Final report

PDS Providing Mineral Supplementation via Water

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Abstract

This PDS aimed to demonstrate water medication as an alternative method of providing supplements to cattle on extensive, commercial properties in northern Australia. Water medication technology supplements cattle via trough water. It can be controlled remotely and offers solutions to challenges of other forms of supplementation, such as wet-season paddock access and labour/time requirements. Two paddocks on a Barkly region property were selected, one was supplemented via the property's usual method (dry lick) and the other via water medication. One hundred preg-tested in-calf heifers were put in each, and cattle performance, water and supplement intake, cost and cattle behaviour data were recorded. The PDS was successful in demonstrating that water medication was an effective method of supplementation. Multiple challenges throughout the PDS resulted in only one year of reliable data for analysis. Also, there were too many variables influencing this data to attribute differences in performance between treatments to the supplementation method alone. The key observations from the PDS were: cattle were successfully and safely supplemented with urea and phosphorus year-round using water medication, supplement and water intakes were able to be monitored remotely, and supplement dose rates changed via the online dashboard with minimal technical skill required, and surface water being available appeared to decrease visits to dry lick as much as it did water troughs.

Executive summary

Background

Mineral supplementation of cattle is widely used across the Northern Territory and can significantly increase production. Traditionally, supplements are in the form of a loose lick in tubs or lick blocks that are placed in the paddocks. There are challenges with this, however, such as urea toxicity if dry licks containing urea get wet, accessibility of paddocks through the wet season to distribute phosphorus, achieving consistent supplementation, insufficient intake by shy feeders, wastage and labour/time costs to distribute lick.

Water medication is an alternative method of supplementation where the minerals are distributed automatically, at a set dose rate (based on daily water consumption) into troughs. This means, that as long as cattle are drinking from the trough, all animals will receive the required amount of supplement. Water medication can also improve consistency of supplementation and allows urea to be supplemented during the wet season without risk of toxicity. Additionally, it offers the benefits of remote monitoring technology where supplement levels and water/nutrient intakes can be viewed online in real-time, any issues with the technology can be alerted to via notifications and dose rates can be adjusted remotely.

Adoption of this technology has been low in the past, partially due to previous models requiring a high level of technical knowledge and the technology not always performing well. In this PDS, newer models developed by DIT AgTech were used, which come with a full service plan meaning the user does not need to maintain the units themselves. The technology has improved to include the remote access, performs much more consistently and the liquid supplements have been developed to be more stable and safely include urea.

This PDS provides northern Australia cattle producers with a demonstration of implementing water medication technology on a commercial cattle station in the Barkly region of the NT. The results can be used as a guide of how water medication may fit into other property's management systems, and whether it may be more suited than supplementing via dry licks.

Objectives

The main objective of this PDS was to demonstrate that water medication can be successfully implemented at a commercial scale without negatively impacting the productivity of young breeders. This also included assessing if surface water following rainfall would limit how often cattle drank from the trough and if that reduced the effectiveness of water medication. Whilst variables other than supplementation method prevented accurate comparison of benefits between supplementation methods, supplementation via water medication was successful and the breeders in that treatment were productive and not negatively affected.

Methodology

Two mobs of PTIC heifers were used in the PDS on a Barkly cattle station; one in a paddock supplemented via water medication and the other in a paddock supplemented via dry lick. Paddocks were selected based on what was available, and were not identical and had different recommended carrying capacities. Crush-side cattle performance data was collected along with blood plasma inorganic phosphorus (PiP) levels, GPS collars were used to assess drinking and dry lick visitation behaviours, water and supplement intake data from the water medication units was used and costs for each treatment were recorded. The PDS ran for two years but problems in the first year meant that only one year of data was available to be analysed (May 2022 – May 2023).

Results/key findings

No data collected from the first year of the PDS could be used for analysis as the cattle had to be moved to other paddocks due to dry conditions part way through the year. Whilst cattle data was analysed for the second year, there were too many variables (eg. paddock differences) to attribute differences between treatments solely to the supplementation method without replication of the trial. Key observations were that the water medication technology worked well once set up, cattle supplemented via water were productive (there were no differences between treatments in pregnancy rate), and GPS data indicated that cattle may have visited the trough sooner after rainfall and more frequently than dry lick stations; so in this situation water medication may be an effective alternative to dry lick. Any challenges encountered with the water medication technology were overcome and other producers can learn from this experience.

Benefits to industry

This PDS was not able to provide a cost-benefit analysis of water medication, but it was able to compare the cost of water medication to dry lick supplementation, and found that the costs of the different supplementation methods were similar (the average cost per head for 1 year of supplementation was $23 for water medication and $21 for dry lick – although the cost of equipment was not included in the dry lick treatment). It also demonstrated how water medication can be integrated into pastoral operations. This PDS showed that the water medication technology used is safe (including for urea supplementation through the wet season), relatively simple, reliable and has improved greatly in recent years. The cattle behaviour data also indicated that, in this location, surface water (encouraging cattle to graze further from water points) may have an equal or bigger impact on dry lick visitation frequency than it does on supplement intake via trough water, which may be an opportunity for further research.

Future research and recommendations

The inability of this PDS to compare the effects of the different supplementation methods on performance means that there may be opportunity for further research to collect more accurate cattle, cost and intake data from large scale commercial paddocks by using technology such as auto-drafters. Further research into the water and supplement visitation or intake behaviours of cattle would also be beneficial, looking at factors such as the effect of surface water on dry lick visitation, and preference of medicated trough water compared to dry lick.

Table of contents

GLOSSARY

PDS	Producer Demonstration Site
MLA	Meat and Livestock Australia
NT DITT	Northern Territory Department of Industry, Tourism and Trade
uDose	DIT AgTech product that regulates & automates the release of liquid supplement into the water supply
DIT Ag Tech	Collaborator in this PDS that offers water medication services
BCS	Body condition score
Blood PiP	Blood plasma inorganic phosphorus
P	Phosphorus
NIRS	Near-infrared spectroscopy
NCW	Newcastle Waters Station (PDS site)
PTIC	Pregnancy tested in-calf
uPro Orange	DIT AgTech's Dry Season (high urea) liquid supplement
uPro Green	DIT AgTech's Wet Season (high P) liquid Supplement
AE	Animal Equivalent

1 Background

Supplementation of extensively managed beef breeding herds in Northern Australia can be beneficial to overcome nutritional deficiencies, specifically phosphorus and protein. However, supplements and their delivery to the breeder herd can be expensive and thus decisions should be carefully made to ensure supplementation is cost effective.

Supplementation programs in northern Australia are generally designed to address phosphorus deficiencies through the wet season and protein shortages through the dry season (via non-protein nitrogen), commonly through the use of dry lick (loose mix) or lick blocks. However, there are many practical challenges to providing supplement to cattle, including limited access to paddocks through the wet season, the need to keep supplements out of the weather, the labour involved in keeping supplement consistently available and limited control over intake by individual animals.

Providing supplements through water is an alternative method which may overcome some of these challenges. Firstly, unless there is surface water available, all cattle must drink from the trough and therefore receive supplement. The dosage rate of supplement can be monitored and adjusted remotely, and the supplement does not need to be topped up regularly which would save on labour costs. As the supplement is in the water, there is no requirement to protect it from the weather, which reduces wastage, and allows urea to be provided into the wet season without the risk of toxicity.

Whilst there are many potential benefits from the use of water medication on extensive cattle properties, it is not currently a widely used technology. Experience of innovators using earlier versions of the technology was that it was unreliable, required high technical skills and the supplement formulas weren't stable in bore water. Since then, the technology and supplement formulas have improved greatly. Water medication systems now have fail-safes built in to regulate supplement dose rates, real-time alerts and monitoring via an online platform, the ability to adjust dose rates or stop/start supplementing remotely and technical services provided by the provider.

This PDS provides a demonstration of adopting water medication into NT beef breeding businesses, so that other producers can see the challenges and benefits of doing so and gauge the potential for adoption on their properties. It also provides quantitative information to advisors, extension officers and researchers about the potential use of water medication in the Northern Territory.

It should be noted that due to issues with the initial experimental design and management of this project, no viable replication of results were obtained. Therefore any data or conclusions cited are only an indication and are not statistically verifiable.

2 Objectives

1. *Demonstrate that year round supplementation via water medication can be successfully implemented at a commercial scale without negatively impacting the productivity of young breeding females, using the performance measures of:*
    a. *Annual liveweight gain*
    b. *Heifer pregnancy*
    c. *Calf mortality and re-conception in first lactation cows*

2. *Demonstrate that water medication is an effective method of addressing phosphorus deficiency during the wet season, measured using plasma inorganic phosphorus*

3. *Conduct a cost benefit analysis to determine the relative economic performance of automatic electronic water supplementation compared to the existing method of supplementation on individual properties*

4. *Use GPS livestock tracking equipment to determine if there is a difference in the frequency that livestock access supplements during the wet and dry seasons*

5. *Implement a series of skills and training development activities using a variety of platforms to increase the knowledge, skills and confidence of 20% of NT producers involved in the PDS*

6. *One producer per region, in addition to the producer-demonstrated sites will have adopted using medicated water to supplement cattle through the wet and dry season. Further adoption expected once results are calculated*

7. *Conduct two field days to showcase the demonstration site results and encourage adoption of key practices.*

3 Demonstration Site Design

3.1 Methodology

This PDS ran over two years, with the methodology changing in the second year. In 2021 (Year 1), two PDS sites were established. One was in the Katherine Region, and the other at Newcastle Waters Station (NCW) in the Barkly Region. At the conclusion of the first year of the PDS, a mutual decision was made for the Katherine region site to discontinue involvement in the PDS. Also, due to seasonal conditions, the PDS cattle at NCW needed to be moved to different paddocks. The new paddocks identified at NCW were smaller and could not hold the number of cattle in each treatment mob. A decision was made to 're-start' the PDS in these new paddocks, with new cattle and smaller mobs. Further detail around the reasons for changes to the methodology can be found in section 3.5.

The general structure of the PDS in both years involved two mobs of PTIC heifers, randomly allocated to a 'medicated' or 'control' treatment. The medicated treatment was put in a paddock where all troughs were supplemented using DIT AgTech water medication technology. The cost of using the DIT system covered the supplement, the equipment and its installation, maintenance, monitoring, and nutritional advice from DIT AgTech. The control treatment was put in a paddock supplemented using the property's usual practice, which was loose lick and lick blocks. Both treatments were supplemented year-round with a urea based supplement in the dry season, and phosphorus based supplement in the wet season.
The paddocks used in the PDS were compared using carrying capacity assessment, soil phosphorus and indication of feedbase quality from faecal NIRS analysis. The liveweight, BCS, lactation status, pregnancy status, weaner weight and weaning rates of heifers were recorded to compare cattle performance. Blood samples were taken from a small group in each treatment to assess phosphorus levels through plasma inorganic phosphorus (PiP) testing). GPS collars were also placed on a small group from each treatment to analyse trough and supplement visitation behaviour.
Supplement intake was recorded for both treatments, and the costs incurred by the station for the control treatment were also recorded to compare with the cost of water medication.

Section 3.1.1 provides specific details of PDS design used at NCW in the second year (2022/2023) of the PDS. Only data from this year was used to calculate results, however, and overview of the Year 1 methodology is included in Appendix 8.1 for reference.

3.1.1 Year 2 (2022/2023)

An overview of the PDS design in Year 2 is shown in Table 1 and Table 2. Figure 1 shows a map of the two PDS paddocks used, where the 'control' paddock was supplemented via dry lick, and the 'medicated' paddock via water medication.

Table 1. Summary of treatments in Year 2 (2022-2023), at the PDS site (Newcastle Waters Station).

Year 2 – 2022/23		
Property	NCW	
Treatment	Medicated	Control
Paddock name	Burns	Steedman
Paddock size (approx.)	1700ha	1500ha
Carrying Capacity	96 AE/km^2	With 3rd trough: 150 AE/km^2 Without 3rd trough: 126 AE/km^2

Soil P status	Acutely deficient – deficient	Acutely deficient – deficient
No. troughs	2 (uDose at each)	2 (a 3rd trough was accessible until the 3/07/22)
Surface water	No waterways or natural water sources (other than from rain)	
No. PTIC first-calf heifers inducted	100 (Brahman and cross-bred)	100 (Brahman and cross-bred)

Table 2. Summary of activities in Year 2 (2022-2023), at the PDS site (Newcastle Waters Station).

Activity	Details
Induction date & crush-side data collected	9/05/2022 - Weight, BCS, Preg status, 5 GPS collars fitted in each treatment
Second round muster date & crush-side data collected	29/10/22 - Switched GPS's, BCS, Lactation status, Blood PiP
Final muster & crush-side data collected	18/05/23 – Weight, BCS, Lactation status, Preg status, Blood PiP
GPS collars deployed	09/05/22 – 5 per treatment 29/10/22 - 5 per treatment
GPS collars retrieved	29/10/22 – 5 medicated & 4 control, 18/05/23 – 3 medicated & 5 control
No. Blood samples analysed	29/10/22 – 20 per treatment, 18/05/23 - 20 per treatment
Faecal sample dates	14/05/22, 15/06/22, 10/08/22, 27/10/22, 25/11/22, 16/12/22

Figure 1. Year 2 PDS paddocks at NCW: Steedman (control) and Burns (medicated) and an overview of land units in each.

Trial Paddock Land Units

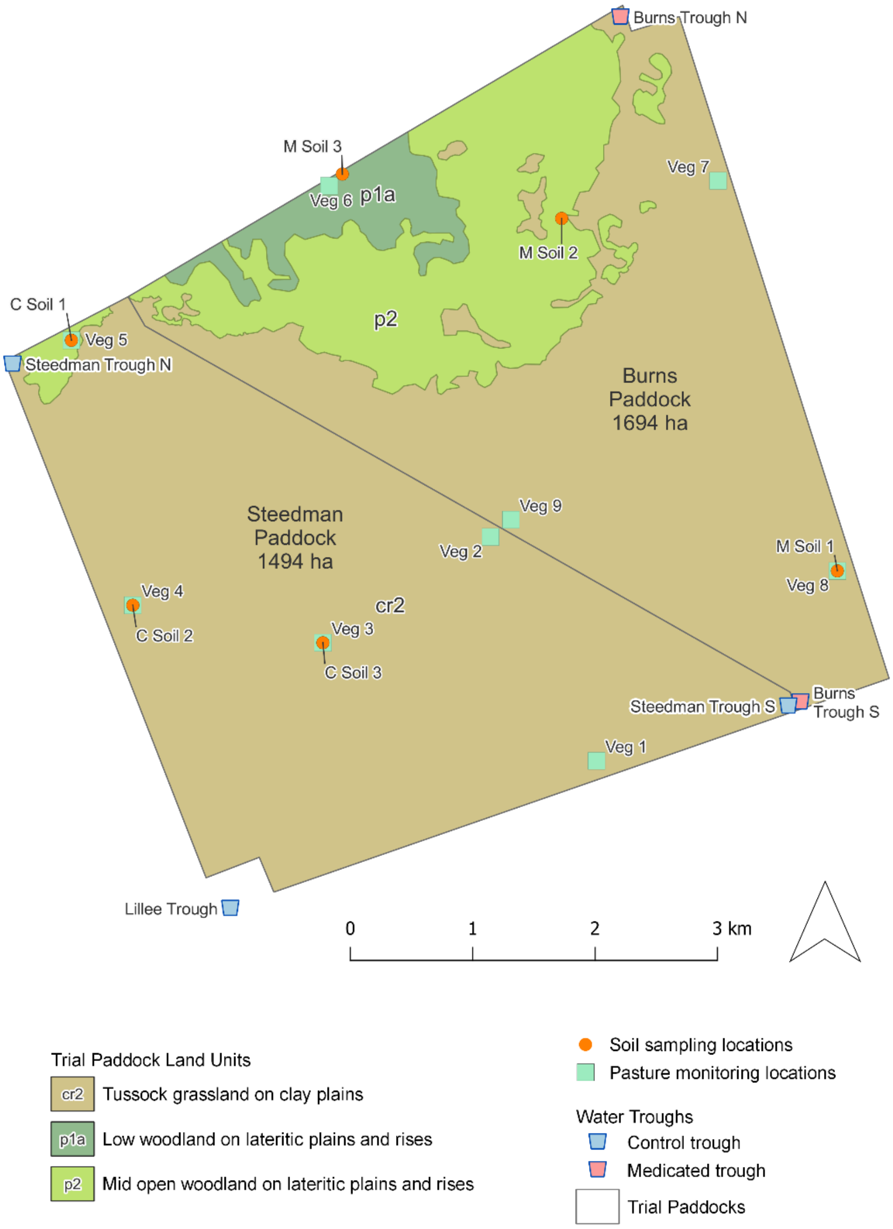
Land Unit	Class	Description	Vegetation Structure	Vegetation Description	Area Ha
cr2	clay plains	level to gently undulating clay plains (black soil plains); cracking clay soils	Tussock Grassland	Mixed species tussock grassland	2567.149
p1a	lateritic plains and rises	plains and rises associated with deeply weathered profiles (laterite) including sand sheets and other depositional products; sandy and earth soils	Low Woodland	Eucalypt low woodland over tussock grasses	112.768
p2	lateritic plains and rises	plains and rises associated with deeply weathered profiles (laterite) including sand sheets and other depositional products; sandy and earth soils	Mid Open Woodland	Corymbia mid open woodland to woodland over tussock and hummock grasses	508.332

Paddock assessments

On the 16/05/22 and 17/05/22, the NCW project manager carried out pasture assessments in both PDS paddocks. Five monitoring points were established in Steedman ("Veg 1-5") and 4 in Burns ("Veg 6-9"), as shown in Figure 2. Points were marked using a picket and GPS coordinates were recorded

on Avenza Maps. Key data recorded was the estimated yield (kg/ha), land condition, percent bare ground, dominant species and other species (inc. tree growth). Photos were taken facing north, south, east and west.
Another assessment was done at the end of the PDS, on the 18/05/23, by the DITT project manager. The same data was recorded and photos taken.

Figure 2. Map of Year 2 PDS paddocks at NCW including pasture assessment ("Veg") and soil sample ("C Soil" = Control, "M Soil" = Medicated) locations.



Soil samples were taken on the 28/10/22 by the DITT project manager. Samples were taken from three sites in each paddock, one in each major land type, following APAL guidelines. Samples were sent to APAL for Colwell P and PBI + Colwell P testing.

Supplementation

In Year 2 at NCW, the control paddock (Steedman) was supplemented as per the property's normal practice. Lick tubs were placed ~500m from each trough. Initially there were three water troughs accessible in this paddock, however, one was closed off on the 3/07/22, at which point the corresponding lick tub (empty) was also removed.
From the 15/05/22 to the 3/11/22 (dry season), the control paddock was supplemented with Red Range loose lick- CPC formulation (32.7% urea, 4.6% phosphorus). Initially, 550kg was distributed, and the tubs were noted to be empty on the 1/08/22 so were re-filled with another 550kg on the 18/08/22.
From the 3/11/22 to the end of the PDS on 17/05/23 (wet season), the control paddock was supplemented with Olsson's lick blocks- CPC formulation (0% urea, 15% phosphorus). Six blocks were put out in approximately the same location as the lick tubs were. Most blocks were finished by 17/05/23 (end of PDS).

The medicated paddock had a uDose installed at each of the two troughs, which were fed by different tanks. The uDose's were set up to inject supplement directly into the trough pipeline, rather than via the tank. From the 15/05/22 to the 3/11/22 (dry season), the medicated troughs were supplied with uPro Orange (39.86% urea, 5.23% phosphorus). DIT AgTech initially set the dose rate at 50mL uPro Orange per 30L water, but lowered it to 60mL uPro Orange per 80L water on the 16/05/22 when cattle appeared to be drinking more than anticipated. The rate was then increased again on the 18/08/22 to 60mL uPro Orange per 30L water when it became apparent that the high water consumption figures were probably incorrect and more normal water consumption figures were being recorded. From the 3/11/22 until the 14/05/2023 (wet season), the medicated paddock was supplemented with uPro Green.

Animal data collection

Upon induction into the Year 2 paddocks (9/05/22), both treatments were weighed, preg-tested, and had GPS collars fitted at Spell Yards, which were located near the previous paddocks used. They were then trucked to Lillee Yards, which were at the southern corner of Steedman paddock, and body condition scored by the vet who had done the preg-testing. That afternoon, the control treatment was let out into Steedman paddock, and the medicated treatment walked along a laneway to Burns paddock.
On the 29/10/22, both mobs were mustered into Lillee yards where the DITT project manager replaced the GPS collars, body condition scored the cattle and took 20 blood samples from each treatment for blood PiP analysis.
At the completion of the PDS, cattle were mustered into Lille yards on the 18/05/23. GPS collars were retrieved, and liveweight and lactation status recorded. A vet was present to body condition score, preg-test and take blood samples from the same 20 animals in each treatment that had initial blood samples taken (except one that was not in the yards at this muster).Weaners were drafted off, weighed in their treatment groups and counted.
All animal data was recorded into the NCW system and provided to the DITT project manager by NCW staff.

Statistical analysis

Cattle performance data was cleaned to remove a small number of animals with hormonal growth promotants, and two that were known to jump out of their paddock, and any from different age groups. Statistical analysis was conducted by a NT DITT statistician. All analyses were run as generalised linear models for either the normal distribution (weight, BCS, blood PiP) or the binomial (pregnancy and lactation). Where appropriate, initial weight was used as a covariate. For weight and BCS analysis, any animals that did not have data recorded at each muster date were excluded.

GPS data was cleaned to remove any corrupted data and dates where cattle were being mustered or in the yards. Any GPS pings (set at 5min intervals) within 50m of a trough or supplement were classed as a visit, to account for the GPS error of ~15m each direction. Pre-rain (17/12/22 – 23/12/22) and post-rain (30/12/22 – 5/01/23) periods were identified to compare differences in visitation behaviours when there may have been surface water available. From the 24/12/22 to the 29/12/22, 226mm of rainfall was recorded at the closest weather station (Elliot NT) which was approximately 50km west of the paddocks.

Supplement intake was calculated using a different method for each treatment. For the medicated treatment, the daily water and nutrient flow to each trough was recorded by each uDose, and downloaded from the uHub online dashboard. The number of animals known to be in the paddock on each day was used to calculate daily intakes per head for water and nutrients. Water lost through trough cleans was not able to be accounted for, which may reduce the accuracy of this data. For the control treatment, the number of days taken for cattle to finish the supplement, and average number of head in the paddock over that time, were used to calculate an average daily intake per head. This method doesn't account for wastage or differing consumption rates between individual animals. Flow meters were also installed on the control paddock troughs in August 2022 to compare water intakes between treatments. These were read periodically until December by the person responsible for checking and cleaning the troughs, and only provide an estimated average water intake of the control treatment on a limited number of days.

3.2 Economic analysis

In the control treatment, only the cost of supplement put out, labour to do so and supplement freight were recorded and used in the economic analysis.
The cost for the medicated treatment was derived by using the actual supplement intake of animals as recorded by the uDose's, and the cost per litre of the supplement. The cost per litre of supplement from DIT AgTech is inclusive of the product and it's delivery, rent and installation of the uDose's, ongoing maintenance and labour involved in delivering liquid supplement to the uDose. The cost per head per day has been calculated for each treatment, however any comparison of this is representative of all differences between paddock and treatments, not just supplementation method.

3.3 Extension and communication

Planned extension and communications outputs as per the PDS agreement were:

- Field days (min. annually)
- Webinar/s
- Workshop/s (in conjunction with field days)
- Video/s (including recordings of webinars, field days and/or workshops)
- In-depth articles
- Case studies
- Producer guides / fact sheets
- Radio interview and updates to NABRC regional committees

3.4 Monitoring and evaluation

The monitoring, evaluation and reporting plan developed for the PDS is outlined in Table 3.

Table 3. The monitoring, evaluation and reporting plan as written in the PDS agreement.

Evaluation level[1]	Project Performance Measures	Evaluation Methods
Inputs – What did we do? *Describe the planned and expected inputs involved in your project*, including *funds, resources, development & projects structures*	• $142,486.67 of in kind DIT AgTech equipment investment, personnel contributions to equipment preparation, installation and maintenance • $25,600 in kind from producer labour, supplying supplement and data collection contribution • Approx. 500 head of livestock per PDS site • Approx. 57,600 ha of land • $75,000 from MLA • $47, 290 from NT DITT in kind contribution • 2 participating core producers in the PDS sites • Greater than 10 observer producers including KPIAC members	○ Detailed record of PDS budget ○ Record of core and observer producers from field days, webinars and other related events ○ Record of cattle data throughout the PDS
Outputs - What did we do? *Describe the outputs planned/expected from your project, including engagement activities & products from demonstration sites*	• Labour cost for both standard practice and water supplementation • Weaning rate, pregnancy rates, reconception rates, liveweight gain of heifers and calves in project • Minimum of two field days in 2021 • Social media output via FutureBeef • Producer engagement and understanding of water supplementation	○ Record hours of labour and salary cost for supplementation ○ Collect cattle data at PDS entry and regular mustering times ○ Record engagement on social media posts, webinars and attendance at events ○ Publication of PDS communication documents
Changes in knowledge, attitudes and skills - How well did we do it? *Describe the changes in KASA that you are planning to achieve*.	• Understanding of the technology, of **core and observer** participants before and after project/activity • Understand how the technology operates and could be implemented in the **core and observer** participants own operations • Experience of producers involved in the PDS – extent to which they found the project/ activity useful or of value. • Acceptance of the technology (current practice or attitudes compared to end of PDS) • Implement a series of skills and training development activities using a variety of platforms to increase the knowledge, skills and confidence of 20% of NT producers involved in the PDS.	○ Comparison of pre and post PDS survey ○ Producer case study
Practice changes – Has it changed what people do? *Describe the practice changes that you are*	• Producer (core & observer) supplementation practice before and after project • Amount of producers investing in DIT Technology • One producer per region, in addition to the producer demonstrated sites will have	○ Sales or enquiries regarding DIT water medication ○ Pre and post survey answers

[1] Note: The headings in column 1 are also listed in the PDS Final Report template.

expecting to achieve by the end of your project	adopted using medicated water to supplement cattle through the wet and dry season	Attendance at the workshops and online participation is additionally a tool for measuring practice change.
Benefits – Is anyone better off? *Describe the benefits that you are expecting to achieve as a result of the project*	• Production benefits (conception, reconception, calf mortality, live weight gain) • Cost benefit analyses (comparison of labour, supplement cost, infrastructure) • Effectiveness of maintaining or increasing supplementation levels for cattle	○ Simple cost benefit analysis of water medication compared to standard supplementation practice or no supplementation during the wet season ○ Comparison of near infrared reflectance spectroscopy (NIRS), faecal P and Plasma Inorganic P testing, comparison of other factors (weight gain, reconception, etc) ○ Applicability to other northern cattle systems
General observations / outcomes – Is the industry better off?	• Potential for water medication to be implemented on commercial stations • Understand the unexpected/expected benefits and challenges of the technology	○ Producer case studies on the two PDS sites ○ Survey of steering committee to identify unexpected benefits ○ Cost benefit analysis of water medication compared to standard supplementation or no supplementation during the wet season

3.5 Challenges affecting methodology

Throughout the PDS, there were a number of challenges that resulted in variations to the methodology and activities conducted, which have influenced the results that can be taken from this PDS. These are outlined below.

Staff Turnover

The management of this project unavoidably changed hands multiple times within NT DITT, DIT AgTech and NCW.

Although there was some handover, unfortunately there is still some missed data, uncertainty around what happened or verbal agreements made earlier in the PDS. Staff turnover also made it hard to measure changes in knowledge.

Most of this affects the first year of the PDS, which has not been used to determine results.

Water Medication Technology and Set-up

In the first year of the PDS, there were a few cases where a uDose had stopped supplementing for a period of time. This was prior to having access to the real-time online dashboard, which now allows for quick notification and response to any issues.

One case of this was due to cattle damaging a uDose unit. A fence was installed around the unit to prevent re-occurrence, however as an online dashboard was not available at the time (which would have alerted project staff sooner) it was not resolved until 23 days later. It was also found at the end of the first year that a uDose had been supplementing to an extra, non-PDS trough where bulls had been drinking. This skewed the water and supplement intake data for the medicated treatment in the first year, which is part of the reason it has not been used.

Before having access to the online dashboard, uDose water flow and supplement intake data was obtained in an excel spreadsheet format after requesting it from DIT AgTech. This data, however, contained many days where the water flow and supplement intakes were listed as “0” at both properties. DIT AgTech explained that this could have been due to the uDose failing to report or losing satellite connection. It is thought, but not confirmed, that the uDose’s were still supplementing as normal through the long periods where “0” water flow was reported. However, because we do not know for sure, we cannot confidently attribute any cattle performance or cost data from the medicated treatments to their supplementation in this first year. This is another reason why data from the first year has not been reported.

These issues were resolved with access to the uHub online dashboard from May 2022, meaning that the units could be monitored in real-time by all project staff, supplementation was consistent and the data was accurate. From May 2022 onwards, any uDose alarms were attended to within days and the only unusual period of data, where water intakes appeared higher than usual, could easily have been caused by something other than the technology.

Although a lot of the data collected during the PDS cannot be used for analysis, overcoming these early challenges highlights the success of recent improvements in water medication technology, and that it is adaptable to extensive pastoral properties in the remote NT.

Paddock and seasonal effects

In both years of the PDS, there are notable differences between the paddocks used for each treatment group.

In the first year of the PDS at NCW, the paddocks used were deemed too different to accurately compare and the medicated treatment was rotated around multiple smaller paddocks throughout Year 1 of the PDS (Table 17).

Following Year 1 of the PDS at NCW, following dry conditions, the land condition in the PDS paddocks had deteriorated and the cattle had to be moved. The new PDS paddocks were chosen, but these were smaller with lower carrying capacities, so the number of cattle had to be reduced. This is a major reason that the PDS was ‘re-started’, with new heifers and only 100 in each treatment.

The paddocks in Year 2 at NCW were also different sizes and the DITT project manager assessed them as having different carrying capacities, which could have influenced cattle performance. Also, the average annual stocking rate in both paddocks exceeded the recommended carrying capacity, which could have limited the response of cattle to supplementation. With only one year of data from these paddocks, and these confounding issues, it is difficult to identify how much the performance of the cattle was due to the effects of the treatments.

Collection of cattle data

There were also some challenges with collecting the cattle performance data.

In the second year at NCW, GPS collars were put on the cattle in May. These, however, had been turned on earlier, before a "re-start" date for the PDS would was decided. This resulted in shorter battery life and only two months of dry-season GPS data being recorded. A number of GPS units fell off the cattle and were also lost in the paddock, therefore their data was not retrieved.

The accuracy of trough and lick visitations is also not known with certainty as cattle were assumed to have visited the trough/lick if their location was recorded within 50m of the trough/lick, but whether they actually consumed supplements on these visits is not known. There is also a 15m buffer on the location recorded by the GPS units and whilst the units were set to 'ping' every 5 minutes, some pings were at intervals of 30 or more minutes.

Faecal NIRS data in the second year was collected until December, after which access to the paddocks was too limited to collect further samples. Therefore, only NIRS data from May, June, August, September, October and November is available.

When starting Year 2 of the PDS at NCW, new cattle were inducted into the PDS but due to timing, it was not possible to be there to take blood samples. This meant that blood PiP was only measured at the end of the dry season and end of the trial, but not at induction.

Weights were supposed to be recorded at the end of the 2022 dry season, however; the yards at the new PDS paddocks were not regularly used and it was not discovered until the cattle were mustered that the weigh-scales were not working. Due to the time it would take to fix/replace them, a decision was made to start processing the cattle without scales. It was not viable or ethical to re-muster the late-pregnancy heifers once the issue was resolved, so end of dry season weights were not recorded at all.

Accuracy of results

Because this PDS only had one year of useable data, which had limitations in itself, and there could be a large paddock effect; it is hard to determine what results are due to the supplementation method and what is an effect of other factors.

The variables, challenges and context of the PDS should be kept in mind when reading the results section of this report.

Katherine Region PDS site

The station that hosted the Katherine region PDS site changed hands part way through the PDS. The management of the cattle to facilitate the sale did not align with what was required for the PDS, and meant that the data needed couldn't be collected so the PDS was not continued at this property. The data that had been collected at this site was not complete enough to use to report results.

4 Results

4.1 Demonstration site results

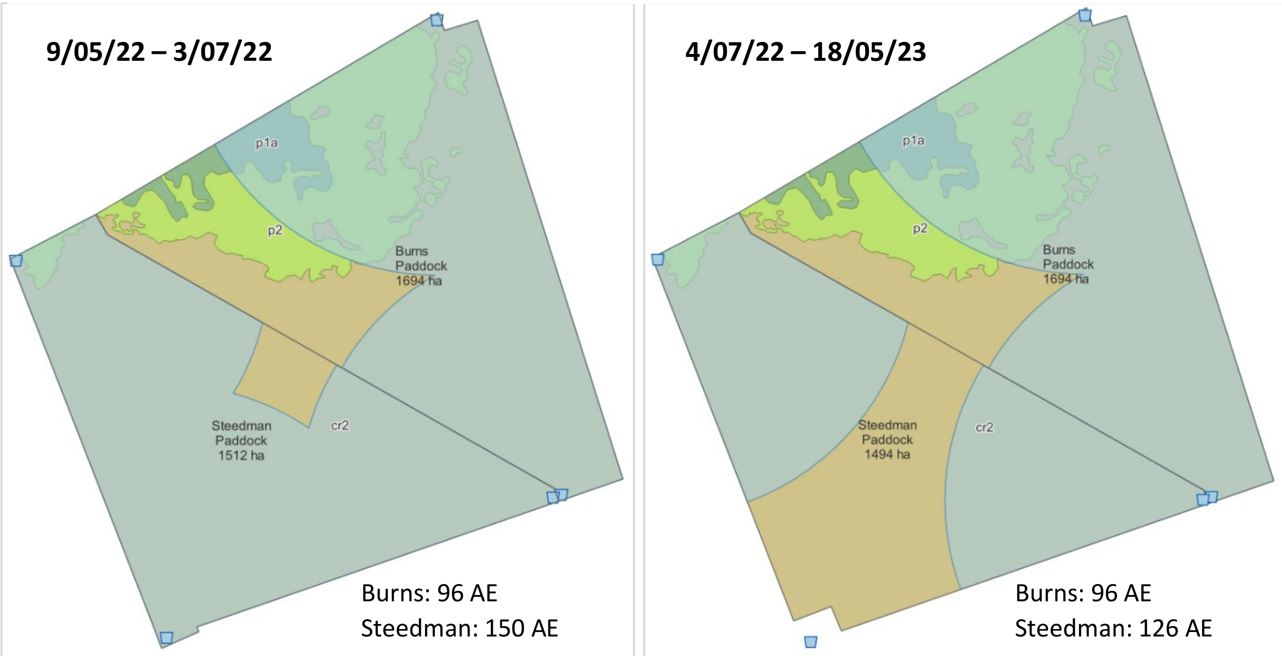
The results presented here are from Year 2 only of the PDS, at Newcastle Waters Station.

The results here are subject to paddock effects and other variables which may have confounded the effects of the supplementation treatments (see section 3.5).

4.1.1 Paddock, Feed-base and Climate

In terms of land types, each paddock was relatively similar, with some variation between the total areas of each land unit (Figure 1). However, the carrying capacities were quite different to begin with due to the third trough in Steedman (control) increasing the watered area (Figure 3). Once this trough was shut off on the 3/07/22, there was less of a difference in carrying capacity for each paddock but Steedman still remained higher.

Figure 3 The watered area (shaded grey) and recommended carrying capacities of Steedman (control) and Burns (medicated) paddocks, before and after the third trough in Steedman was shut off on the 3/07/22.



With 100 PTIC heifers put in each paddock, averaging around 1.43 AE each over the year (Bush AgriBusiness Pty Ltd, 2023), the average stocking rate across the PDS exceeded safe carrying capacity with the exception of the period where Steedman had a third trough accessible (Table 4). Note, the stocking rate did increase further, when bulls were put in (January), and did vary by one or two head that escaped from the paddocks.

Table 4. A comparison of the recommended carrying capacity in each paddock and the actual stocking rate, calculated as the annual average AE of 100 400kg PTIC crossbred breeders (Bush AgriBusiness Pty Ltd, 2023). The carrying capacities from after the third Steedman trough was shut off have been used as they represent the majority of the PDS.

(4/07/22 – 18/05/23)	**Watered area (3km radius)**	**Recommended carrying capacity**	**Actual AE in paddock (annual avg.)**	*Difference*
Steedman (control)	9.80 km^2	126 AE	143 AE	*17 AE*
Burns (medicated)	12.92 km^2	96 AE	143 AE	*47 AE*

Soil P tests showed that both PDS paddocks were similarly deficient in phosphorus (Table 5). The land condition of both paddocks was approximately B condition to begin with, and both declined to a lower B or C condition over the year. This, however, is subjective as different people did the paddock assessments.

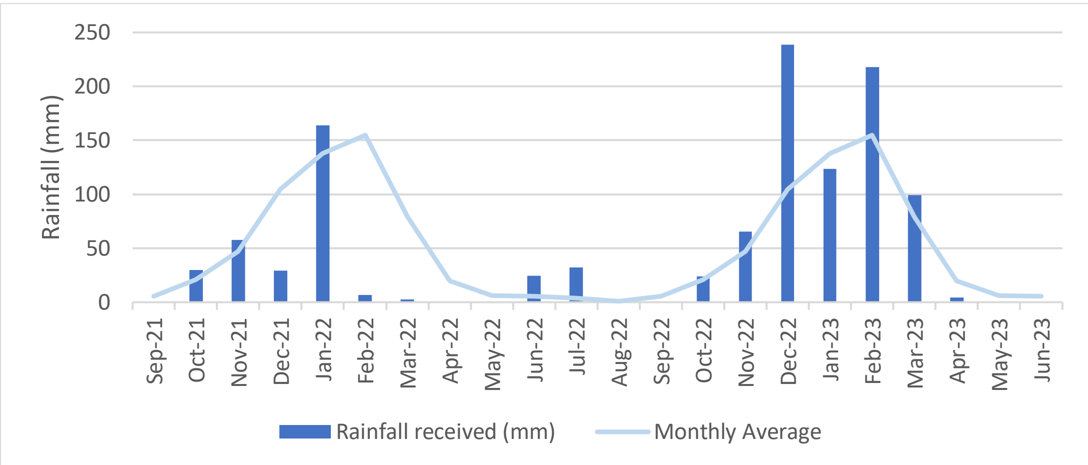
Table 5. Soil test results for the two PDS paddocks (samples collected 28/10/22). Colwell P <4 = acute, 4-6 = deficient, 6-8 = marginal, >8 = adequate (Jackson, et al., 2023).

Sample Site	Colwell P mg/kg	PBI + Col P	P status
Steedman 1	4.8	54	Deficient
Steedman 2	1.9	64	Acute
Steedman 3	1.4	58	Acute
Burns 1	3.1	54	Acute
Burns 2	4.6	69	Deficient
Burns 3	1.9	30	Acute

From faecal NIRS results (Appendix 8.2), dry matter digestibility of pasture in both paddock was around 60% through the dry season, increasing to around 64% by November. The increase in the medicated paddock's dry matter digestibility appeared to occur earlier than in the control paddock. Diet crude protein levels were similar for both treatments, and ranged from maintenance to high. Metabolisable energy intake of both treatments was also similar, ranging from maintenance to very high (Symbio Laboratories, 2019). There was higher variation in the diet non-grass percentage. It should be considered that multiple people collected the faecal samples and so these results are subject to sampling error.

As seen in Figure 4, Year 2 of this PDS followed a below average wet season. The wet season of the following year, though, was above average. The poor wet season beforehand may have reduced the performance of cattle, and the above average 2022/23 wet season may have led to increased surface water during the PDS period.

Figure 4. Rainfall received the closest weather station (Elliot, NT) during the PDS timeframe, compared to the long-term monthly average (Bureau of Meteorology, 2023).



4.1.2 Cattle performance

There were some statistically significant differences in cattle performance between treatments, remembering that this may not be due to the supplementation method as there was no replication in the trial design and there were factors other than the treatments that impacted performance.

Both lactating (wet) and non-lactating (dry) cattle in both treatments had positive average weight gains (Table 6). Weight gain was higher in the Control paddock in both wet and dry cattle, but the difference was only significant in wet cows which gained an average of 22.7kg ($P<0.01$) more than wet cattle in the medicated treatment.

Table 6. Live weight changes of cattle in each treatment from the 9/05/22 (start weight) to the 18/05/23 (finish weight).

Treatment	**Start weight (kg)** P>0.05	***Lactation status***	**Finish weight (kg)** P<0.01	**Weight gain (kg)** P<0.01
Control	338	*Wet*	394[a]	+59.9[a]
		Dry	503[b]	+169.3[b]
Medicated	329	*Wet*	371[c]	+37.2[c]
		Dry	468[b]	+133.9[b]

As shown in Table 7, the control treatment had a slight increase in body condition score (BCS) through the dry season, whereas the medicated treatment had a slight decrease. However, overall there was no difference between treatments in total BCS change over the year.

Table 7. Body Condition Score changes of cattle in each treatment.

Treatment	**Start BCS** P>0.05	**End of Dry Season BCS** P<0.01	**Dry Season BCS change** P<0.01	***Lactation status***	**Finish BCS** P<0.01	**Wet Season BCS change** P<0.01	**Total BCS change** P<0.01
Control	3.55	3.77	+0.22	*Wet*	2.81[a]	-1.01[a]	-0.75[a]
				Dry	3.50[b]	+0.17[b]	0.00[b]
Medicated	3.54	3.18	-0.36	*Wet*	2.67[b]	-0.51[c]	-0.87[a]
				Dry	3.64[b]	+0.50[b]	+0.14[b]

Both treatment's average blood PiP decreased through the wet season (Table 8). The medicated treatment began the wet season with a much higher blood PiP than the control treatment; however, this decreased more than the control treatment's average did.

Table 8. Change in Blood Inorganic Phosphorus (PiP) of the same 20 head from each treatment. On moderate pastures, PiP <1 = acutely deficient, 1-1.5 = deficient, 1.5-2 = marginal (Jackson, et al., 2023).

Treatment	**End of Dry Season blood PiP (mMol/L)** P<0.01	***Lactation status***	**Finish blood PiP (mMol/L)** P<0.01	**Total blood PiP change (mMol/L)** P>0.05
Control	2.25	*Wet*	1.03[a]	-1.24
		Dry	1.74[ab]	-0.36
Medicated	3.24	*Wet*	1.39[b]	-1.77
		Dry	1.64[b]	-1.70

As shown in Table 9, there was no statistical difference between treatments for weaning percentage or average weaner weight. Although the differences in re-conception rate between treatments would normally be large enough to impact production or base management decisions on, they were not statistically significant from each other (due to the small number of animals) and so it is not possible to be confident that the difference is real.

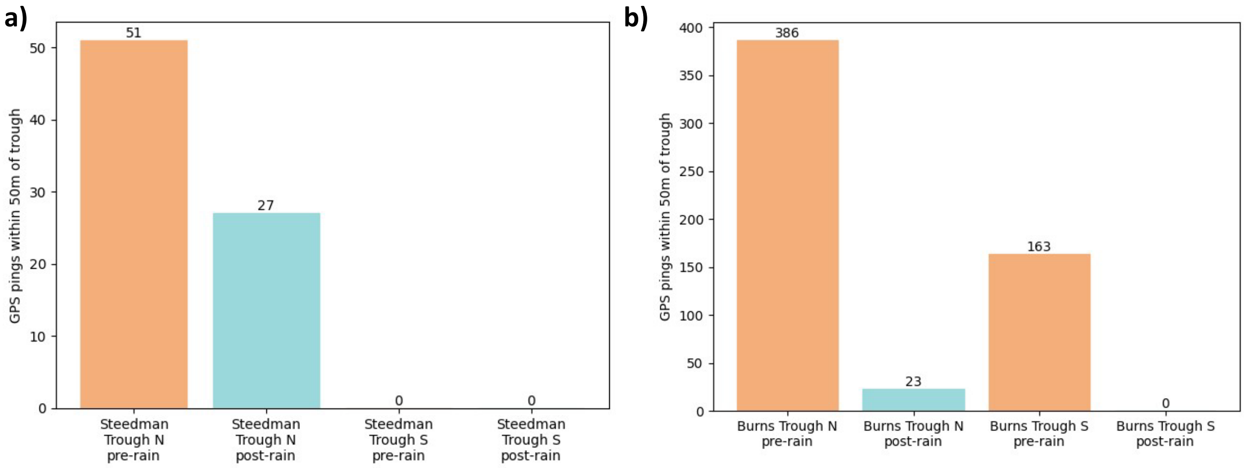
Table 9. Reproductive performance of each treatment. Weaning rate = percent of cattle lactating at the weaning muster, and re-conception = the number of lactating cattle that were preg-tested in-calf after the weaning muster.

Treatment	**Weaning rate %** P>0.05	**Avg. weaner weight (kg)** P>0.05	***Lactation status***	**Re-conception %** P>0.05
Control	89.5	159	*Wet*	72.7
			Dry	55.6
Medicated	86.6	161	*Wet*	59.2
			Dry	81.8

4.1.3 GPS data

In the control paddock (Steedman), GPS collared cattle only drank at the northern trough in the pre- and post-rain periods identified (Figure 5a). The amount of GPS pings within 50m of this trough was much lower in the week after significant rainfall than it was in the week beforehand. The same trend was seen in the medicated paddock (Burns), where the combined number of pings within 50m of troughs went from 549 in the week before rain, to just 23 in the week following rain (Figure 5b).

Figure 5. Frequency of trough visits, presented as number of GPS pings <50m from trough, in a "pre-rain" week (17/12/22 – 23/12/22) compared to a "post-rain" week (30/12/22 – 5/01/23), at both roughs in a) the control paddock and b) the medicated paddock.



The paddock use by GPS collared cattle visibly changed from the week before rain (Figure 6) to the week after rain (Figure 7). There was an obvious movement from the grassland land type with clay soils, to the woodland land type with sandier soils in the medicated paddock. The control paddock had less woodland country, but the control cattle stayed closer to it (and the northern trough) and concentrated in a few other areas in the north of Steedman paddock in the week following rain.

Figure 7. Paddock utilisation of GPS collared cattle in a "pre-rain" week (17/12/22 – 23/12/22).

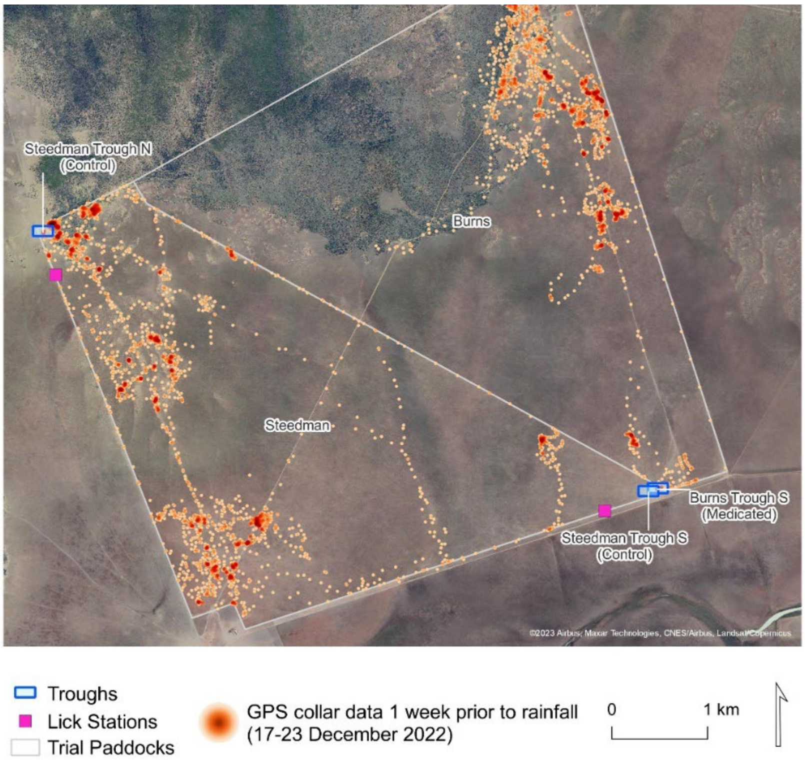
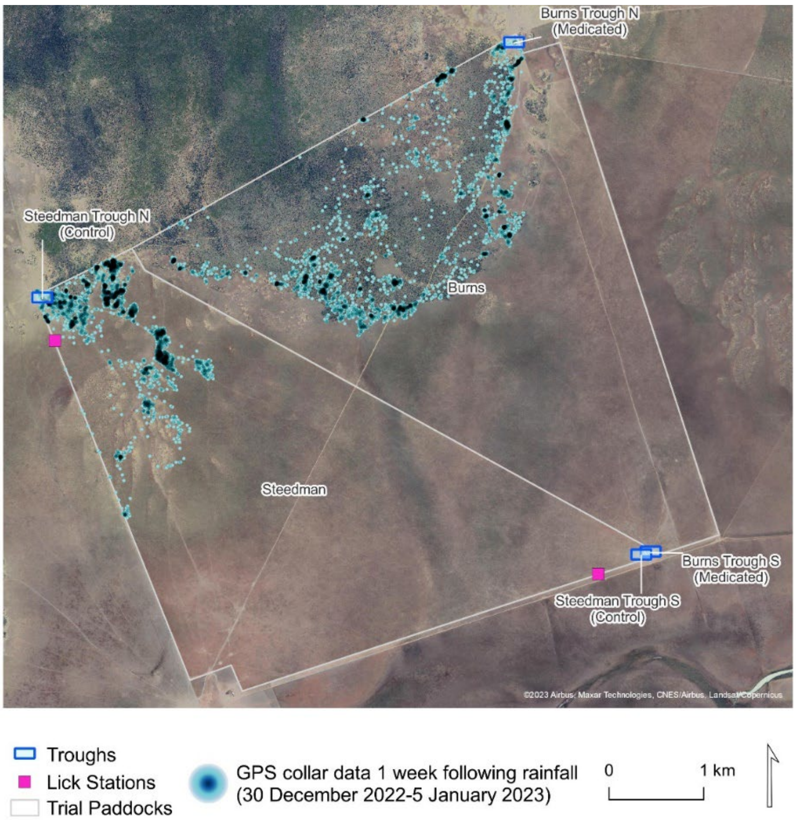
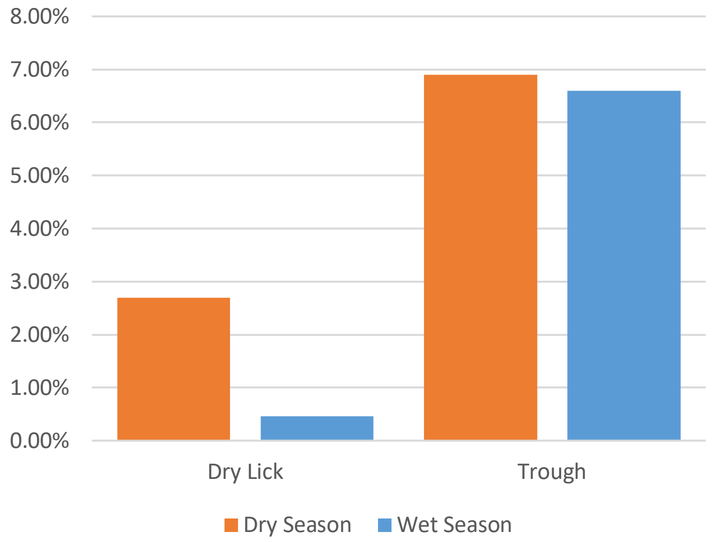


Figure 6. Paddock utilisation of GPS collared cattle in a "post-rain" week (30/12/22 – 5/01/23).



As shown in Figure 8, control cattle spent more time overall at the trough than they did at the dry lick. The percent of visitations to dry lick was significantly lower over the whole of the wet season than it was through the dry season; however, the decrease in trough visits was marginal during the wet season.

Figure 8.Comparison of trough and supplement visitations, presented as percent of GPS pings <50m from the trough/supplement throughout the control paddock (Steedman) for the whole of the dry and wet seasons.



4.1.4 Supplement intake

Dry season supplement was distributed to the control treatment twice between May and November, and wet season supplement once at the beginning of November, as shown in Table 10. There was a recorded period of 17 days from when control cattle finished available dry season lick and when it was refilled.

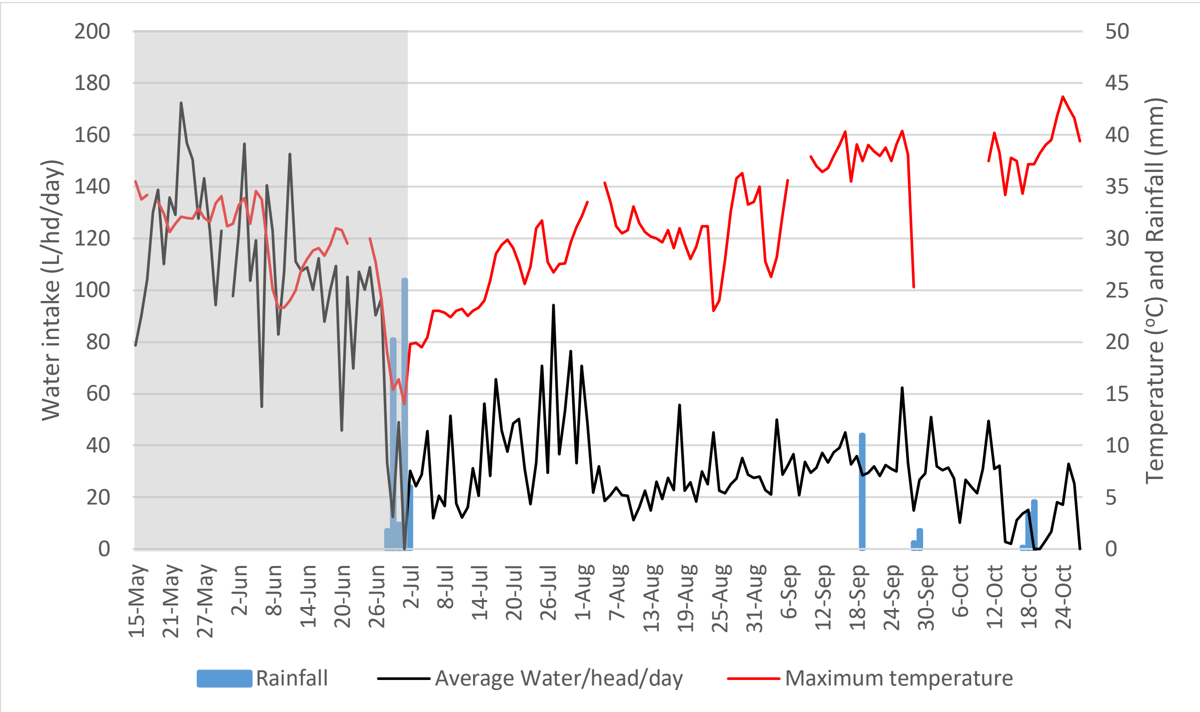
Table 10. Dry lick supplement records for the control treatment used to calculate daily intake.

Date in	Date finished/removed	Amount	Type	No. head in paddock**
12/05/2022*	1/08/2022	550kg	Red Range loose lick	101
18/08/2022	3/11/2022*	550kg	Red Range loose lick	101
3/11/2022	17/05/2023*	780kg	Olsson's lick blocks	96
*For analysis of intake, 15/05/22 was used as the start date, 27/10/22 as end of dry season and 14/05/2023 as the end date to match the medicated supplement periods and avoid mustering days (166 days dry season, 191 days wet season)				** Number of head in paddock includes cattle not supposed to be in that treatment, and herd bulls.

Figure 9 and Figure 10 show the water, and therefore nutrient consumption of medicated cattle over the dry and wet seasons in the medicated paddock. The amount of nutrient dispensed in the trough depended on the dose rate at that time, the changes to which are listed in Table 11. As the period from the 15/05/22 to the 2/07/22 appears vastly different to 2/07/22 onwards, the shaded area in Figure 9 is being treated as a potential error that could skew intake and cost data. Therefore, the 15/05/22 – 2/07/22 has been labelled a "preliminary" period and has been excluded from the calculation of results.

Water intake per head per day was high at the beginning of the dry season, reaching over 150L/hd/day (although it should be noted that this was in the preliminary period and could be inaccurate ie. actual consumption may not have been this high). It fell to 0L/hd/day following rainfall at the end of July, and after peaking at around 95L/hd/day around the 26/07/22, settled around 25L/hd/day for the remainder of the dry season despite climbing temperatures and limited rainfall.

Figure 9. Dry season daily water intake of cattle in the medicated treatment as recorded by the uDose's and downloaded from the uHub dashboard. Rainfall and maximum temperature are also shown. The shaded area from the 15/05/2022 – 1/07/2022 indicates the "prelim"



The wet season water intake of the medicated treatment (Figure 10) consistently decreases following rainfall, and increases to a maximum of 48L/hd/day alongside an increase in temperature in early December.

Figure 10. Wet season daily water intake of cattle in the medicated treatment as recorded by the uDose's and downloaded from the uHub dashboard. Rainfall and maximum temperature are also shown.

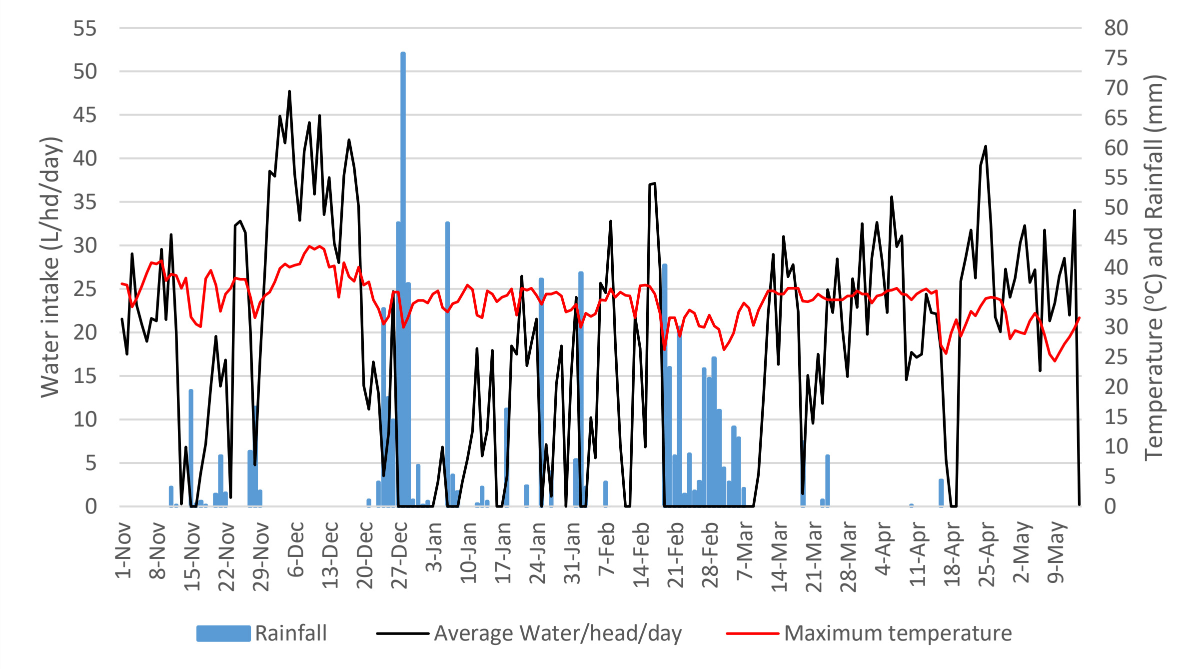


Table 11. uDose records from throughout the PDS, including changes in nutrient dose rate, alarms, maintenance and re-fills of supplement that may have impacted intake data recorded.

Date	Event
14/05/2022	Dosage rate 50mL uPro per 30L water (both uDose's)
16/05/2022	Dosage rate decreased to 60mL uPro per 80L water (cattle drinking more than anticipated)
23/05/2022	South Burns uDose alarm: "Nutrient probe- no comms". DIT AgTech advised that the uDose will continue working normally with this error.
31/05/2022	South Burns tank empty, and uDose still displaying alarm: "Nutrient probe- no comms". uDose was reset manually.
8/06/2022	Both units topped up with ~1000L supplement. Dosage rate increased to 50mL uPro per 30L water (both uDose's)
1/08/2022	South Burns uDose alarm: "Conductivity sensor not detected". Disappeared when uDose was restarted.
16/08/2022	Dosage rate increased to 60mL uPro per 30L water (both uDose's)
18/08/2022	North Burns uDose leaking on the out-flow side of the conductivity probe. Leak repaired and uDose serviced on 20/08/2022.
14/09/2022	South Burns uDose alarm: "The conductivity sensor has stopped communicating with the doser". Resolved by DIT AgTech on the 16/09/2022
3/11/2022	uPro Orange supplement replaced with uPro Green (both uDose's).
17/11/2022	South Burns uDose alarm. DIT AgTech found crack in flow sensor. Pump and flow sensor replaced on 22/11/2022. Breathers added to both units.

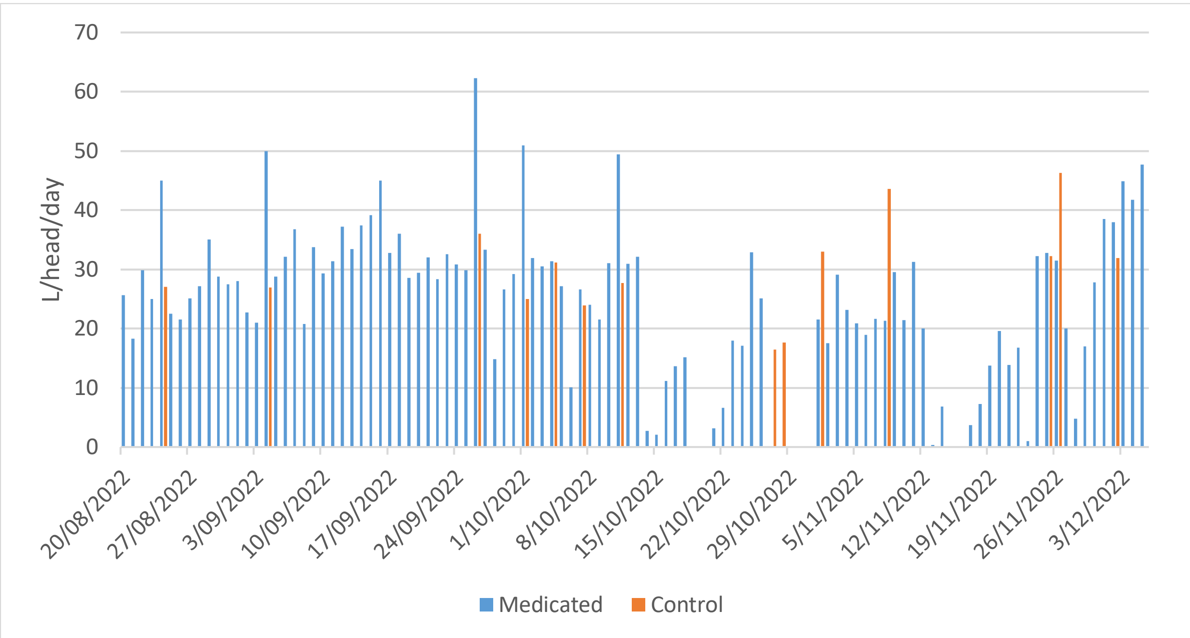
As an indicator of supplement and water intake consistency in the medicated treatment, Table 12 outlines how many days had little to no water flow. This was significantly higher in the wet season, where the number of days with 0 water flow recorded increased by 20%.

Table 12. The number of days where cattle in the medicated treatment drack small amounts of trough water, potentially limiting their supplement intake. Any events where cattle could not drink (i.e. trough empty, mustering) have been excluded.

	% Days 0 water flow	% Days <5 L/head	% Days <10L/head
Dry Season	1%	4%	4%
Wet Season	21%	24%	34%

In August, flow meters were installed on the control troughs to determine if water intakes were similar between treatments. As shown in Figure 11, on the days these flow meters were read the control treatment's average water intake was mostly similar to that of the medicated treatment on the days either side. The medicated treatment's water intake was much higher on the days the control flow meters were read, as this is when the troughs were cleaned and water lost from medicated troughs could not be accounted for in these calculations.

Figure 11. A comparison of daily water intake of cattle in each treatment. Medicated treatment data has been obtained from the uDose's, and control treatment data averaged from manually-read flow meters installed in August. Note, obvious outliers in the medicated data on dates when the trough was cleaned.



The two treatments received a different level of P and urea in their supplements, resulting in different nutrient intakes (Table 13). Excluding the "preliminary" period , urea and P intake was slightly higher in the medicated treatment through the dry season. In the wet season, medicated cattle were supplemented with both urea and P whereas control cattle could only safely be fed P supplement. The control treatment's received intake was almost double that of the medicated treatment, although as control supplements were uncovered, wastage from exposure to the weather could have contributed to what was calculated to have been consumed.

Table 13. A comparison of the nutrient intakes of cattle in each treatment. This assumes all supplement was consumed with no wastage.

	Phosphorus (grams/head/day)		**Urea (grams/head/day)**	
	Control	*Medicated*	*Control*	*Medicated*
Dry Season	3.25	*2.18*	23.13	*21.42*
Wet Season	6.25	3.93	n/a	8.60

4.2 Economic analysis

The results of this economic analysis are specific to this scenario as they are not based on a replicated trial design and are subject to the limitations discussed previously. They also assume all dry lick was consumed and not wasted, are missing some costs involved in dry lick supplementation (eg. equipment), are property specific and don't indicate cost per gram of P/urea fed. Table 14 summarises the costs incurred during Year 2 of this PDS at NCW. With the "preliminary" period excluded, the average cost per head for the year in the medicated treatment was marginally higher (Medicated = $23, Control = $21 per head for 1 year of supplementation), but the cost for the control paddock may also be underestimated as the cost of equipment was not included.

Table 14. Summary of costs for each treatment, where the control treatment costs were provided by NCW staff and the medicated costs were derived from intake data recorded by the uDose's. *The control treatment cost may be an underestimate as things such as cost of equipment weren't included.

	Control (dry lick)		Medicated	
	Dry season	Wet season	Dry season	Wet season
Number of Cattle	101	96	95	97
Total Costs	$1,978	$2,059	$1,962	$2,528
Labour	$72	$36	Price of medicated supplement is inclusive of all services including labour, freight and hire of uDose's	
Freight	$180	$128		
Input Cost (lick)	$1,726	$1,896		
Equipment costs	unknown	unknown		
Average Cost ($/hd)	$20	$21	$21	$26
Avg. total $/head	$21 /hd*		$23 /hd	

Due to confounding factors when assessing differences in cattle performance data between treatments, and the fact that statistical analyses found that differences between treatments (eg. reproductive performance) were not statistically significant, a cost benefit analysis would not be accurate and so has not been performed.

4.3 Extension and communication

Extension and communication of this PDS has been difficult, as there have been many unforeseen challenges affecting the data and there is the risk that any observations shared may be taken as direct pros or cons to water medication, when really they could have been due to something else entirely.

There was still opportunity for some extension activities to raise awareness of the PDS and share the process of implementing water medication on a Northern Territory cattle station. These included:

- Presentation introducing the PDS at the 2021 Katherine Research Station field day (~10 attendees excluding NT DITT staff).
- Presentation introducing the PDS at the 2021 Douglas Daly Research Station field day (~20 attendees excluding NT DITT staff).
- Project page on FutureBeef updated throughout the PDS (Providing Mineral Supplementation via Water (Producer Demonstration Sites) - FutureBeef)
- Two articles in FutureBeef eBulletins, one introducing the PDS and the other an update (https://mailchi.mp/futurebeef/103-907953 , https://mailchi.mp/futurebeef/calfwatch-update-bottle-teat-photos-before-and-after-calving)
- Presentation at the 2022 Victoria River Research Station BeefUp forum, providing an update of the methodology of the PDS and learnings from the first year (excluding MLA and NT DITT staff, 22 producers attended and ~25 advisors/others).
- One social media post with updates/links to updates on the PDS (Appendix 8.3)
- A webinar summary of the PDS outcomes as a part of the 2023 NT DITT webinar series- recording will be made available on YouTube.

There has been four direct enquiries about the PDS to the NT DITT project lead, both via email and in person at events.

4.4 Monitoring and evaluation

The staff turnover and limited extension outputs throughout the PDS have made it difficult to measure knowledge increase as a result of the PDS.A brief, informal survey was sent to the last NCW to be involved in the PDS to gain some idea on what the on-station perception of water medication is now. Their responses are in Table 15.

Table 15. A short survey completed by the former station employee that managed the PDS for part of the second year.

	1-5 scale
Prior to your involvement in the PDS, how would you rate your knowledge of mineral supplementation of cattle in the Barkly region?	1
Prior to your involvement how would you rate your knowledge of water medication technology?	1
Following the PDS, how would you rate your knowledge on mineral supplementation of cattle in the Barkly region?	3
Following the PDS, how would you rate your knowledge of water medication technology?	3

Do you (or does the station) intend to change/improve supplementation of cattle on your property after your experience in the PDS?	Dependent on cost-benefit analysis. Current practice works well so cattle performance improvements and cost/time effectiveness would need to be clear to make a change. The scale at which water medication would need to be adopted may be a barrier.
Has involvement in this PDS led to a decision of whether to adopt/not adopt water medication on your property?	Company is waiting to read final report
Are you aware of other properties adopting water medication technology as a result of this PDS?	No

DIT AgTech has reported of an increase in Northern Territory clients over the last three years, and at least one additional property is trialling water medication.

5 Discussion

5.1 Paddock comparison

Before discussing any cattle or cost data, it is important to state that there could be a large paddock effects on the data which could confound the effects of the treatments. The paddocks were different sizes, had different watered areas and carrying capacities; and since there was only one year of data and no replication, the effects of the treatments can't be assessed accurately.

In terms of soil P and diet quality (as per the faecal NIRS results in Appendix 8.2), the pasture quality was quite similar in each paddock and both had a similar proportion of 3P species. However, these measurements were subject to sampling error, and were taken by different people throughout the PDS. The largest limiting factor is likely utilisation rate of the pasture with it being overstocked and declining in land condition, which could have masked any response to supplementation (either method).

5.2 Cattle performance

The cattle performance data from this PDS cannot be used to accurately compare the treatments due confounding factors such as paddock differences, stocking rate differences, lack of replication and other issues previously mentioned. Bearing this in mind, the data recorded indicated that performance was slightly better in the Control paddock.

Weight gain was higher in the Control paddock in both lactating (wet) and non-lacting (dry) cattle, but the difference was only significant in wet cows which gained an average of 22.7kg ($P<0.01$) more than wet cattle in the medicated treatment. This could be due to a number things: Firstly the grazing pressure was higher in the medicated paddock, as the carrying capacity of the control paddock was assessed to be between 126 – 150 AE (depending if 2 or 3 water troughs were being used), compared to 96 AE for the medicated paddock (and both paddocks had 100 heifers). Another factor was the higher phosphorus (P) supplement intake in the Control paddock, as growth is greatly reduced by P deficiency, and improved by P supplementation in P deficient country. Through the wet season the average P intake of the control treatment (6.25g/hd/day) was significantly higher than the medicated treatment (3.93g/hd/day). However, with breeders needing 10g of P supplement per day, the intakes achieved via either supplement method may not have addressed a potential P deficiency (Jackson, et al., 2023). Increasing the dose rate of wet season supplement (uPro Green) in the medicated treatment and altering the lick block formulation for the control treatment could be a solution if this is the case.

While blood samples were not collected at the beginning of the dry season, the cattle had come from the same mob and were randomly allocated to treatments so likely started with similar blood PiP levels. If this is the case, the medicated treatment may have had a higher increase in blood PiP throughout the dry season as they had a higher blood PiP (+0.90 mmol/L) than the control treatment at the end of the dry season. The medicated treatment received 1.07g/hd/day less P through the dry season, but there is a possibility that the assumed P and urea intake of the control cattle is over estimated as it doesn't account for lick wastage or varied intakes between individual animals (shy feeders). This would support the benefits of consistent and uniform nutrient intake across all animals that can be achieved through water medication.

Following the wet season, lactating cattle in the control treatment had a significantly lower blood PiP than the medicated treatment (1.03 vs 1.39 mMol/L) despite consuming more P from their supplement during the wet season (6.25 vs 3.93 g/day). However, this could be due to the calculation of supplement intake not being a reflection of actual intake due to supplement being dissolved by rain and not consumed and the fact that the medicated group had a higher average PiP level at the start of the wet season (3.24 vs 2.25 mMol/L). The PiP level and P intake of the medicated treatment were both lower than desired and to overcome this, the P content of the of the water medication supplement could be increased.

There were no statistically significant differences between weaning rate, weaner weights or re-conception of wet or dry cattle. Unfortunately the problems encountered during the PDS do not allow a rigorous comparison of the effects of the treatments on reproductive performance. All that can be said was that the performance of the treatments was similar during this PDS.

5.3 Cattle behaviour

Note. The estimated calving dates of all cattle were between the 15/12/2022 and 16/01/2023. Their behaviour during this time may have been different to 'normal'.

5.3.1 Trough visitations before and after rain

The GPS location data from both paddocks, gives an indication of how often cattle were visiting water troughs and dry lick stations, and if this changed when there was surface water available. There were only a maximum of five animals collared in each treatment, with two collared control cattle jumping into the medicated paddock at one point, and GPS batteries running out at different rates, so this small data set may not be representative of the behaviour of the whole mob.

GPS data collected before and after a rainfall event on 23/12/22 was used to study how a rainfall event effected cattle behaviour. In the week before the selected rainfall event, there were a much higher number of GPS pings around the troughs in both paddocks than in the week after the rain event (Figure 5). A similar trend is shown in Table 12, where there were significantly more days with lower water intake in the wet season than the dry season. This suggests that the cattle were utilising surface water for drinking following rainfall, as would be expected. The higher number of pings within 50m of medicated troughs compared to control troughs could be due to a number of things such as where cattle were preferring to camp, GPS errors, the behaviour of individual collared animals, cattle preferring to drink the medicated trough water or potentially cattle not needing to leave the trough as frequently to access supplement.

It is also noticeable that in the week following high rainfall, all the collared cattle stayed mostly around the red soil and none visited the south eastern parts of either paddock where the soil was black. The collared cattle in Control paddock also had a much larger grazing distribution during this week, likely due to the larger area of red soil, which likely benefited the medicated treatment cattle (lower grazing density = more available feed per animal).

5.3.2 Dry lick vs trough visitations

The number of visits to the trough and dry lick were compared for the whole of the dry season and wet season to assess whether utilisation of surface water following rain affects supplementation. In the control paddock, there was a much larger percentage of pings at the trough than at dry lick stations for both seasons. This supports the theory of using water medication to achieve more consistent and uniform supplementation of cattle. Visitations to dry lick also dropped off significantly in the wet season, whereas visitations to the trough remained similar. While caution should be used in extrapolating too much from the small number of GPS collared animals that contributed to this data, it may indicate that cattle prefer drinking from medicated troughs which may provide advantages when cattle stop visiting dry lick while surface water is available.

5.3.3 Water intake

The MLA Water Medication Guide suggests that 400kg breeders will drink approximately 70L per head per day in dry, hot (32^{o}C+) conditions (Entwistle & Jephcott, 2005). Similarly, the NT best practice manual states 8L per kilogram of dry matter of pasture intake, plus up to 30% for production animals, which would equate to 60-80L per head per day in this scenario (Mayes, Sullivan, Oxley, MacDonald, & Golding, 2009). However, as shown in Figure 9, the dry season water intake of cattle in the medicated treatment was very inconsistent. This suggests that the water intake data collected before 2/7/22 is not accurate as intakes of 150L/day were recorded and this seems unlikely. Also the large difference between data recorded before and after 2/7/22 suggests that there was a problem with the data before 2/7/22. Other evidence that the data collected post 2/7/22 is correct is that the flow rate data gathered from the control paddock was similar to that of medicated cattle post 2/7/22. Therefore the data pre 2/7/22 has not been used and data collected post 2/7/22 has been taken as being representative of the whole dry season and used in calculations of supplement intake and cost of supplementation.

It was not possible to determine the cause of the problems with the recording of water intake data prior to 2/7/22. Some potential causes could be:

- There could have been a leak, however one was not noticed by NCW staff and there wasn't a consistent flow/loss of water- the peak flow times were consistent with when cattle were drinking normally. Unless water was leaking only when the trough was filling, however the only reported leak from a uDose was in November and from the North Burns unit (which had normal-looking intake data).
- Troughs could have been cleaned more frequently or a tap turned on elsewhere, although with the high flow times being twice a day, every day, this seems very unlikely and NCW staff would have mentioned this.
- There was an issue with the uDose sensor or recording of water flow, but none of the alarms as listed in Table 11 line up with the large changes in water intake.

Figure 11, highlights how much trough cleans (when water is drained from troughs to clean them) may be skewing the medicated intake data. The amount of water lost through trough cleans has not been subtracted from daily water flow in the medicated treatment due to not having a record of every trough clean and how much water was lost. This means that the cost of water medication (per head per day) is somewhat inflated by the water used when cleaning troughs.

The wet season water intakes as shown in Figure 10, as expected are very low or zero around the time of rainfall. During periods of no rainfall, intakes climbed back up to around 30-45L/head per day, similar to the dry season (excluding the "preliminary" period). This is consistent with the GPS data showing fewer trough (and dry lick) visits when surface water is available.

5.4 Cost-benefit

The costs recorded for the different supplementation methods in this PDS are specific to this location and can only be used as a guide for other properties where the situation may be different (eg. different dry lick costs, distances travelled to distribute lick, labour costs etc.). The cost of dry lick supplementation for this PDS is also very much an estimate and does not include the cost of equipment to feed the lick in, whereas all costs (equipment, supplement and services) are included in the price of water medication.

Also, the accuracy of costs reported here for the medicated treatment is dependent on the accuracy of the supplement intake data recorded by the uDose's, and as explained in section 5.3.3, there some sources of inaccuracy in this data (ie. the amount of water "wasted" during trough cleans was not subtracted, and the data collected post 2/7/22 was used as being representative of the whole dry season due to problems with the data recorded pre 2/7/22). The total cost of medication cannot be calculated based on actual invoiced amounts, either, as not all supplement was used during the PDS period. For example, when supplement was switched from uPro Orange to uPro Green, the uPro orange was pumped out first rather than having, them mixed together; and there was some supplement left over at the end of the trial.

Bearing these things in mind, the calculated costs of water medication were slightly higher (Medicated = $23/head vs Control = $21/head, from 15/05/22 -14/05/23).

Conducting a cost-benefit analysis is difficult with so many variables affecting both the accuracy of costs and performance of cattle (the benefits). As there were no significant differences between the treatments in cattle performance and the cost of the supplementation methods was similar, the conclusion was that this PDS found that water medication was similar to dry lick supplementation both in terms of cost and cattle performance.

It is also worth noting than not all the benefits offered by water medication are quantifiable or can have a dollar value placed on them. Things such as being able to remotely monitor supplement levels and adjust dose rates, not having to remove urea-based lick when it rains and being able to feed urea in the wet season, and not having to do weekly lick-runs are hard to measure and the amount of benefit these offer is going to vary highly on each property.

6 Conclusion

There were a lot of learnings that came out of the Mineral Supplementation via Water PDS in regards to designing producer demonstration sites on commercial properties, and collecting data for analysis. If the data is to be used to statistically compare specific parameters, more care needs to be taken to ensure there are no other variables that could skew the results, which will always be difficult in commercial settings. Considering this is a demonstration site, though, there are observations on the implementation and use of water medication in this scenario that are of value to industry.

6.1 Key Findings

- This PDS demonstrated the recent improvements in water medication technology, allowing users to remotely monitor and adjust settings on the units,
- The liquid supplements were stable in bore water, and phosphorus and urea were safely fed via water year-round,
- The cattle supplemented via water were productive and their performance was similar to that of cattle supplemented with dry licks. Although we acknowledge that there were confounding factors and that it was not a rigorous comparison of the treatments,
- Observations of the behaviour of cattle with GPS collars fitted showed that, as expected, they stopped visiting the trough daily after significant rainfall and also stopped visiting dry lick. However, they seemed to take longer to return to visiting the dry lick than they did the trough.

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8 Appendix

8.1 Year 1 data

Some of the Year 1 data that has not been used for analysis or interpretation is included below.

Table 16. Summary of initial PDS design in Year 1 (2021-2022), at NCW. Note. This year of data has not be used to obtain results.

Property	NCW	
Treatment	Medicated	Control
Paddock name	Multiple over trial period: Daley, Vautins, Fulton, Sterling and Lewis	Spell
Paddock size (approx.)	840ha, 500ha, 1700ha, 540ha, 1600ha	4400ha
Carrying Capacity	n/a	n/a
Soil P status	n/a	n/a
No. troughs	1 in each paddock (fed by same tanks so all medicated)	3
Surface water	-	-
No. PTIC first-calf heifers inducted	166	149
No. Indicator steers	21	18
Induction date & crush-side data collected	07/06/21 • Weight • BCS • Pregnancy status	
Second round muster date & crush-side data collected	03/12/21 • Switched GPS's • Weight of GPS collared cows only	
Final muster & crush-side data collected	27/03/22 • Weight • Lactation status 02/08/2022 • Pregnancy status • BCS • Lactation status	
GPS collars deployed	09/06/21 – **10** 03/12/21 - **9**	09/06/21 – **10** 03/12/21 – **4**
GPS collars retrieved	03/12/21 – **9** 27/03/22 – **7**	03/12/21 – **4** 27/03/22 - **3**
No. Blood samples analysed	07/06/21 – **50** (not labelled with treatment)	
	27/03/22 - **38**	27/03/22 - **45**

Faecal sample dates	Unknown

Some details around the methodology used in the first year of the PDS are missing due to changes in project staff, and missing records. Because of this, as well as differences between treatment paddocks on both properties and further challenges and inconsistencies outlined in section 3.5, it is not feasible to use and data from the first year to compare the effect of supplementation method on production and costs.

Table 17. Summary of cattle, paddocks and GPS collars at NCW site in Year 1 of the PDS.

	MEDICATED TREATMENT	CONTROL TREATMENT
NUMBER OF TRIAL CATTLE AT MARCH '22	153 + 21 steers	149 + 18 steers
PADDOCK	*Number of different paddocks throughout 1st year:* • 109hd in **Daley** 09/06 – 06/10 • 57hd in **Vautins** 09/06 – 06/10 • 21 steers in **Fulton** 28/08 – 06/10 • 130hd in **Fulton** 06/10 – 11/10 • 57hd in **Sterling** 06/10 – 11/10 • 187hd in **Fulton** 11/10 – 01/12 (+ 5 bulls on 22/11) • 192hd **Lewis** 01/12 – January • 192d in **Fulton** January – 26/03	Spell • 166 heifers put in on 09/06 • 18 steers put in on 28/08 • 5 bulls put in on 16/12

Table 18. Summary of liveweight (kg) at NCW during Year 1. Note, this data cannot be directly linked to supplementation method.

	Dry Cows on 27/03/22			*Wet Cows on 27/03/22*		
(kg)	Medicated	Control	**Difference**	Medicated	Control	**Difference**
Avg starting Wt	408.9	371.3	37.5	368.7	332.4	36.3
Avg finish Wt	457.2	439.4	17.8	404.9	382.6	22.3
Median Start Wt	415	390	25	369	317	52
Median Finish Wt	459	450	9	395.5	373	22.5
Avg Wt gain	48.3	68.1	**19.8**	35.9	50.2	**14.3**
Median Wt gain	35.5	67	**31.5**	19.5	56	**36.5**

Figure 12. An example screenshot of what the majority of the water medicator data looks like from NCW in year 1, where it is not known if blank cells are a result of lost satellite connection or zero water flow. This data has not been used to determine final results as its accuracy is unknown.

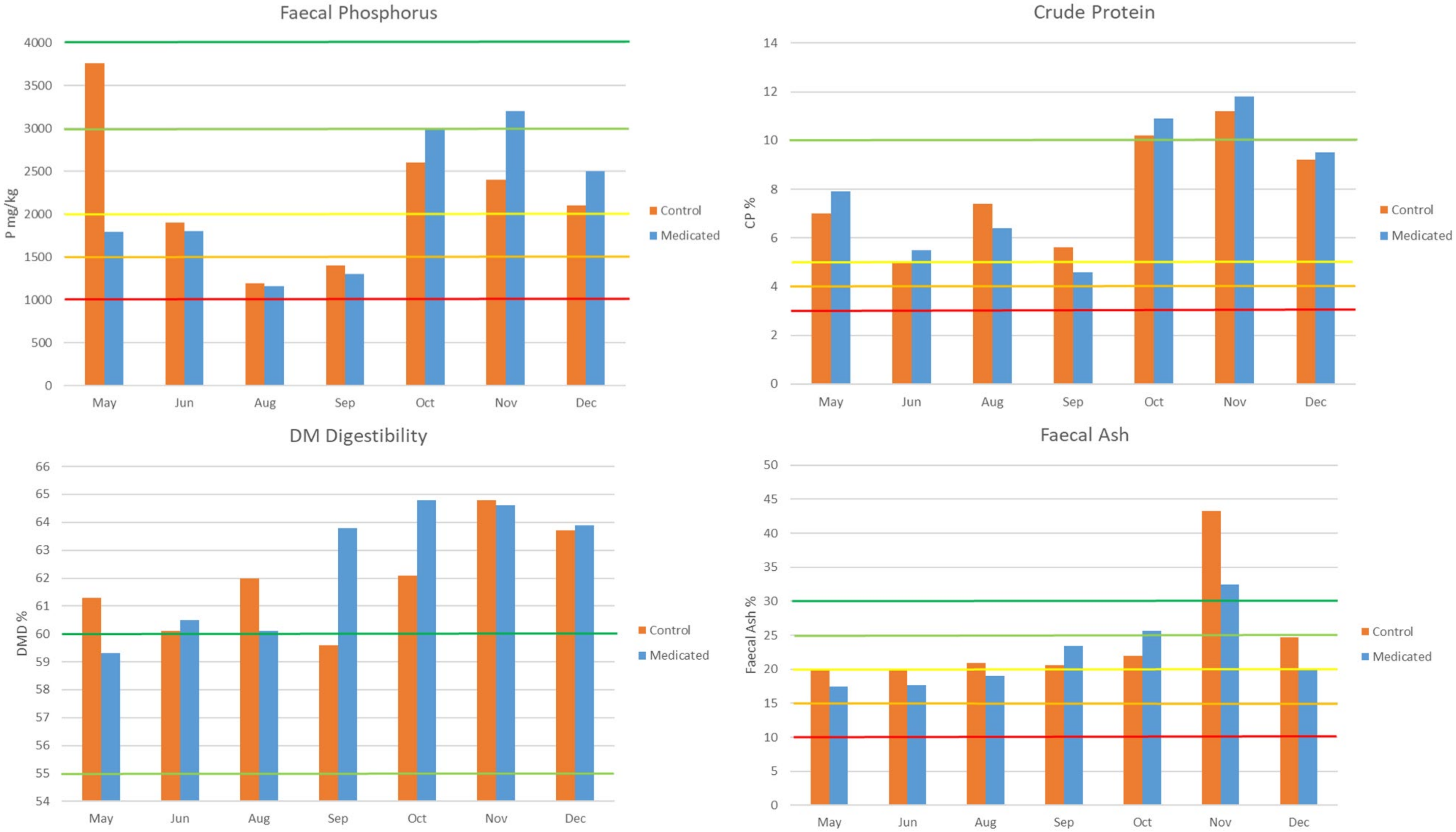
	21/09/2021	22/09/2021	23/09/2021	24/09/2021	25/09/2021	26/09/2021	27/09/2021	28/09/2021	29/09/2021	30/09/2021	1/10/2021	2/10/2021	3/10/2021	4/10/2021	5/10/2021	6/10/2021	7/10/2021	8/10/2021	9/10/2021
Daily Water Flow (L)		21700.00	21700.00		72630.00				28620.00	45080.00						21020.00	20700.00	30560.00	20930.00
Daily Nutrient Flow (L)		54.26	54.26		180.02				70.90	107.57						34.98	34.42	51.00	34.01
Av Water/head/day		116.04	116.04		388.40				153.05	241.07						112.41	110.70	163.42	111.93
Supplement type	org	org	org	org	org	org	org	org	org	org	org	org	org	org	org	org	org	org	org
UREA Equivalent (g/head)		115.77	115.77		384.11				151.29	229.51						74.63	73.43	108.83	72.56
Phosphorus Equivalent (g/head)		15.09	15.09		50.06				19.72	29.91						9.73	9.57	14.18	9.46
No. of Cattle Supplemented (estimated from paddock records)	187.00	187.00	187.00	187.00	187.00	187.00	187.00	187.00	187.00	187.00	187.00	187.00	187.00	187.00	187.00	187.00	187.00	187.00	187.00
Daily Cost (total)	$ -	$ 115.19	$ 115.19	$ -	$ 382.18	$ -	$ -	$ -	$ 150.53	$ 228.36	$ -	$ -	$ -	$ -	$ -	$ 74.26	$ 73.06	$ 108.28	$ 72.19
Av. Cost /head/day	$ -	$ 0.62	$ 0.62	$ -	$ 2.04	$ -	$ -	$ -	$ 0.80	$ 1.22	$ -	$ -	$ -	$ -	$ -	$ 0.40	$ 0.39	$ 0.58	$ 0.39

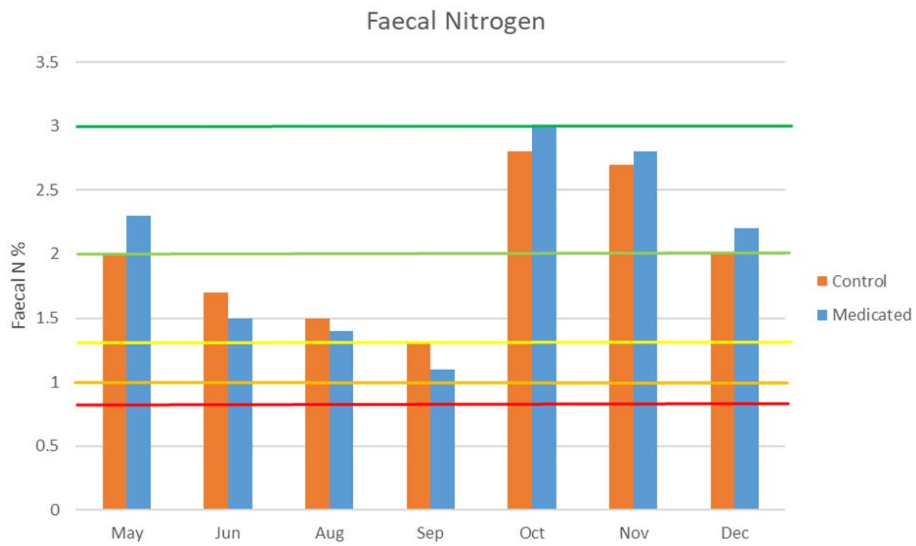
uPro Orange HB (g/L)		**uPro Green (g/L)**	
Urea	P	Urea	P
399	52	188	86

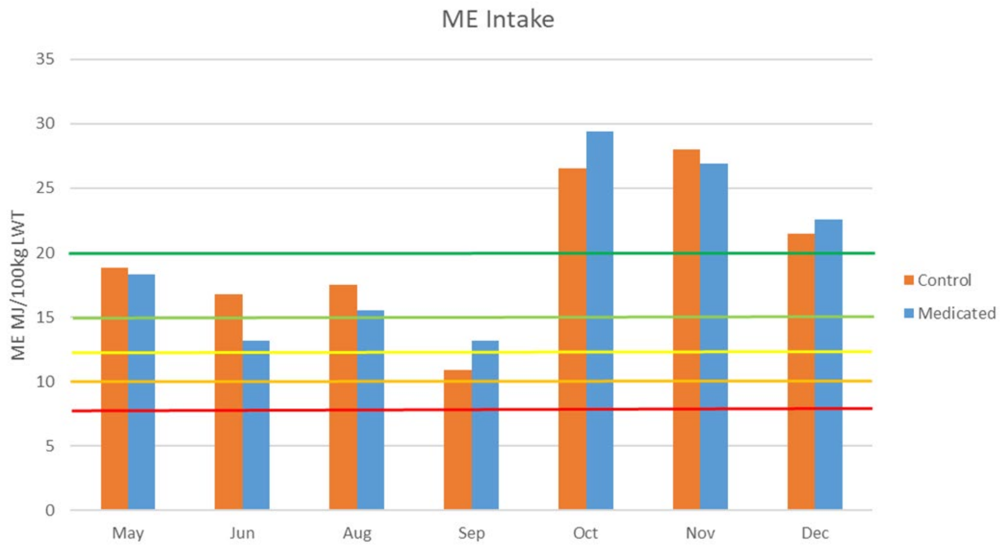
uPro Orange HB ($/L)	**uPro Green ($/L)**
2.123	1.815

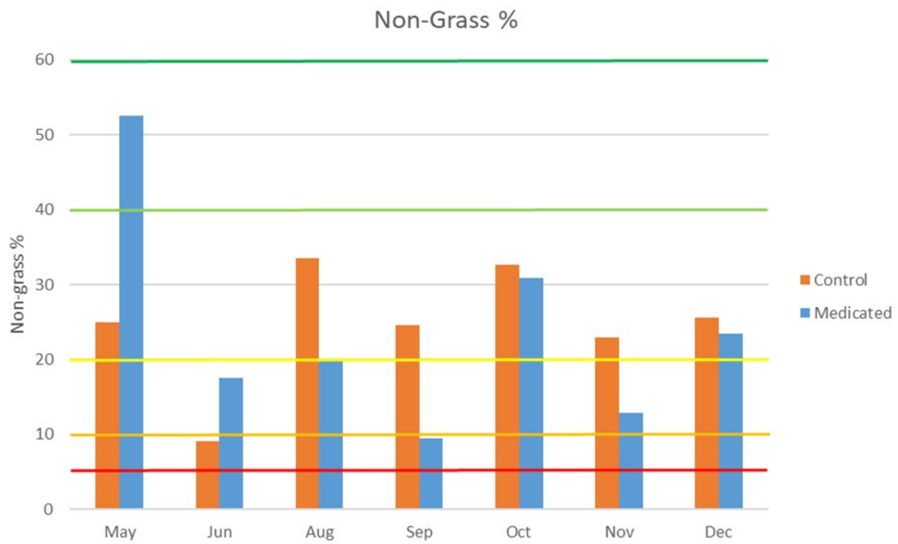
8.2 Faecal NIRS results (Year 2)

Figure 13. Faecal NIRS results from year 2 (2022) of the PDS, where coloured lines illustrate very low (red), low (orange), medium/maintenance (yellow), high (light green) and very high (dark green) levels for each parameter (Symbio Laboratories, 2019).




Faecal Nitrogen
Faecal N %
3.5
3
2.5
2
1.5
1
0.5
0
May
Jun
Aug
Sep
Oct
Nov
Dec
Control
Medicated


ME Intake
ME MJ/100kg LWT
35
30
25
20
15
10
5
0
May
Jun
Aug
Sep
Oct
Nov
Dec
Control
Medicated


Non-Grass %
Non-grass %
60
50
40
30
20
10
0
May
Jun
Aug
Sep
Oct
Nov
Dec
Control
Medicated

8.3 Communications

Figure 14. Screenshot of Facebook post about the PDS in the" AgricultureNT" group.

PlantIndustries Chelsea
November 28, 2022 ·

DITT Pastoral Extension Officer, Stacey Holzapfel, recently travelled down to the Barkly to the Supplementation via Water, Producer Demonstration Site (PDS).

Supplementing cattle via water is an alternative method of supplementation to dry-lick, and one which could overcome barriers to achieving consistent supplement intake, particularly through the wet-season.

The liquid supplement is pumped from a water medicator into the tank or trough at a regulated rate as the trough fills. Once the water medicators are set up, they can be checked and controlled remotely.

However, the efficacy of this technology may be limited when cattle are able drink from surface water rather than the trough. To investigate this, GPS collars are being used to track their movements and identify any changes in utilisation of the troughs, and therefore intake of supplement, when surface water is available.

More here: Providing Mineral Supplementation via Water (Producer Demonstration Sites) - FutureBeef

You, Leanne Vandersman, Alison Kain and 17 others   1 share

Future Beef Website Project Page

Providing mineral supplementation via water (Producer Demonstration Sites)
Page published: August 17, 2023 | Page reviewed: May 9, 2024

It cannot be argued that supplementation of extensively managed beef breeding herds is beneficial to over come mineral deficiencies and improve animal performance, but it can also be costly. Supplementation decisions should be carefully considered to ensure that the benefits in terms of cattle performance exceed supplementation costs.

Supplementation via water medication is one of the cheaper methods and ensures that animals receive the appropriate amount of supplement for their body weight as it overcomes issues with shy feeding and gorging. Furthermore, providing consistent phosphorus (P) supplementation to cattle during the wet season, which can be challenging when paddocks are often inaccessible for long periods of time and many forms of P supplements need to be protected from rainfall.

Urea can also be supplemented through water medication when properly managed, allowing urea supplementation to continue during “shoulder seasons” when the protein content of pasture may be low but the chance of rain makes supplementing with urea loose licks and blocks risky. Delivery of supplement through water medication allows supplementation to continue year-round, more consistently and efficiently. Water medication technology is currently not widely used, however it provides an opportunity for the remote control of dose rates in quick response to changes in seasonal conditions, but does require a certain level of management and technical skills to maintain.

The Producer Demonstration Site (PDS) is investigating whether mineral supplements can be effectively provided through water medication systems and looks at the effectiveness of water medication through the wet season.

Little is understood about the water consumption behaviour of cattle that also have access to surface water, particularly after a rain event and how frequently they return to the water medicated trough or to consume other forms of supplement.

Objectives

- Demonstrate that year-round supplementation via water medication can be successfully implemented at a commercial scale without negatively impacting the productivity of breeders,
- Demonstrate that water medication is an effective method of addressing phosphorus deficiency during the wet season,
- Conduct a cost-benefit analysis to determine the relative economic performance of automatic electronic water supplementation compared to the existing method of supplementation on individual properties,
- Use GPS livestock tracking equipment to compare the frequency of livestock access to medicated water troughs and lick blocks during the wet and dry season,
- Increase the awareness, knowledge and confidence of NT producers in water medication systems through various extension platforms and events.

Producer Demonstration Sites

In 2021, two MLA producer demonstration sites were established in collaboration with the Northern Territory Department of Industry, Tourism and Trade (the department) and DIT AgTech Ltd.

In the first year (up to the end of the 2021/22 wet season), there were some inconsistencies in data collection and in the data retrieved from the water medicators, which limited the accuracy of results. This was largely due to multiple handovers of the project with unforeseen staff changes, as well as the challenges associated with running trials on commercial properties.

In early 2022, the PDS was reviewed and 'started over' so that more accurate results could be gathered in the second year. Summaries of the PDS in each year are below:

Year 1 (2021/22)

At the Barkly region site, 166 breeders were assigned to a 'water medicated' group, and 166 assigned to the 'control' group, which were supplemented using the property's usual practice (loose lick mineral supplementation). At the Katherine region site, 223 breeders were assigned to the 'water medicated' group and 149 assigned to the 'control' group.

When inducted into the trial, animals were weighed, body condition score (BCS) was recorded and a base phosphorus status was determined by collecting blood samples from 50 animals from each group to measure plasma in organic phosphorus (PiP). Ten animals from each treatment group were fitted with GPS collars to record the proximity and frequency of visitation of animals to the water trough and or lick supplement. The amount and costs of supplement distributed to the water medicated treatment was provided in reports from DIT AgTech, and the amount and costs of dry lick distributed was recorded by the property.

Following the 2021 dry season and 2021/22 wet season, weights, BCS and PiP were recorded and analysed. Re-conception rates and weaning percentage was recorded for one property, but sufficient data was not available from the other property. GPS data was downloaded from the GPS collars that were able to be retrieved.

Year 2 (2022/23)

Two new paddocks were selected at the Barkly site for the water medicated treatment (1700 ha) and control/dry lick treatment (1500 ha). Both paddocks have two troughs, and water medicators were installed at both troughs in the water medicated treatment's paddock. Supplement is directly injected into the trough line to ensure no other trough sare contributing to the intake data. Water medicators (uDOSE) are maintained by DIT AgTech and can be remotely monitored via an online dashboard (uHUB). Water flow meters were placed in the control paddock for comparison. Soil P tests and pasture assessments were conducted in both paddocks.

Two hundred PTIC first-calf heifers were inducted in May 2022, with 100 allocated to each treatment. Weights and BCS were recorded at entry, and 5 GPS collars placed on each treatment. Twenty blood samples from each treatment were collected for blood PiP testing. Faecal samples are being taken monthly for NIRS analysis of diets, including phosphorus, crude protein and digestibility. Following the 2022 dry season and 2022/23 wet season, GPS data, weights, BCS and PiP are being recorded and analysed.

Results so far:

Year 1 (2021/22)

While we cannot draw definite conclusions from the first year of data; it is important to report observations and the experience of setting up new water medication systems.

In the water medicated treatment, the water and supplement intake of the cattle was recorded by the water medicator (uDOSE). During the first year, the data could not be seen in real-time by the project management team, so updates on the water medicators were provided by DIT AgTech or from manual checking of the units. This increased the risk of faults within the medicator going unnoticed, and there were cases on both properties where that did happen (due to a range of challenges) meaning those cattle were not supplemented for significant periods of time. This hasn't been a problem since, as all collaborators have access to the uHUB online dashboard and are able to see real-time intakes and uDOSE information and alarms. There was also evidence of lost satellite connection by the uDOSE in the data recorded from this first year, which DIT AgTech has addressed by incorporating internal memory into the uDOSE.

First year supplement intakes and costs of the medicated treatment were to be based on the water medicator reports, but because of the missing data we were not able to accurately compare costs and nutrient intakes between the water medicated and control treatment. It was also noticed that the condition of each paddock was quite different at the end of this first year. Hence why the PDS moved to new paddocks the following year.

The weight gain and blood PiP results reflected the possible absence of supplement in the water medicated treatment as the control treatments had a higher weight gain than the water medicated treatments on both properties, and higher average blood PiP. Initial results from the second year of this trial show the opposite, suggesting that these differences were probably due to the technical issues early-on and supplement was not being delivered to the water troughs and possibly due to differences in pasture quality for the water medicated treatment.

The GPS data from the first year appeared different for each property and paddock for the amount of time cattle would go without visiting a trough. One paddock in the Barkly showed periods of only 3-4 days with no trough visits by collared cattle, whereas one paddock in the Katherine region had periods of over 10 days at a time during the wet season where no collared cattle visited a trough. It is likely that these gaps in 'visits' were similar for how often the control treatment visited the dry lick supplement.

Year 2 (2022/23)

During the second year (2022-2023), the water medicators have been monitored remotely by project staff and data has been available in real-time. The few alerts from the water medicators that have been received as notifications were acted on very quickly with the help of the uHUB dashboard. The exception was an over-estimate of water intake from one uDOSE for one month. The medicator was still supplementing, but water intake per head appeared much higher than it was for this period. This may have been due to a water leak, and it was resolved easily by re-starting the uDOSE.

At the end of the 2022 dry season, blood PiP was significantly higher in the water medicated treatment than the control. All of the 20 sampled medicated cattle had above adequate levels of PiP, whereas 7 of the 20 control cattle sampled had marginal or deficient PiP. It should be noted that these cattle did not have PiP measured at the beginning of this second year, but they were allocated to treatments at random. There was no difference in BCS between each treatment. Dry season weight gain was not measured due to issues with the scales and unexpected rainfall limiting access.

GPS units were on 5 heifers in each treatment (only 4 were retrieved from the water medicated treatment) and they gave a picture of proximity to water over part of the dry season. Due to GPS batteries running out sooner than expected, we were unable to get data for the complete dry season. The GPS data will benefit from further statistical analysis, but initial observations can be reported. Table 1 summarises the average number of trough visits per day foreach treatment, as well as the number of visits to the dry lick supplement in the control treatment (defined as being<20 m from the trough or supplement). There was no significant difference between treatments for the average daily visits to the trough, but quite a difference between visits to troughs and visits to dry lick.

Table 1. Summary of trough and supplement visits of GPS collared cattle between the 15/05/2022and 10/07/2022Treatment averages2022 dry season	**Medicated treatment:trough/supplement visits**	**Control treatment:trough visits**	**Control treatment:supplement visits**
Average per day	1.6	1.4	1.1
Median per day	1.4	1.8	0.2
Minimum per day	0	0	0
Maximum per day	11.3	8	10.6
Number days with 0visits(average of all collared cattle)	8.5	7.2	28.6
Max consecutive days with 0 visits(average of all collared cattle)	3.8	3.6	9.8
% days with 0 visits	14.5	12.6	54

There were cases where a collared animal in the water medicated treatment did not visit the trough for up to six consecutive days and therefore did not consume supplement during this period. However, there was one individual collared animal in the control treatment that did not visit dry lick supplement for 11 consecutive days. Gaps in urea consumption can be detrimental to the rumen microbiology, so consistent intake is important. These periods of no visits occurred after rainfall in June/July, and further insight into the frequency of trough visits will be available after the wet season.

Final data for this PDS was collected in May 2023, and the final report will be available in early 2024. Keep an eye out for extension material relating to this PDS throughout the remainder of 2023, including a FutureBeef webinar.

If you would like more information, or would like to receive updates on results and extension of this PDS, please get in touch with Stacey Holzapfel, NT DITT Pastoral Extension Officer on (08) 8973 9730.