Forecasting forage yields using the ARIMA model in pastoral areas of East Africa

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Introduction Predicting forage supply is an age old quest for pastoralists, particularly in fragile and drought-prone areas of Africa. Traditional methods of forecasting forage used by many communities have become less effective due to climate change, frequent droughts and decline of grazing areas. Conflicts relating to available forage and water resources are increasing, because more marginal lands are put to crop production. A new forage forecasting technology has been developed that provides a comprehensive view of current forage condition (Stuth *et al.*, 2004). A multiple species grazing land plant growth hydrology based model (PHYGROW) was parameterised with site-specific soil, plant community, grazer data that was spatially linked with satellite weather and predicted daily available forage (Rowan, 1995). The objective of this study was to explore use of the Auto-Regressive Integrated Moving-Average (ARIMA) procedure in forecasting a 30, 60 and 90-day available forage.

Materials and methods The Livestock Early Warning Systems (LEWS) project has developed a monitoring system to assess emerging trends in forage supply and animal condition on pastoral rangelands of Ethiopia, Kenya, Uganda and Tanzania. The PHYGROW model was parameterised on 400 sites in the study region and decadal runs made from Jan. 2002 to June 2004. The LEWS country teams selected 81 sites for model verification. Fifty, 0.5 m^2 quadrats were sampled on each validation site representing the 8 x 8 km grid using a comparative yield method (Haydock & Shaw, 1975). Regression equations converted the rankings into actual forage values. After each dekad, 30, 60 and 90-day forage forecasts were estimated using the ARIMA model with Normalised Difference Vegetation Index (NDVI) as covariate according to Box & Jenkins (1994).

Results The results indicated a good relationship between forage yield estimations with PHYGROW and field observations (R^2= 0.96 and SEP= 161 kg/ha). The ARIMA time series forecasting methodology provided suitable projections well within normal sampling errors. The observed R^2 and SEP (kg/ha) values for the 30, 60 and 90 day forecast of grazeable standing crop were 0.93/139, 0.84/206, and 0.71/254 respectively (Figure 1).

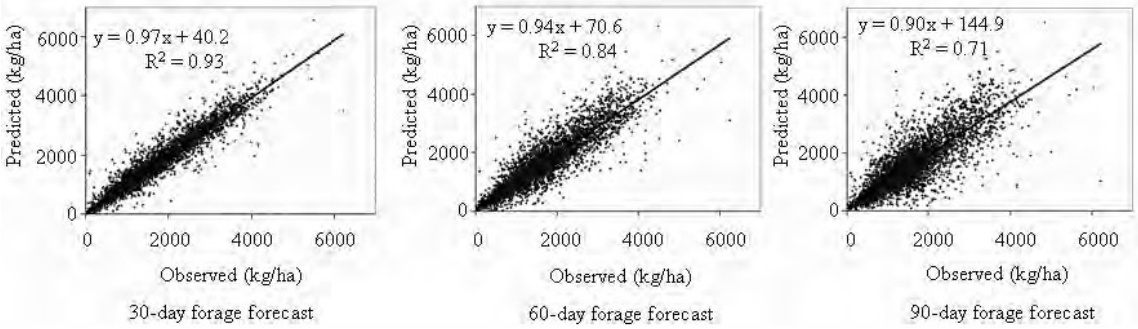

Figure 1 Relationship between observed and predicted 30, 60 and 90-day forage forecasts

Conclusions This methodology allows a new powerful mechanism for decision makers to visualise with a progressive 90-day analysis window emerging "hot spots" (spatial areas of forage scarcity/abundance) that are difficult to perceive and determine if they are going to recover or worsen.

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