

A national approach to map management practices that improve soil condition

Ground cover mapping using remote sensing has been identified by the Australian Collaborative Land Use and Management Program (ACLUMP) as a primary method for monitoring the adoption of sustainable farming practices and as an indicator of soil condition ⁽⁷⁾. ACLUMP has been working towards establishing national standards for: reporting land management practices; field measurement of fractional cover; and the use of remotely-sensed fractional and land cover products to monitor and interpret ground cover levels over time. The focus has been on the more intensively managed agricultural areas under cropping and modified grazing land uses ⁽⁶⁾. These ACLUMP activities are informing the state and federal governments' natural resource monitoring programs. ACLUMP activities are also linked to other initiatives such as the Terrestrial Ecosystem Research Network (TERN) which is providing nationally consistent time-series datasets underpinned by a network of observational sites.

Adoption of practices which maintain ground cover

Land management practices that are encouraged to maintain ground cover include: reduced tillage; stubble retention; careful timing or avoidance of long cultivated fallow for cropping areas; careful management of stocking rates and; increasing the proportion of perennial vegetation in pastures for grazing areas.

The adoption of these practices has increased over time and now nearly 60 per cent of the area under crops and/or pasture use no tillage and retain stubble (Figure 1).

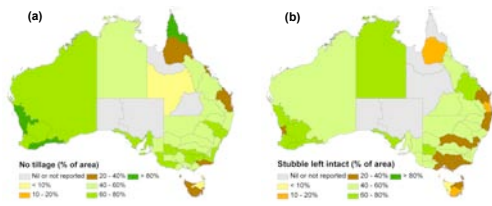


Figure 1. Land prepared for crops and/or pastures within a natural resource management region using management practices encouraged to retain ground cover; (a) no tillage (apart from herbicide spraying or sowing), (b) stubble left intact (no tillage, crops direct drilled) ⁽²⁾.

Calendars of operations

ACLUMP partners have compiled nearly 500 calendars of operations indicating the timing of typical management practices for the major cropping and modified pasture land uses occurring in a natural resource management (NRM) region. The variation in management practices which impact ground cover levels and their timing across Australia is illustrated for wheat crops in Figure 2.

The calendars are based on expert opinion and provide context to interpret satellite imagery for ground cover maintenance. The calendars will also assist with the location and number of ground cover reference sites and supplement the results of the Australian Bureau of Statistics' Agricultural Resource Management Survey.

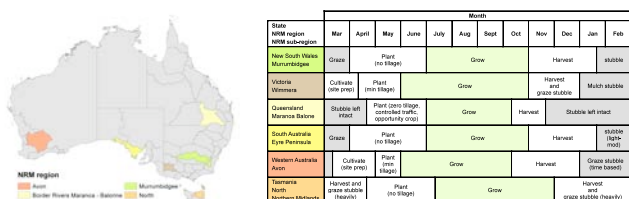


Figure 2. Timing of management practices influencing ground cover for rain-fed wheat in selected NRM regions, derived from the calendars of operations.

Ground cover reference sites

ACLUMP has assessed the suitability of existing monitoring sites for use to calibrate and/or validate remotely sensed fractional cover (Figure 3).

Methods of ground cover collection were compared with a modified discrete point transect sampling method which measures the bare soil, and the photosynthetic and non-photosynthetic vegetation fractions of ground cover. This method is used in Queensland's and New South Wales' state-wide landuse and trees study (SLATS) programs and is being adopted nationally as a consistent approach for measuring fractional cover in the field (Figure 4).

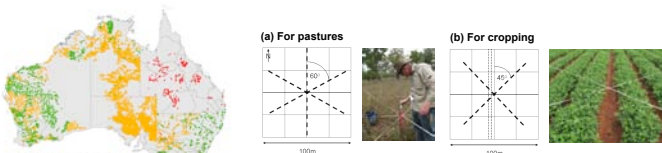


Figure 4. Layout of transects to measure ground cover at 1 metre intervals to calibrate Landsat imagery (30 metre) and then to upscale to MODIS (500 metre) imagery ⁽⁶⁾.

Figure 3. Suitability of sites for calibration and/or validation of remotely sensed fractional cover.

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Interpreting fractional ground cover time-series

A MODIS-derived (500 metre) vegetation fractional cover product ^(3,5) has been selected to monitor ground cover for Australia. Using this product, monthly, seasonal and yearly trends in the ground cover fractions can be considered (Figure 5).

Coupled with land use or land cover information and calendars of operations these trends can infer the impact of management practices at a particular location (Figure 6). Climate is the other key factor influencing the fractional cover dynamics.

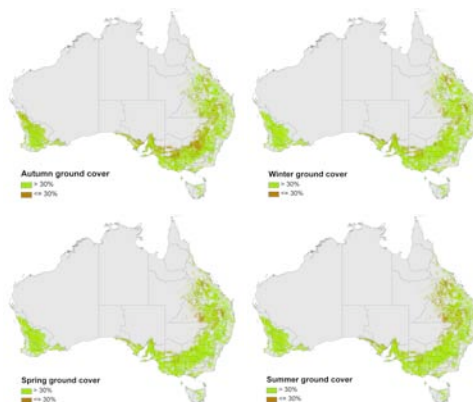


Figure 5. Areas under cropping and modified pastures with ≤ 30 per cent ground cover (in 2005-06) and hence prone to wind and water erosion ^(1,3).

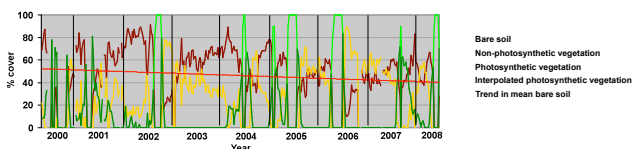


Figure 6. Trends in fractional cover during opportunistic cropping in the Fitzroy catchment, Queensland. The decreases in area of bare soil suggest changes in stubble management ^(3,4).

Directions

The Australian Collaborative Land Use and Management Program is working to deliver:

- A national field manual to standardise reference site selection, field measurement and data entry
- A network of several hundred reference sites for priority landscapes, land uses and management practices to provide reliable estimates of fractional cover (e.g. informed by Figure 7)
- A comprehensive, spatially explicit national database of land management practices to complement the remotely sensed products
- New products using finer resolution sensors (i.e. Landsat) to augment the temporal frequency of the MODIS-based fractional and land cover products
- Improved understanding of the natural and human-induced variability in ground cover levels through observing the influence of climate and land management practices on fractional cover dynamics.



Figure 7. Fractional cover reliability used to identify priority locations for ground cover reference sites in areas under cropping and modified pastures ⁽¹⁻³⁾.

References and data sources

- (1) ABARE-BRS (2010) Land Use of Australia, Version 4, 2005-06.
- (2) Australia Bureau of Statistics (2009) 2007-08 Agricultural Resource Management Survey (cat. no. 4627). <http://www.abs.gov.au/auststatsabs@nslfmi4627>
- (3) CSIRO Land and Water (2009) MODIS-derived vegetation fractional cover. ftp://ftp0data.wron.csiro.au/rs/MODIS/products/Guerschman_etal_RSE2009v2.0
- (4) Geoscience Australia and ABARE-BRS (2010) National Dynamic Land Cover Map, Version 1.
- (5) Guerschman JP, Hill MJ, Renszulla L, Barrett DJ, Marks AS, Botha E (2009) Estimating fractional cover of photosynthetic vegetation, non-photosynthetic vegetation and bare soil in the Australian tropical savanna region upscaling the EO-1 Hyperion and MODIS sensors. *Remote Sensing of Environment* 113, 928-945.
- (6) Schmidt M, Tindall D, Speller K, Scarth P (2010) Ground Cover Monitoring with Satellite Imagery in Agricultural Areas and Improved Pastures. (Department of Environment and Resource Management, Queensland: Indooroopilly).
- (7) Stewart JB, Rickards JE (2010) Developing National Protocols to Map Ground Cover Management Practices in Cropping and Grazing Systems: Report on an Australian Collaborative Land Use and Management Program Workshop, 12-13 May 2009, Brisbane. (Bureau of Rural Sciences: Canberra).

ACLUMP is a consortium of Australian and state government partners that promote the development of nationally consistent land use and land management practices information for Australia. The program is under the auspices of the National Committee for Land Use and Management Information.
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