Putting precision livestock research to work in extensive livestock production systems

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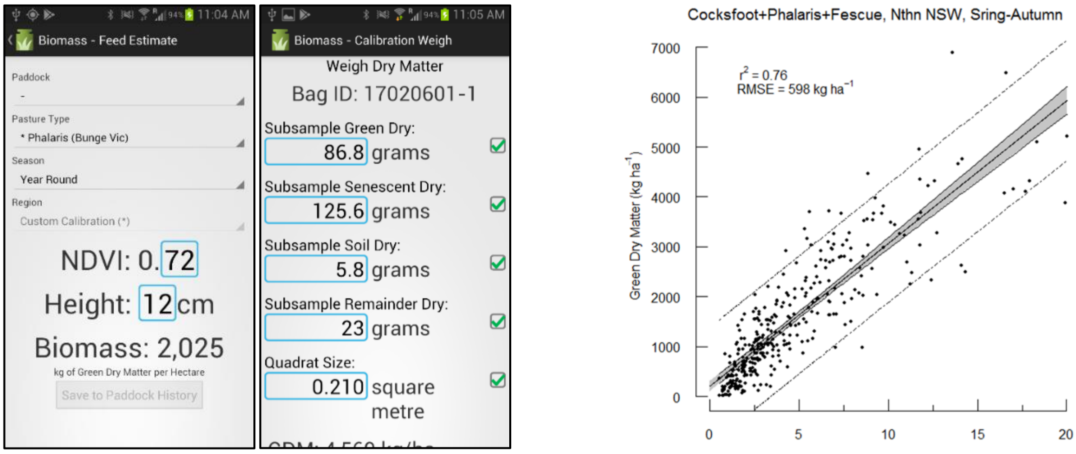
Since the relatively recent appearance in precision agriculture circles (as opposed to the domain of livestock R&D) of precision livestock management (PLM), this new form of PA has come a long way. In extensive farming systems, where the geographical conditions are challenging (large spatial scale and often considerable environmental heterogeneity), there are fewer precision livestock technologies at work than compared to, say, intensive livestock production systems. However the time lapse between R&D and operational use appears to be significantly shorter. R&D first reported only a few years ago is appearing in operational form owing largely to the proliferation of existing OEM devices or systems that can be easily repurposed by producers to put the R&D outcomes to work. In the context of extensive operations, to date, precision livestock R&D has tended to focus on two areas, independent of one another; namely feed base monitoring/management tools, and animal monitoring/management tools. Only recently are we seeing practical attempts to bring the two together.

Without getting embroiled in defining precision livestock 'management' or 'farming', it is possible to get an idea of how this field is shaping up in extensive livestock production from the R&D activities underway. For example feed base tools include remote and proximal optical sensing of pasture biomass (green fraction and also total standing biomass) at a range of scales. This is enabled by satellite remote sensing (ranging from 6 ha per pixel in the case of Pastures from SpaceTM which utilises the MODIS satellite and more recently 0.09 ha utilising Landsat data) and handheld active optical sensors such as the Greenseeker®, supported by smart phone apps (Figure 1) which provide either point measures or transect average estimates. More recently, the operational use of Crop Circle® (another active optical device devised for handheld use) on helicopters for larger scale pasture assessment has also been reported by producers (Figure 1).

Web/cloud-based data delivery systems of larger scale satellite-image derived products have also come a long way. Despite a drawn-out gestation since last centurys, Pastures from Space (now in its latest form Pastures from Space Plus® -https://pfs.landgate.wa.gov.au/) is experiencing something of a resurgence, and demand-driven from the producers themselves, in the market place. FarmMap4D (http://www.farmmap4d.com.au/), a very recent addition to the market place is another. Many of these platforms include value-add capabilities such as PfS Plus with its attendant stocking rate calculator capability and mobile device app and FarmMap4D with its ability to link to the national property boundary database.

Livestock tracking and on-board accelerometers are another class of technology gaining wide spread use in R&D thanks to emergence of OEM global navigation satellite systems (GNSS- eg GPS) based devices that can be easily configured for deployment under full operational (farming) conditions on animals. Examples include the 3G-enabled PetrekTM (www.pettrackinoz.com.au) and USB accessible I-gotU (www.i-gotu.com) (Figure 2). More recently devices such as the LP-WAN enabled mOOvement allow remote access to GNSS tracking data with sampling intervals of tens of minutes (http://www.moovement.co/smartfarming).

These sorts of technologies are now being applied to answering higher-level R&D questions almost as fast as they are appearing in the market place. Examples include understanding how cattle interact with limited feed base in extensive (~ 100,000 ha) rangeland holdings of northern Australia (Figure 4) and how feed intake and associated weight gains can be incorporated with harvester yield maps to quantify total yield in crop-graze systems.



(a) (b)

Figure 1. (a) Biomass Feed estimator app including a self-calibration procedure and (b) example of crowd-sourced data (Source: Karl Andersson, CRC-SI)

(a) (b)

Figure 2. Crop Circle active optical sensor (a) configured and (b) deployed for operational helicopter-borne pasture assessment (Source: Matthew Monk, Sundown Pastoral Company and Derek Schneider, UNE-PARG).

(a) (b)

Figure 3. GNSS tracking devices such as I-gotU can be easily (a) re-purposed and (b) configured for operational field deployment (Source: Jamie Barwick UNE-PARG)

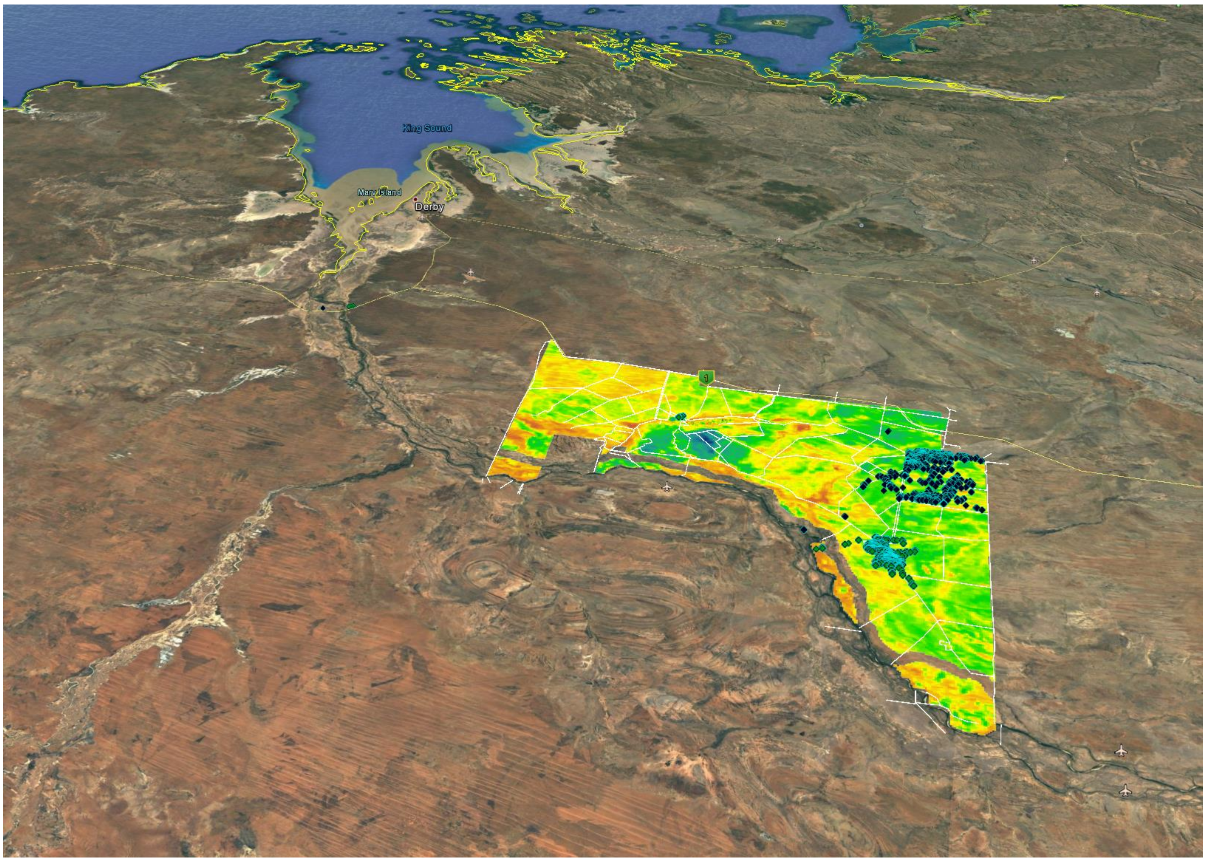
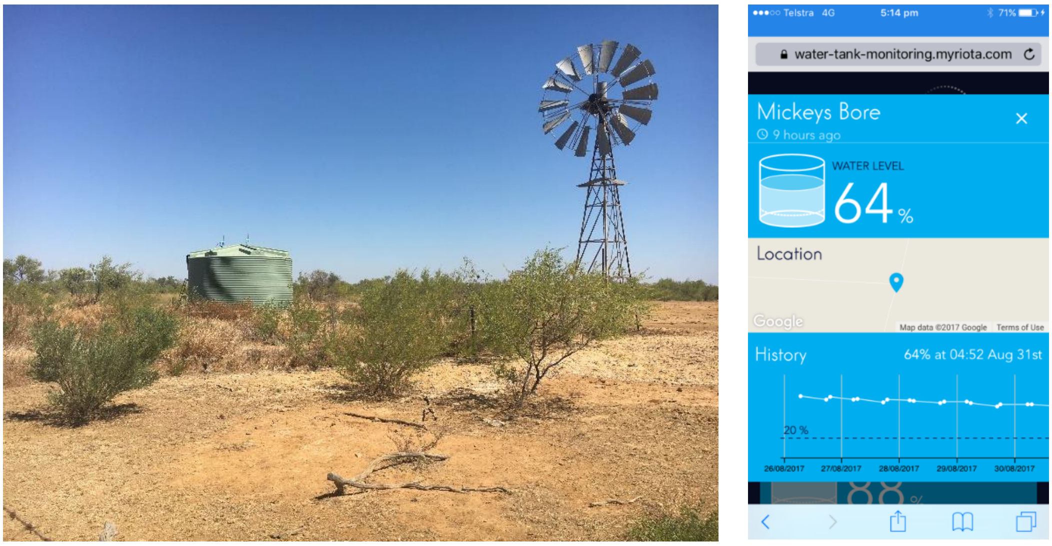


Figure 4. GNSS tracking devices coupled with readily-accessible satellite image products such as this temporal forage 'persistence' maps allow an understanding of animal-landscape interactions (Source: author and D. Schneider UNE-PARG). This particular farm is 298,000 ha.

Telecommunications sits at the very heart of many of these extensive livestock production innovations. It is not hard to see why, in a world where internet of things (IoT) device installations in agriculture is expected to more than double from ~30 million only 2 years ago to more than 75 million in 2020 (a compound annual growth rate of 20%; BI Intelligence, 2016), the livestock sector will experience similar growth. Moreover countries like Australia, with our reliance upon a 'connected extensive livestock future' must pay attention to getting producers connected (Lamb 2017). There is considerable innovation activity in connecting extensive farming systems. Within-farm connectivity options include the direct use of mobile cellular networks (where they exist), innovations in radio wide area networks (eg LPWAN, LoRA WAN) and also rapidly emerging satellite 'direct' systems, especially IoT-specific satellite communications systems (Figure 5).



(a) (b)

Figure 5. Remote bore (tank level) monitoring system utilising a new capability to manage ~100,000 IoT devices at any time streaming in from low earth orbit (LEO) satellite communications links (Source: CRCSI/Myriota)

This presentation will discuss some of the emerging operational PA system in extensive livestock farming and look at some of the constraints and opportunities of realising our digital agriculture future for extensive livestock systems.

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