First add water

BEETALOO STATION

Farm Facts

60km east of Elliot, 800km south of Darwin, NT Barkly Tablelands

Enterprise: Cattle

Brahman and Brahman-Senepol cross beef production

Property Size: 1,054,700 hectares

Average Annual Rainfall: 450-650 mm

Elevation: 220 m

Motivation for Change

- Previous experience that water supply is critical for productive grazing on vast properties

Innovations

- Delivering a reliable water supply to support grazing across vast areas of previously unused native rangelands
- Establishing smaller paddocks on a very large scale to concentrate grazing animals to ensure managed use of pastures and continuing improvement of soils
- Innovations commenced: 2002

Key Results

- Significant increase in carrying capacity – 100,000 head of cattle viewed as "conservative"
- Development of an innovative vision for grazing in Northern Australia
- Delivering time-controlled planned rotational grazing on a significant scale

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The innovative practices developed by John Dunnicliff and his family at Beetaloo provide, potentially, an efficient and sustainable method of cattle production applicable to vast areas of northern Australia – just by adding water.

When the Dunnicliff family acquired Beetaloo in 2002, it had been managed for the previous century in the traditional way. Much of the country was effectively virgin cattle country, having never really been grazed, while the areas near water had been seriously over-grazed and the pastures and soil were degraded. With experience running grazing properties in various regions of Australia, including the Kimberley region where water supply is an equally important issue, they could see the potential to significantly increase productivity while simultaneously rehabilitating the degraded landscape. The key was the provision of water.

Since taking over the properties, John Dunnicliff has embarked on a massive development program to provide stock water across vast areas of the properties. The scale is based on a model that cattle should not have to walk more than 2km for water. Full implementation of the plan could see production expand from the current carrying rate of 50,000 head of cattle to a potential target of 100,000, with an ultimate production cost of 32 cents per kilogram.

Advice was obtained along the way from tropical animal production expert Dr Steve Petty, who is based at Kununurra, and from holistic management experts, Terry McCosker and Allan Savory.

A Whole Lot of Land

The Dunnicliff family has been farming in various parts of Australia, starting in northern New South Wales and including King Island and the Kimberley Region of far north-west Western Australia. In 2002, they acquired Beetaloo Station, which encompasses the perpetual pastoral leases of Beetaloo, OT Downs and Mungabroom.

Beetaloo Station is vast. The total area of Beetaloo and OT Downs is 707,800 hectares and the Mungabroom property is 346,900 hectares. Combined, the total area is 1,054,700 hectares or 10,547 square kilometres. The distance from west to east is approximately 130km and from north to south about 120km - as the brolga flies. Approximately 50,000 cattle are currently run on the properties.

Beetaloo Station extends over one million hectares

The climate in this region is monsoonal. Average annual rainfall ranges from 450mm in the south-east of the properties to 650mm in the north. However, nearly all of this falls in the wet season from November to March. Due to the hot climate, annual potential evaporation is about 2700mm. This means that, while rainfall is not particularly low, there is a substantial water availability deficit in the dry season.

Newcastle Creek runs through the Beetaloo property, providing a series of wet season waterholes and three large wetlands that rarely dry completely. The OT Downs property, part of the northern watershed of Newcastle Creek, also has some wet season waterholes and semi-permanent wetlands. The Mungabroom property has no permanent water, only temporary waterholes along the creeks after the wet season. Large volumes of good quality water are available from shallow aquifers underlying the entire area.

The dominant soil types across the property are heavy, hard-setting alluvial clays that have formed on the flood plains. Lateritic sandy soils and red earths are derived from sedimentary rock, such as sandstone and limestone, which underlies and projects above the alluvial plains.

The natural vegetation includes open plains dominated by Mitchell grass (*Astrebla spp.*), which occur on the heavy clay soils. These plains are surrounded by and interspersed with woodlands and low open forests dominated by coolabah (*Eucalyptus coolabah* or *Eucalyptus microtheca*) and bauhinia (*Bauhinia cunninghamii*). The sandy soils and red earths support dense low forest of lancewood (*Acacia shirleyi*) with scattered eucalypts.

Water birds, including pelicans, ducks and brolgas, are prolific on the wetlands, temporary waterholes and earth tanks. Wedge-tail eagles, kites and other raptors are a common sight.

Wetlands and waterholes support significant biodiversity

John and Trish Dunnicliff manage Beetaloo Station with the assistance of their daughter, Jane, and her husband, Scott Armstrong. The Dunnicliff and Armstrong families participate in a program with the Barkly Landcare Conservation Association, which has a project to investigate production from differing grazing techniques, and will contrast rotational grazing on Beetaloo with a nearby 'control' of the status quo management style, set stocking and with a biodiversity monitoring program run by the Northern Territory Department of Natural Resources, Environment, Arts and Sport.

Improving Production through Adding Water

When John purchased Beetaloo there were 40 bores and associated 'turkey nest' earth tanks scattered over the properties. John considers that "Less than 10% of the land area was effectively watered. Most of the country was in a relatively natural state, apart from areas affected by heavy stocking, surrounding most of the watering points. Large areas had never been grazed, due to lack of water. As a consequence, fires were a constant problem before each wet season".

John's observations of the grazing effect at increasing distance from water points (see images, right) suggested that the realistic maximum effective grazing distance from water is less than 2km. Cattle no doubt go further from water to graze when pastures near the bore are depleted – some people argue up to 10km – but John believes that the constant travel to and fro would eliminate any benefit and they will work off any weight gain on the way. This observation has been substantiated by work done by the CSIRO.

There are other management problems associated with using vast paddocks, such as the inability to control grazing intensity, inability to force cattle to graze less palatable areas and the high cost and inefficiency of mustering.

The cumulative effect of this form of grazing management is gradually declining grazing value, as the accessible pasture becomes degraded, increasing vegetation and soil degradation and loss of habitat for native species.

Cattle on degraded land close to a watering point

Top to bottom: Pasture at watering point; 1km away; 2km away; and 3km away from watering point

John could see the grazing potential in extensive areas of native pastures which were being very inefficiently used. Drawing strongly on his previous experience in the Kimberly, he saw the opportunity to develop, "A large scale, naturally sustainable cattle operation that is simple to operate, economically viable, environmentally sustainable, productively utilises all the available grazing area and aims at being an industry leader in low cost beef production".

By developing a water supply and reducing paddock size to distribute grazing pressure across large areas previously inaccessible to cattle, John believed that he could relieve pressure from previously overgrazed areas and facilitate rotational grazing that would enhance soil fertility and pasture growth.

The solution was providing many additional water points to encourage the cattle to graze areas previously not accessed. Now about three quarters of the way through implementing this solution across the million hectare property, the evidence is becoming clear, and John says, "We are looking for an increase in perennial pastures, and opening up of previously unwatered, unutilised country is increasing carrying capacity dramatically. As a consequence stocking rates are being increased to utilise this capacity".

Undoubtedly, the expense of developing the necessary water supply infrastructure was a major impediment. However, arguably the more problematic impediment was overcoming the traditional paradigm, that cattle production in the open rangelands of northern Australia is effectively based on practically uncontrolled grazing across vast areas. John notes that uncertainty and self doubt were a challenge to overcome in implementing innovative methods in the region. Advice received from Dr Steve Petty, Terry McCosker and Allan Savory assisted in reinforcing his plans and concepts.

Cattle now graze previously untouched pastures due to the provision of water nearby

Grazing in the Northern Australian Rangelands

Pastures

Possibly the first mention of the Barkly Tablelands region by a European is by William Landsborough. Writing in 1860 while searching for the Burke and Wills expedition group, Landsborough, leader of the "Queensland Relief Expedition" described "... a plain with the richest soil, and with grasses of the most fattening nature, but which at this time are old and dry. This tableland I have named Barkly Plains, after His Excellency Sir Henry Barkly[1]" (Purdie et al. 2008).

The lease was first settled by Harry Bathern (also known as Bullwaddy) at the turn of the 20th Century. When the Dunnicliff family took over the lease in 2002, the land had been managed for a century in the traditional 'Top End' manner with few infrastructure improvements and a reliance on seasonal watering points, a few bores and dams and whatever grassland was available within cattle walking distance to water.

Landsborough's comment that the grasses were "old and dry" has proved remarkably perceptive. It reveals a fundamental reality that is still relevant today: while the region has considerable potential for grazing, much of it is not being used. Pasture growth is prolific when there is ample rainfall. But nearly all of the rain falls in the few months of the wet season. This rapidly dissipates in the hot climate of the dry season. The pastures then go to seed and senesce, by which time they are of little use for fattening cattle.

There are only two ways to ensure that the grasses remain useful for grazing: animal impact or burning. The grasses regenerate readily after burning, but at the cost of loss of organic matter, soil biota and volatile nutrients. Frequent burning degrades the soil. Conversely, brief periods of high pressure grazing consumes or knocks down the pasture before it goes to seed and senesces. This maintains pasture in a vigorous growing condition.

New grass shoots after burning

Water provision in traditional local grazing management was to pump bore water to open earth tanks then troughs, resulting in substantial evaporation

Water Access

Grazing in the vast expanses of northern Australia depends entirely on access to water. Cattle can travel only limited distances each day to reach water without loss of condition. While the landscape is extensive, very little of it is sufficiently close to water to be effectively used for stock grazing. The small number of (relatively) permanent water sources has been increased significantly since the realisation that there was a significant underground source of artesian water. While bores had been sunk by previous owners to access this water, by 2002 the distribution of bores was grossly insufficient to provide water to much of Beetaloo.

Traditional grazing management on the Barkly Tablelands was to drill a bore, from which water was pumped by windmill to an open earth tank and then to a trough. A large percentage of the water pumped evaporated, which meant that, where used, a large amount of the diesel fuel used was wasted.

Sparsely distributed bores typically led to serious over-grazing close to the bores and steadily decreasing grazing with increasing distance from the bores.

Over years of grazing, this leads to the elimination of the native perennial pasture species close to the bores and colonisation of annual species. The annual species have grazing value but do not persist for long through the growing period. This low-value ground cover steadily spreads out from the bores year after year. Immense areas too far from the bores are left unused – like the "old and dry" grasses noted by Landsborough in 1860. Perennial pasture species also die through stagnation.

Adding Water

The Infrastructure

To extend the use of land on Beetaloo Station, John's basic strategy is to establish a network of bores to provide a reticulated water supply system. The previous paddocks that were scores of square kilometres can then be reduced in size. Building on his observation that the maximum effective distance that cattle can travel is less than 2km, the goal initially was to reduce paddock size to 4km by 4km (1600 hectares). Observing that it is still difficult to get grazing pressure high enough to use the pastures effectively at that paddock size, this is in the process of being reduced to 3.3km by 3.3km (1200 hectares). Consequently, as John points out, "This water development is being carried out in conjunction with an extensive fencing program".

A network of bores is being installed and connected with 75mm diameter pipe installed at a depth of 800mm running along the fence lines. Burying the pipe 800mm deep ensures it does not expand and contract with temperature changes, which could cause leaks to develop. A steel tank of 170,000 litres useable capacity or a plastic tank of 20,000 litres capacity is installed at each fence intersection. The tanks are filled from the bores by diesel pump. Windmills could not generate the pressure required for this and solar-powered systems are far too costly. Despite the long distances to travel to them, the pumps are manually operated because remote electronic switching systems have been found to be unreliable.

Concrete or steel troughs installed in the corner of each of the four nearby paddocks are filled from the tanks by gravity. Each bore supplies around nine tanks and each tank supplies four paddocks. The pipelines being linked in a grid arrangement means there is multiple back-up in the event that a bore fails. Similarly, having four troughs in each paddock provides a backup in case a tank is unserviceable.

One person is employed full-time during the dry season to maintain the bores, tanks and trough system, including refuelling, servicing and repairs.

The helicopter provides both transport and safety capabiliities

Water infrastructure now comprises a network of steel or plastic storage tanks, concrete or steel troughs and and bores
Inset: A diesel bore pump

Work place safety is a major concern in this remote region. As well as ensuring all staff attend safety briefings, providing safety equipment and ensuring appropriate signs are in place around the sheds and homestead area, staff at Beetaloo Station are trained in first-aid. Using a helicopter for travel around the property has the dual benefits of enabling faster travel for work purposes and providing a means of rapid evacuation of an injured person.

The Cost

Developing the water supply is a massive investment. Each kilometre of laid pipe costs around $3000. Even with the most cost-effective methods, the bores, tanks, fencing and other costs incurred to develop each water point come to around $60,000. This seems a lot until the capital cost is divided by the number of cattle each unit of the investment can support, making it much more achievable.

Besides financial obstacles in obtaining capital, John has encountered other challenge in implementing his watering program across Beetaloo Station. He has experienced "resistance and scepticism from some members of the grazing community and industry bodies in relation to the changes", and regularly battles the restrictions on availability and supply of resources due to isolation. John states that trial and error and working closely with suppliers has been essential to resolve various technical issues, such as tanks failing.

Regardless, John continues to fund the development incrementally, investing all outputs from production increases back into the watering program.

The Benefits

John has sought to implement his changes using a holistic approach to livestock management with minimal chemical and artificial inputs. His fundamental focus is on soil, plant and animal health and animal welfare.

"Experts indicate the targeted carrying capcity is conservative."

Providing many smaller paddocks with troughs in each corner has delivered many benefits. John notes, "By increasing the available watering points, and control of the cattle with associated fencing systems, pasture availability has increased dramatically. This has enabled the spelling of paddocks, to assist with the regeneration of plants, and in turn soil health".

Stock density can be increased to force cattle to graze a much higher proportion of the pasture than they would if left to roam much larger areas. The perennial pasture species are high value for grazing provided they are grazed early in the growing season. If they are not grazed early in the season they go to seed and soon lose nutritional value. Grazing each area in turn with a high stock density for a brief period – three days grazing with a mob of 6000 cattle units is the current aim – prevents loss of pasture value.

The necessary stockpike of fencing materials, water tanks and polypipe stretches to the horizon

At the same time, heavy grazing for a short period, together with the trough location that distributes cattle movement to four points within each paddock, prevents overgrazing, which discourages regeneration of annual species, and reduces soil degradation. Most importantly, short periods of intensive grazing build up soil condition and encourage pasture growth in the long term by breaking down senescent vegetation and litter and adding dung.

The pastures and soils are benefitting from the new grazing regime

The Stock

John believes that with full infrastructure implemented across the property that he will be able to achieve a target carrying capacity of 100,000 cattle, and says, "Experts indicate the targeted carrying capacity is conservative".

The planned carrying capacity with the current water infrastructure implementation is 75,000 cattle units, based on a 400kg animal; a breeding cow is 1.5 units and a mature bull 2.0 units. Herd bulls run permanently with the herd.

At that carrying rate, annual production is expected to be 25,000 cattle units. These are young bulls (maximum weight 350kg) grown for the Indonesian market and larger animals grown for other export markets. Bulls produced other than for this prime export line provide herd bulls for the local and Indonesian markets and for meat markets in the Philippines and the Middle East. Most heifers are retained for herd growth and replacement. Heifers not in calf at 24 months age and culled cows are also sold to the overseas meat markets. John is active in building relationships with his markets, travelling overseas and also receiving visitors to Beetaloo. This has given him confidence in regards to his animals' welfare after export. His clients are also satisfied that they are receiving quality, grass-fed stock, meeting their needs and expectations.

"...a well organised, productive, sustainable business operation that will benefit the whole environment and landscape, without any unnatural side effects."

The Brahman cattle have advantages in the hot climate, being resistant to ticks and tolerant of the heat. However, fertility is generally lower than for other breeds. Crossing the Brahmans with Senepol, a short-haired breed originating in Senegal, West Africa, and developed on the Caribbean Island of St. Croix specifically also to cope with a tropical environment, has been found to provide some resolution to this issue. In addition, John's practice of culling 'empty' 24 month old heifers ensures that the breeding herd is gradually being selected for fertility.

Ticks are a common problem with cattle in the tropics and sub-tropics. Selecting tick-resistant cattle breeds helps, but does not eliminate the problem. Resting each paddock from grazing for long spells breaks the life cycle of the tick and therefore saves on other control treatments. This provides a further key benefit of the change from uncontrolled set stocking across large areas.

Cattle are bred to cope well in the tropical environment and are for resistance to ticks

An Innovative Vision for Grazing?

The experience on Beetaloo Station has demonstrated that cattle production can be significantly increased in northern Australia by providing adequate water supply to areas with grazing potential. There is also scope for the increasing carbon build-up in the restored soils to be achieved across vast tracts of land.

John knows that he is developing "...a well organised, productive, sustainable business operation that will benefit the whole environment and landscape, without any unnatural side effects. The changes being implemented have already been attracting attention from other graziers, advisors, industry bodies and NT Government".

However, he advises, "The cost of infrastructure on the scale required is enormous. The sheer size of the lease limits the pace of change that can be achieved. Make haste slowly, because the costs of getting it wrong are huge".

But this innovative approach also brings other opportunities. Beetaloo is too big for one family. The family's vision for the property is to enable it eventually to be divided into a number of units, each of which can support an efficient family run business. This could ultimately be a model for efficient and sustainable cattle production applicable to the vast areas of northern Australia, which, as John says, "Is essential for the long term survival of the industry and its participants".

[1]Sir Henry Barkly was the then Governor of the colony of Victoria and president of the Royal Society of Victoria

Reference: Purdie, J., Materne, C., and Bubb, A. (2008) *A field guide to the plants of the Barkly Region of the Northern Territory,* Barkly Landcare and Conservation Association, Katherine, Northern Territory.

This case study is an excerpt from the Soils for Life report:

Innovations for Regenerative Landscape Management:
Case studies of regenerative land management in practice

REPORT SUMMARY

The Need for Change

Despite good practices of many of our land managers and farmers linked to some good science, the realities of an increasingly arid and degraded landscape will impact significantly not only on the productivity and viability of agricultural enterprises, but also on the health of our environment and the wellbeing of every Australian.

Landscape degradation is an issue of national and global concern. Landscape management practices including, but not limited to agriculture, forestry and fire have caused significant damage and in the process have altered the earth's natural biosystem. Consequently the precious resources of soil and water necessary to sustain life are being lost at unsustainable rates.

Unprecedented global challenges are arising in the face of this massive degradation of the landscape.

Soil erosion due to traditional agriculture is occurring at a rate between 10 and 100 times faster than the soil's natural formation process (pedogenesis)[1,2]. Healthy soils are necessary to provide sufficient amounts of food with quality nutrition and fibre to meet global requirements.

Three billion people globally already have inadequate water and sanitation. It is assessed that 80% more water will need to be accessed by 2050 to feed the potential global population of more than nine billion[3]. Unless all limited soil and fresh water resources are understood and wisely managed, we are at risk of escalating social disruption and regional instability.

Even with its significant land area, Australia is not immune to the consequences of landscape degradation and increasing future needs. Despite good practices of a number of land managers and farmers allied to some good science, the realities of an increasingly arid and degraded landscape are being experienced across the country. These include:

- increasing acidification, particularly in the south-east;
- declining soil health, caused by the loss of soil organic carbon (SOC);
- erosion;
- severe salinity;
- diminishing river flows;
- high evaporation and runoff rates;
- decreasing availability of groundwater; and
- reduced resilience to impacts of extreme and variable weather events such as drought, flood and fire.

The current state of the Australian natural landscape is further challenged by stresses from our changing climate, unsustainable management practices (such as reliance on high energy inputs), increased mining activity and urban expansion.

The national and global challenges being faced are interrelated and can be best met through a comprehensive coordinated approach focused on improved regenerative environmental management practices.

Landscape Regeneration for our Future

The key process drivers for landscape regeneration are **soil**, **water** and **vegetation**. Together in a natural system, supported by a constant flow of solar energy, these provide a regenerative cycle.

By restoring natural systems through improving landscape management practices, we can maximise water use efficiency, improve soil health, nutrient cycling and biodiversity of vegetation. A properly structured soil, with good levels of SOC, allows greater infiltration and retention of rainfall. Every gram of carbon in the soil can retain up to eight grams of water.

Currently, approximately 50% of rainfall on the Australian landscape is lost to evaporation due to poor soil structure and insufficient groundcover. By improving soil structure – particularly carbon – through increasing organic matter in the soil, we will be able to better capture and retain any rain that falls, making it available to plants for longer.

Through revegetation, groundcover is improved, and subsequently so is the quality of the soil, enhancing water infiltration. In turn, improved soil health and efficiency in water use contributes directly to the ability to support a biodiversity of vegetation and species.

If properly supported, this regenerative cycle can continue to sustain and improve the natural resource base and therefore landscape resilience and productivity.

Restoring these natural cycles and becoming more efficient in the use of natural resources is fundamental to the provision of sufficient food, fibre and water for a growing population. Business as usual is neither viable nor sustainable. Effective practical policies and actions are needed now.

Landscape Regeneration in Action

Innovative farmers are using high performance regenerative landscape management methods and fighting the trend of continued degradation of the landscape with its heavy reliance on external inputs. They are demonstrating sustainable, regenerative practices on their land. With relevant policies and incentives these practices could be extended successfully and quickly to involve a significant number of Australia's 135,000 farmers. Whilst there are always opportunities to learn more, enough is already known to take action now.

Soils for Life has documented some of these regenerative practices in 19 case studies across a range of locations and land-use types. Experiences shared by the 17 innovative farmers and two community organisations in the Soils for Life case studies demonstrate successful action being taken to restore the landscape. Due to the interrelated nature of soil, water and vegetation, benefits can be experienced across all process drivers regardless of the particular area of focus.

The Soils for Life case studies describe a range of techniques being used to obtain positive, regenerative outcomes, including:

- Applying organic composts, fertilisers and bio-amendments;
- Encouraging natural biological cycles and nutrient transfer;
- Implementing time-controlled planned grazing;
- Using grazing management and animal impact as farm and ecosystem development tools;
- Retaining stubble or performing biological stubble breakdown;
- Constructing interventions in the landscape or waterways to slow or capture the flow of water;
- Fencing off water ways and implementing water reticulation for stock;
- Investing in revegetation;
- Pasture cropping;
- Direct-drill cropping and pasture sowing;
- Changing crop rotations;
- Incorporating green manure or under-sowing of legumes;
- Managing for increasing species diversity;
- Controlling weeds through increased competition by desirable species;
- Reducing or ceasing synthetic chemical inputs; and
- Integrating enterprises.

PRINCIPLES FOR REGENERATIVE LANDSCAPE MANAGEMENT

Our case studies show that many different techniques can be applied to regenerate the landscape. Farmers and land managers commonly tailor a variety of methods to their own landscape and personal preferences. There is no single solution to landscape regeneration.

The following principles consistently emerge as underlying their regenerative practices – regardless of location or enterprise. These can be applied by other landholders as a basis for their own regeneration journey.

- Improve the structure of soil, through enhancing organic matter content
- Use and conserve rain where it falls
- Manage holistically
- Care about the land as a resource
- Commit to education and constant learning
- Search out communities of interest for help and advice
- Work on best land and extend from there
- Strive for maximum groundcover, for the majority of the time
- Manage times of plenty for times of shortage
- Reduce reliance on off-farm inputs
- Observe, measure and respond

Notes:

1 United Nations Environment Program, 2012, UNEP Year Book 2012: Emerging issues in our global environment, http://www.unep.org/yearbook/2012

2 Pimentel, D., 2006, 'Soil erosion: A food and environmental threat.' Environment Development and Sustainability, 8, pp119-137

3 Barlow, M., 2007, Blue Covenant: The Global Water Crisis and the Coming Battle for the Right to Water, McClelland & Stewart

CASE STUDY 4 - BEETALOO STATION NT

Other case studies and the full *Soils for Life* report are available at: www.soilsforlife.org.au.

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CARING FOR OUR COUNTRY

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