Department of Agriculture and Fisheries – Drought and Climate Adaptation Program

DCAP Project Final Report

Project ID	**DCAP 8 - Customised Pasture Alerts by email.**
Grantee Name	

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1. Executive Summary

This project aimed to provide graziers with the critical information they need to be prepared for and manage the impacts of drought. One of the most fundament decisions to enable graziers to make proactive climate responsive decisions is to match livestock numbers to available pasture on their individual properties. The *'Pasture Alert'* renamed during the project to the *'Pasture Growth Alert'* is a property-scale report providing historical and future outlooks for rainfall and pasture growth to be delivered through the DSITI's decision support system FORAGE. The report assists graziers with phased proactive destocking in the face of drought by providing a timely prompt for decision making.

A prototype *'Pasture Growth Alert'* report (see Attachment 1) has been developed by DSITI in consultation with DAF grazing land management scientists. The report provides 6 pasture growth alert levels from 'very-low' to 'extremely-high' based on: 1) the rainfall and pasture growth outlooks, 2) last 12 month rainfall and pasture growth and 3) current ground cover for individual properties. The rainfall seasonal forecast is calculated based on ENSO probabilities forecast sourced from International Research Institute for Climate and Society (IRI); the forecast is made by more than 20 dynamical and statistical models for SST in the Nino 3.4 region (Barnston, et al. 2004) (http://iri.columbia.edu/our-expertise/climate/). The pasture growth outlook is calculated from the northern Australian grazing simulation model GRASP (McKeon, et al. 1990) incorporating rainfall outlooks and taking into account of current conditions including soil water status, ground cover and soil nitrogen availability for that location.

Relevant management advice under each alert level is provided to trigger early decision making in relation to stocking rates for season ahead. The prototype *'Pasture Growth Alert'* has been reviewed by DAF grazing land management scientists; further refinement, enhancements and validation of the alert are planned over the next 12 months, as well as the development and delivery of an extension package for the DAF extension network. Further development/improvement of the report could potentially include assessment of the forecast skill and options to use other seasonal outlook systems such as SOI, SPOTA-1 and ACCESS-S. The report will be refined based on feedback from DAF extension staff and grazing land consultants.

Subject to future Drought and Climate Adaptation (DCAP) priorities, the final *'Pasture Growth Alert'* will be made available through the FORAGE system on the LongPaddock website in May 2018 and the report will be available on

demand, or in a new feature unique to the *'Pasture Growth Alert'* – where users can subscribe to have the PDF reports emailed to them on a regular basis or once a user defined threshold has been reached. The *'Pasture Growth Alert'* tool could also be used in the future with safe carry capacity calculations to enable grazier's to determine forage budgets specific to their property's resources.

2. Project Background

The current paradigm of drought-related 'advice products and systems' (e.g. LongPaddock, AussieGRASS, FORAGE and VegMachine online) requires users to actively seek new information from the various sources as it becomes available. To provide easier access to the information, and after consultation with users, we wanted to provide users with the option of receiving an early warning customised property-scale drought report, generated on alert threshold conditions, or regularly delivered by email through DSITI's FORAGE system. Users will register their email address and choose a default threshold, or select a specified level of pasture growth, at which they would like to be emailed the report. The conditions for triggering the alert would have a combined assessment of 'remote-sensed ground cover', 'previous season's growth' and 'pasture growth forecasts'. The result is an operational decisions support system that links ENSO forecasts from IRI to pasture growth prediction for the season ahead.

3. Project Methodology

The prototype *'Pasture Growth Alert'* report has been developed by DSITI in consultation with DAF grazing land management scientists and is part of the DSITI FORAGE decision support system. The report provides 6 pasture growth alert levels from 'very-low' to 'extremely-high' based on: the rainfall and pasture growth outlooks, last 12 month rainfall and pasture growth and current ground cover for individual properties.

Rainfall
The historical rainfall is sourced from SILO climate database with the historical pasture growth simulated using the GRASP model (see pasture growth). A moving window of the previous 12 months and the last six months (total 18 months) historical rainfall information is given. The rainfall seasonal outlook is calculated based on ENSO probabilities forecast sourced from IRI with the forecast made by more than 20 dynamical and statistical models for SST in the Nino 3.4 region (http://iri.columbia.edu/ourexpertise/climate/). The forecasts provide the likely probability for El Niño, Neutral and La Niña conditions for the next six months. Specifically, the rainfall forecast is calculated through the following steps: 1) obtaining ENSO forecast probability for El Niño , Neutral and La Niña conditions for each of the next six months and the historical analogue years for El Niño, Neutral and La Niña; 2) obtaining the historical (1889-present) rainfall for the same month corresponding to each of the next six months going to be forecasted; and 3) calculating the weighted average of the historical monthly rainfall for each month corresponding to the six forecasted months with the weights as the forecasted probability of an El Niño, a Neutral and a La Niña. These weighted averages for each month are then treated as the forecasted monthly rainfall for the six months. This methodology can be applied to the SOI phase and potentially other seasonal forecast systems.

Pasture growth
A moving window of the previous 12 months and the last six months (total 18 months) historical pasture growth information is given. The pasture growth outlook is simulated by the GRASP model incorporating the rainfall outlooks and takes into account the current soil and pasture conditions (e.g. soil water status, ground cover and soil nitrogen availability).

Ground cover
The current total ground cover percentile is sourced from DSITI's Remote Sensing Centre, which indicates the ranking of the cover over an assessed period (1990 - present) for each 30m pixel on the property.

Decision tree analysis
A decision tree has also been developed to assess the pasture growth alert level and assign relevant 'management advice' under each risk level (see Attachment 2). The above mentioned information, including historical rainfall and pasture growth, the rainfall and pasture growth outlooks and the current ground cover information is assessed against the decision tree and a relevant risk level is then assigned for the user to prompt an on-ground management

response. For example, if the pasture growth outlook is higher than the long-term average, the pasture growth in the last 12 months is higher than long-term average of the same period and the current average ground cover is higher than 50th percentile, then the pasture risk level is set to be 'very low.' The 'management advice' is developed considering the risk level and the season the forecast produced.

Validation
A t-test is conducted to check if the forecasted rainfall or pasture growth is significantly different (higher or lower) from the long-term average of the rainfall or growth for the same period. If the t test is not significant for a month, it indicates that the forecast for that month mainly reflects climatology and is not different from average conditions.

Further forecast skill tests will be developed in the next stage of the development of the report.

User feedback
Feedback was received from DAF grazing land officers (Emily Barbi - Rockhampton and David Phelps - Longreach), including recommendations to clarify what the alert is for and improve the management advice, the decision tree, pasture growth modelling and the presentation of the report. Initial feedback from David Phelps revealed the intention of the report was misunderstood and it was thought to be a forage budgeting tool. While forecasting pasture growth will inform the future development of a forage budgeting tool we have changed the report name from '*Pasture Alert'* to *Pasture Growth Alert'* to avoid ambiguity. Other recommendations will be discussed and implemented in the next stage of the development (see Attachment 3 for more details).

4. Project Results

4.1 Achievements and Outcomes
- A prototype '*Pasture Growth Alert'* report has been developed.
- A moving window of the previous 12 months and the last six months (total 18 months) historical rainfall and pasture growth information are given.
- Six month rainfall and pasture growth outlooks are estimated.
- Six pasture growth alert levels have been developed based on the historical and forecasted rainfall and pasture growth, and the current ground cover information.
- A detailed description is given for the six pasture growth alert levels.
- Management advice under each alert level is provided to facilitate drought management decision making.
- A push email system has been developed (though not currently open for subscription) to allow users to subscribe to the report on a threshold or temporal basis.

4.2 Unintended Outcomes
To enable the push mail alert feature of the report we need to store users' emails on the FORAGE decision support system, we have to install additional privacy features on the LongPaddock website. This additional development could not be added to the scope of the LongPaddock redevelopment project (DCAP DSITI project 10). However, we intend to deliver this in the near future and the LongPaddock website redevelopment is completed.

4.3 Partnership Formation
DSITI has entered into a collaborative licence agreement with the International Research Institute for Climate and Society (IRI) to enable the use of the IRI ENSO forecasts in the '*Pasture Growth Alert.'*

4.4 Lessons Learned

The *'Pasture Growth Alert'* has excellent potential to assist graziers and has received positive and enthusiastic responses from DAF grazing land scientists, extension officers, and consultants. However we are trying to convey very complex information and a mix of future forecast probabilities and modelling uncertainties and translate them in management advice. Therefore we need to continue to work with DAF grazing land scientists, extension officers, and consultants to improve the decision tree, pasture growth modelling, and the presentation of the report. We also recognise the need for DAF extension staff to help to validate the usefulness of the alert by applying the management advice over the next 12 months with producers to provide insightful feedback to DSITI scientists to improve the reports and develop a training package for extension to be able to explain and apply the report with

landholders.

4.5 Implications for the Future

To give grazier's the inside edge to master Queensland's drought-prone climate, we need to continue to enhance and build on critical drought support technologies such as the *'Pasture Growth Alert.'* We need to re-engage with rural industry to provide the tools pastoralists need to become climate-savvy graziers who will continuously adapt to Queensland's variable and changing climate.

To achieve this we need to:

- engage with producers, DAF drought support officers, reef support officers, regional body extension staff and industry consultants to refine and test the *'Pasture Growth Alert.'*
- develop and deliver training and extension package will be for 'Pasture Growth Alert' through DAF extension networks.
- build on this pasture growth outlook early warning system to equip graziers and industry advisers with advanced tools that incorporate climate forecasts into our holistic understanding of grazing systems, including the simulation of management decisions in response to modelled pasture production (from GRASP).
- provide carrying capacity calculations and forage budgets specific to their property's resources to give graziers an understanding of the impact of climate on their grazing enterprise.
- enhance our tools to take advantage of the increasing availability of satellite-derived data, which allows spatially explicit measurements of the land surface condition to increase modelling and customised analyses at the paddock to property scale.
- focus on the user and engage with producers, DAF drought support officers, and industry consultants, these tools will prompt proactive management decisions that reduce economic and environmental exposure from the impacts of drought.
- although rainfall is a highly variable requirement for grazing enterprises, we can develop grazing systems that incorporate science and technology that minimise exposure, reduce risk and make the best possible decisions.

5. Conclusion

A prototype *'Pasture Growth Alert'* report has been developed, which provides an early warning reduced pasture outlook to prompt graziers to make proactive early destocking decisions in the face of drought. When released, this report can be requested by the user from the FORAGE website located on LongPaddock on an ad hoc basis; and can also be supplied by subscription, where the report will be sent to users regularly (e.g. monthly or quarterly) or on a pasture growth threshold alert basis. Further validation and user feedback is required from DAF land management officers and consultants to improve the management advice, pasture growth modelling and the presentation of the report. We are also planning to enhance the report to include forecast skill and options to use other seasonal forecast systems such as SOI, SPOTA-1 and ACCESS-S. The *'Pasture Growth Alert'* tool could be used in the future with safe carrying capacity calculations to enable graziers to determine forage budgets specific to their property's resources.

6. Financial Statement (Revenue received/Expenses paid/Revenue unspent

As agreed to be supplied after financial reporting for June has been completed.

7. Additional Information

Nil.

8. References

Barnston, A. G., et al. (2003), Multimodel ensembling in seasonal climate forecasting at IRI, Bull. Am. Meteorol. Soc., 84, 1783-1796.

9. Appendices/Attachments

9.1 Milestone Reports
Provided.

9.2 Case Studies
See attachment 3 for list of properties being tested in the user feedback table.

9.3 Project Reports
N/A

9.4 Scientific Papers
N/A

9.5 Products/Product Descriptions
See attachment 1 the prototype *'Pasture Growth Alert.'*

9.6 Other Relevant Attachments

N/A