitoring of crop health throughout the season (TRMM), estimates of the percent of normal production harvested (MODIS, AVHRR), development of rangeland depletion curves (MODIS, TRMM), and inputs to models projecting food price changes over the coming year (AVHRR, SPOT Vegetation). As a recently funded NASA application, we are currently developing short-term (1-3 month) projections of these indicators to improve early warning of food insecurity for decision and policy makers worldwide.

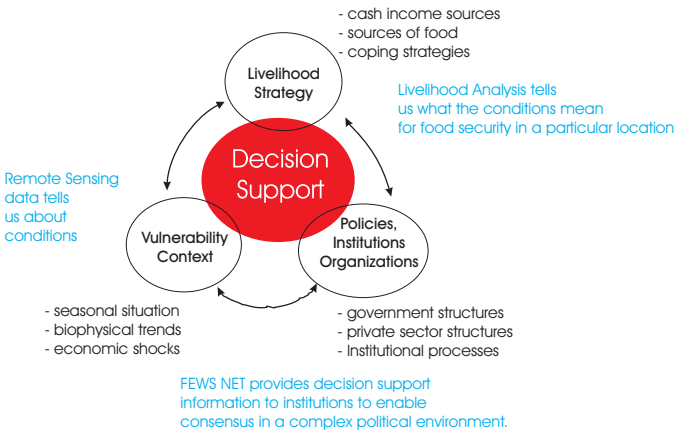
NASA Satellite Data used for Famine Early Warning

FEWS NET collaborates with NASA, NOAA, USGS and USDA to create appropriate and timely climate and crop monitoring products so that it can create guidance for decisions makers in the US and abroad. The biophysical parameters that FEWS NET is monitoring has grown from simply gauge rainfall and vegetation (AVHRR) to derived products that are closer to the information that is needed. There are still significant gaps in information, such as measurements of cropped area in regions with small field size, and continuous and reliable rainfall gauge data.

Table 1: Biophysical Parameters being monitored by FEWS NET

What is being monitored?	How is being Monitored?	NASA Satellite
Precipitation	RFE - Rainfall Estimate	AMSR E
	TRMM - Tropical Rainfall Monitoring Mission 3b42RT	TRMM, NOAA
	GTS Station Data - Global Telecommunication System	
	CMORPH - NOAA CPC Morphing Technique	NOAA OLR
Derived Precipitation Products	SPI - Standardized Precipitation Index	TRMM, NOAA
	SOS - Start of Season	
	ITCZ - Intertropical Convergence Zone	
	WRSI - water requirement satisfaction index	
	Rangeland WRSI	
Clouds	OLR - Outgoing long wave radiation	MODIS
	IR - Infrared Temperature	
	Water Vapor - MODIS	
Global Climate Indicators	MJO IR - Madden Julian Oscillation/ 200 h/PA velocity potential	NOAA SST
	GFS Vorticity	
	ENSO phase - Sea Surface Temp Anomalies	
Precipitation Forecast	GFS model - Global Forecast System	
	NCEP/ETA model	
Vegetation	AVHRR GIMMS NDVI (normalized difference vegetation index)	AVHRR
	AVHRR NOAA Vegetation Health	AVHRR
	SPOT Vegetation NDVI	
	MODIS NDVI	MODIS
Soil Moisture	SSM/I Soil Moisture	AMSR E
	CPC Leaky Bucket model	NOAA OLR
	MI - Moisture Index	TRMM
	SWI – Soil Water Index	
Fires	MODIS Rapid Response	MODIS
Snow	Snow station data	MODIS
	Snow depth grid	
	Snow cover	
	Snow Water Equivalent	
Hydrology	BERM - Basin excess rainfall model - flooding	TRMM, NOAA
	Reservoir levels	JASON, TOPEX
	Cyclone Monitoring	TRMM, NOAA
Seasonal Forecasts	IRI SSTA + COLA AGCM temp and precip predictions	

FEWS NET Livelihood Framework Incorporates Biophysical and Socio-Economic Data



Examples of Biophysical Products.

Below you can see examples of the Africa biophysical data products. FEWS NET uses a mix of measured data on rainfall and vegetation density and models that use these parameters as input. Figure 6a and 6b shows the standard NDVI and RFE products for Africa. Figures 7-10 show some derived products that use the RFE as input but are closer to the crop information needed for decision making. We are currently creating projected parameters that will allow information on the growing season 2-5 months in the future to be incorporated into the decision making system.

Figure 6a. AVHRR NDVI anomaly September 2005

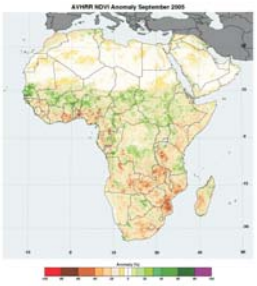


Figure 6b. Rainfall Estimates for September 2005

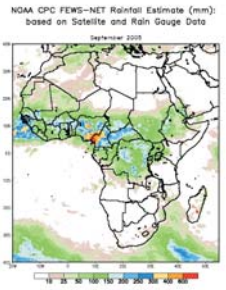


Figure 7. Water Requirement Satisfaction Index for Sept 05

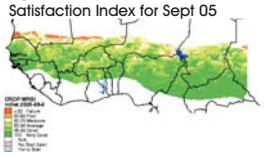


Figure 8. Start of Season for West Africa, September 2005

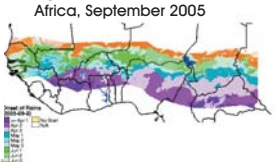


Figure 9. Standardized Precipitation Index, from RFE, September 2005

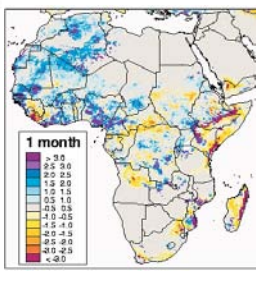
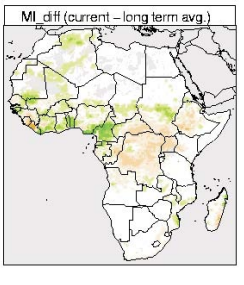


Figure 10. Moisture Index, using RFE, temperature, Sept 05



Livelihood Framework provides Context for Remote Sensing and Economic Data

FEWS NET uses a livelihoods framework to provide information on the impact of climate and economic variability for the countries in which it works. To do this, it provides Zone Maps and Profiles, and data on the cash income sources and sources of food for three groups in each zone. These groups are the poor, middle and better off economically, defined with local criteria (see Figure 2 A and B). For Each group, we are able to see the possible impact of a particular hazard by knowing what the usual way of making a living is. In non-industrialized countries, low-income people make their living from a combination of food and income-earning activities. Food insecurity results when one or more of these strategies fail and no alternatives can be found (FEWS, 2005a). FEWS NET uses the livelihood concept to reveal how and why people survive (and fail to survive) in difficult times (Mathys, E., 2005). Figure 5 shows the countries and regions where these Livelihood Baselines have been completed and where they are still be developed.

Livelihood Baseline Examples: Niger

Figure 2a. Niger Livelihood Zone Map

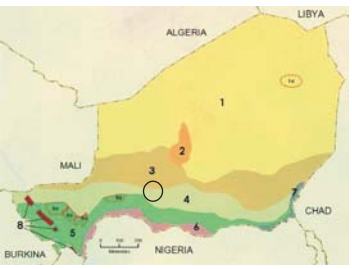


Figure 2b. Niger Agro-Pastoral Zone (4) Wealth Definitions

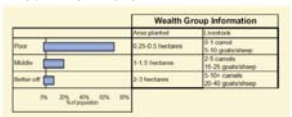


Figure 3a. Food Sources for Niger's Agro-Pastoral Zone (4)

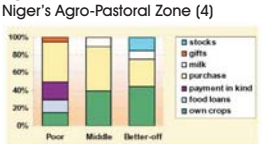


Figure 3b. Cash Income Sources for Niger's Agro-Pastoral Zone (4)

Figure 5. Countries where FEWS NET has completed Baselines