final report

Project code: P.PSH.1104

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Date published: 1 July 2019

PUBLISHED BY
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The design of a production management system for an intensive northern Australian grazing operation to determine optimal production approach

This is an MLA Donor Company funded project.

Meat & Livestock Australia acknowledges the matching funds provided by the Australian Government to support the research and development detailed in this publication.

Abstract

The project addressed two essential requirements for cattle and pasture management in the context of an intensive Wagyu production program based on irrigated tropical pastures. These were a comprehehensive data recording system, if possible commercially available, and the most efficient means of weighing cattle grazing over up to 80 paddocks in pivot clusters over a significant distance. Two off the shelf grazing-based farm management programs were used and evaluated, and suitability assessed. This continued as the potential to incorporate new features was explored. For cattle weighing, movement of cattle to a number of robust, fixed, strategically located yard facilities with scales, either permanent or mobile, was identified in the circumstances of the operation to be the most efficient means of frequent weighing of variable cattle mob sizes and types over a 10 km location range. This was in comparison to fully portable equipment.

Executive summary

The Pardoo Wagyu beef program is located in the Pilbara region of Western Australia, utilising a pivot-irrigated tropical pasture base. The innovative nature and scale of the operation would require rigorous management control and data recording. An aim was if possible to gather all data into a single recording program.

Two aspects of this were identified as

1. Grazing management recording
2. Cattle weight change data collection

To this end, the approach (1) was to use and assess at least two off the shelf software recording programs to evaluate suitability, including ease of data collection, connectivity and real time availability to multiple levels of staff and facility for management and analysis. The alternative was a much more complex and expensive process to commission a custom built program.

Two commercially available programs were utilised, based initially on their capacity to record the movement of cattle rotationally grazing over up to 80 cells within the initial 12 pivots. Over the time of the project hay and crop production were integrated into the area, requiring an additional suite of data records. The capacity of the programs was evaluated for these additional requirements as well for sharing of data from existing recording software measuring soil water, weather, irrigation, and cattle weighing and other treatments.

Both programs had excellent grazing recording, and cattle and paddock treatment capacity. One was found to have more capacity in the Pardoo context to upload relevant data from a range of other farm recording systems, and to build in specific requirements identified.

With final stage feedlotting imminent and the marketing of high-grade Wagyu beef emerging, management effects on individual animal and carcase data are seen as of advantage. It is not to be expected that any grazing or farm management software would accommodate the magnitude of this aim, but program capacities are being evaluated.

With regard to cattle weighing (2) timely capture of cattle weight changes in association with grazing management was essential. It was an additional means of calibrating pasture quality and alerting to any impending cattle health issues. In the early period before cattle turnoff, weight gain in association with accurate recording of costs provided the only means of calculating beef Cost of Production (CoP), a vital business Key Performance Indicator (KPI).

In consultation with staff the challenges inherent in conveniently weighing cattle in the intensive grazing environment were identified. At the time of commencing the project the concept of mobile weighing equipment was seen as efficient. Recognising the use for portable equipment for needs other than weighing, basic cattle capture and restraint features were proposed. These concepts were proposed to a commercial manufacturer of cattle handling equipment and an appropriate prototype facility constructed.This was employed and objectively evaluated in the context of the grazing operation. Cattle management, time and labour including OH&S considerations were considered.

The equipment was used in a variety of contexts including unforeseen grazing subdivision alterations and remodelling of facilities (fencing, water points, landways, paddock size). A template was created to objectively compare methods of weighing responsive to cattle management and staff issues.

Fully transportable scales and the required yards were found to be inefficient, taking approximately twice as long (in the circumstances, 332 compared with 170 minutes on average) to weigh cattle in the context of the pivot pasture layout as did the use of a fixed facility. In addition the labour and effort necessary had OH&S implications.

Movement of cattle to a number of robust, fixed, strategicly located yard facilities with scales, either permanent or mobile, was identified in the circumstances of the Pardoo operation to be the most efficient means of frequent weighing of variable cattle mob sizes and types over a 10 km location range.

For timeliness it was established that the distance to the yards should be minimised where possible. With the pivot cluster arrangement as located a distance of approximately 1 km from any cell this had challenges with three yard locations.

The place of walk over weighing in intensively grazed pivot-irrigated pastures should be further evaluated.

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1 Background

Pardoo Beef Corporation (PBC) and MDC have a collaborative co innovation program underway incorporaring extensive research for cattle optimisation. The business is pioneering the production of high quality Wagyu cattle on irrigated pasture in North Western Australia.

The scale and intensity of the beef production program, and the many untested assumptions underlying the initial business and production plan, demanded robust initial data collection and analysis of a pioneering nature.

One of the first initiatives under the collaborative program was the design of an automated system to collect various disparate sources of production and growth performance data (both pasture and animals) within a northern Australian irrigaton environment enabling real time analysis of different input combinations, allow for comparative analysis between individual irrigation units, all management activities, inputs scenarios and production response analysis.

The project comprised two activities: evaluating a grazing management recording system which reflected the requirements of a mosaic irrigation operation, and the comparison and evaluation of cattle weight collection from a large number of separate pivot-irrigated pastures intensively sub divided.

The management insights gained from the development and use of such a system will have application and value to existing and new entrants into intensive livestock management on tropical pastures, for which no guidelines for recording and data capture have been published.

2 Project objectives

2.1 Grazing management recording

There exist a number of commercial software programs developed to record and analyse cattle and sheep grazing enterprises across Australia. The objective was to use and assess at least two of these recording systems to evaluate the off the shelf offering in the field for its suitability, including ease of data collection, connectivity and real time availability to multiple levels of staff and facility for management and analysis.

The alternative was a much more complex and expensive process to commission a custom built program.

The requirement for rigorous grazing management recording became evident when considering the beef production program from grazed pasture:

- Up to 10,000 cattle
- 80 subdivisions
- Large and at times rapid changes in pasture growth rates (40 to 180 kg/ha/day)
- Staff turnover at times high

2.2 Cattle weighing

With the intensive and novel beef production program as described, it was recognised that timely capture of cattle weight changes in association with grazing management would be essential. It is an additional means of calibrating pasture quality and alerting to any impending cattle health issues. In the early period before cattle turnoff, weight gain in association with accurate recording of costs provides the only means of calculating beef Cost of Production (CoP), a vital business Key Performance Indicator (KPI).

The objectives were to compile a list of the specific requirements for efficiently gathering individual cattle weights unique to the irrigated grazing systems, and in association with a manufacturer of cattle handling equipment design and develop an appropriate facility. This was employed and objectively evaluated in the context of the grazing operation. Cattle management, time and labour including OH&S considerations were considered.

3 Methodology

3.1 Grazing management recording

The two off the shelf software programs chosen initially were Maiagrazing™ and AgriWebb™

These were employed sequentially and separately, the aim being to use over an annual interval. Both utilised mobile phone apps for record entries in the field, which would be uploaded to the main program website when phone and internet connectivity were available.

A staff member was allocated a central priority role in assembling, managing and confirming the data collection on a daily basis, and liaising with the Project manager and the system provider with queries if necessary.

In the case of both programs, it was identified that the Pardoo program would benefit from additional features not at the time available. Discussion was initiated with the providers as to the possibility of incorporating these. Linkage to other data gathering programs were explored in each case, the aim being if possible a “single desk” record management system. In this way data analysis, recording and KPI review could be facilitated.

3.2 Cattle weighing

In consultation with staff, the issues inherent in conveniently weighing cattle in the intensive grazing environment were captured. At the time of commencing the project the concept of mobile weighing equipment was seen as efficient. Recognising the use for portable equipment for needs other than weighing, basic cattle capture and restraint features were proposed.

These requirements were proposed to a manufacturer of cattle handling equipment and an appropriate prototype facility constructed. This was then evaluated in the context of the cattle management program as described.

The equipment was used in a variety of contexts including unforeseen grazing subdivision alterations and remodelling of facilities (fencing, water points, landways, paddock size). A template was created to objectively compare methods of weighing responsive to cattle management and staff issues.

4 Results

4.1 Grazing management recording

Maiagrazing™ was selected as the first program to use. Its key and appealing feature was graphic portrayal of cattle movements and paddock status. Staff easily understood the use of a personal mobile phone to record the grazing movements of all cattle mobs.

Cattle mob and paddock treatments could be entered in the field on a mobile phone app by appropriate staff, and were synchronised to the website when phone connectivity was available. These could be reviewed and analysed subsequently. The records would enable more efficient pivot by pivot comparison.

During the year paddock size and configuration was altered to facilitate machinery operation, both for planting and harvesting of forage crops for silage and for hay making as a component of pasture management as well as provision of supplementary feed. After consideration and discussion the recording was recommenced taking into account the change in paddock size.

Pivot/paddock recording continued, whilst seeking assistance from program providers as to cropping recording and the incorporation of crop, including hay, production, and recording of supplementary feeding from a variety of sources. The recording of irrigation was seen as an important feature for Pardoo as water was a key input. Irrigation was guided and recorded using a separate program and initial discussions sought the integration of this with Maiagrazing™.

AgriWebb™ was next implemented and reviewed. Cropping staff were comfortable with the opportunity for cropping activity recording, analysis and KPI review, together with the ease of access for automatic uploading from other programs and equipment available in the areas of weather, cattle weighing and water usage. Grazing recording was similar although not as graphically displayed. Features sought by Pardoo were discussed with the provider and in some cases rapidly made available. This was useful.

Analysis of records and graphic presentation was more advanced in number of features and presentation, although not all features relevant to Pardoo.

At the stage of project completion AgriWebb™ remains in use, with additional features seen as adding to its value being discussed with the providers.

The consideration of a custom-designed program is being explored, as the Pardoo program will soon enter the next phase of specialist feedlotting and marketing programs internationally. Tracking of individual animals through feedlot and carcase appraisal will be required. Indications to date are that this would be considerably more expensive, both initially and ongoing.

4.2 Cattle weighing

The geographical context of the intensive cattle grazing operation is shown in Fig 1.

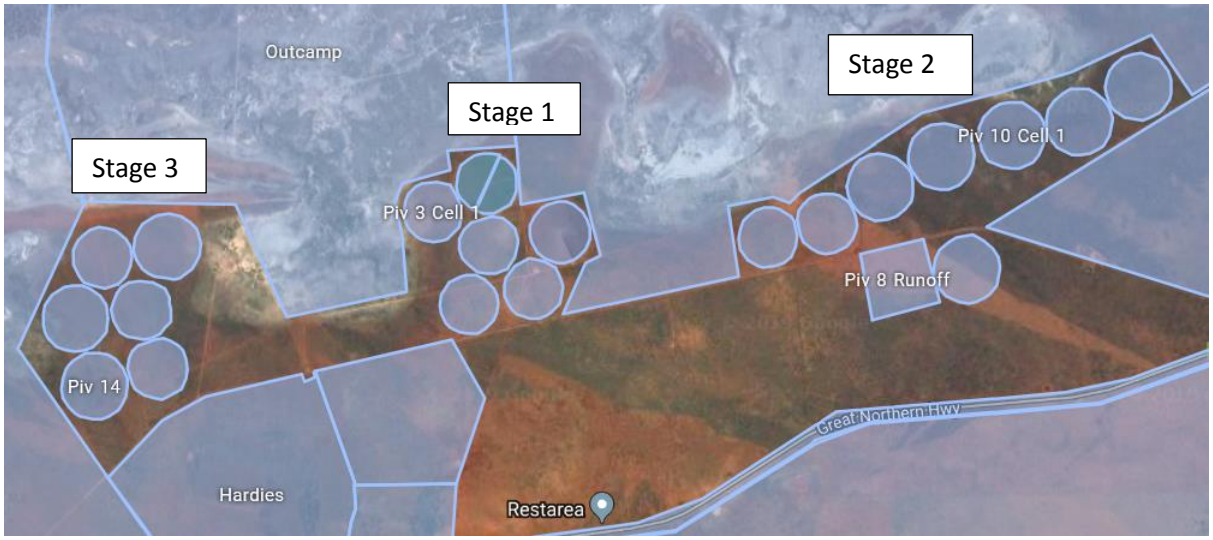

Fig 1. Irrigated pastures Pivot layout

With regard to weight recording, the aim was to weigh representative mobs monthly. As development progressed the number of pivots increased, as did mob numbers. Of significance was the variety of mob type – for example, weight range, breed , reproductive state. Grazing management became more complex, as did weighing opportunities.

At the commencement of the project (Stage 1) most of the pivots in operation were subdivided into 8 sectors or cells, with a access to a central area where a watering point was located. Pivots were 40 ha in area, with 5 ha cells. Pivots in the subsequent Stage 2 were 50 ha divided into 4 sectors or cells, with both central and peripheral watering points. A third Stage designated for incorporation of a cropping rotation comprised both 40 and 50 ha pivots, without subdivision, with a single peripheral watering point.

Since the project commenced the significance of paddock layout for machinery operation in the pivots became more a priority, and removal of the central bare area with water point common to all cells in a pivot was progressively implemented.

Initially in the context of Stage 1 fully portable yards were assembled within the central area of a pivot, cattle mustered from the cell in which they were grazing at the time into the yards, and after weighing typically returned to another cell. This was a time-consuming and labour-intensive process associated with assembling and dismantling the necessary cattle handling facility. Consideration was given to constructing a fixed yard shell in the central area (Fig. 6). To this could be added a lesser number of portable panels the result being reduced labour and increased strength of the structure.

With the modification of pivots with cropping requirements incorporated, the number of structures requiring construction became impractical, and three permanent yards were used each accessed by cattle from the three separate stages. Over the course of the project two of these had permanent cattle handling facilities including scales incorporated; until then then the mobile scales were transported to and manoevered into position.

The configurations explored to evaluate cattle weighing were objectively recorded (Table 1) by an independent observer.

Observations and feedback from staff involved were recorded.

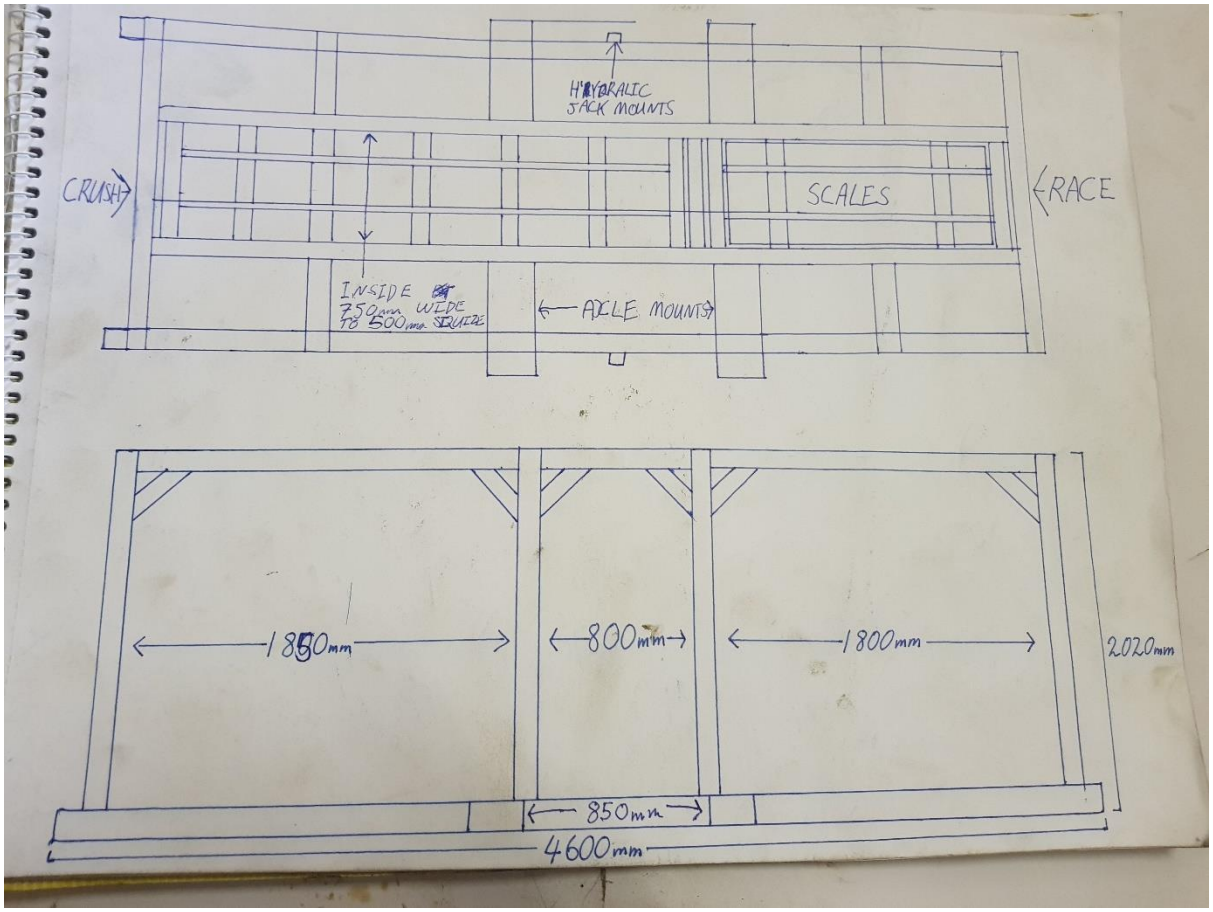

Fig.2 Initial design concept of combined weigh box and crush

Fig. 3 Mobile equipment in place

Fig. 4 Cattle weighing in progress

The equipment design and mode of action is shown in Figs. 2, 3, 4 and 5. An electronic NILS tag reader was incorporated into the weigh box.

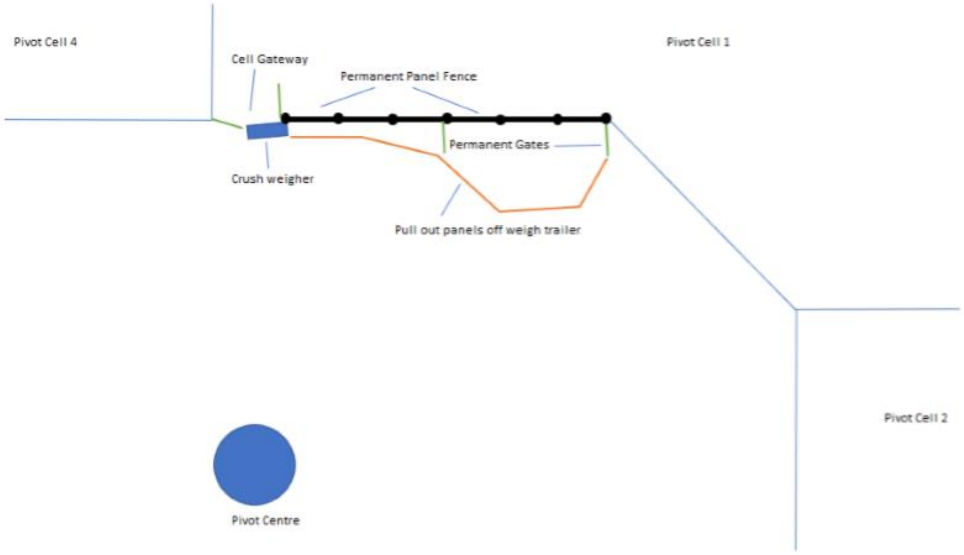

Fig. 5 Combination of fixed and portable yard weighing facilities.

Operation	Labour units (vehicle requirements)	Fully mobile and transportable scales and yards. Weighing performed at each pivot. Time (minutes)	Movement only of scales to permanent yard facility strategically located at each pivot cluster. Time (minutes)
Transport scales and portable yards to pivot	2(2 veh.)_	12 (8-20)	
Transport scales only	1(1 veh)		9 (7 -18)
Unload panels, erect yard structure	3 - 4	135 (120-180)	n/a
Manoeuvre scales into position and assemble	2 - 3	12 (8-18)	12 (8-20)
Muster cattle to yards	3	22 (20 - 30)	45(15-80)
Weigh 100 cattle	3	55 (40-90)	48 (30 - 60)
Return cattle to cell	1 - 2	n/a . Cattle move directly to cell	33 (10-55)
Dissemble and load yard panels	3 - 4	70 (60-125)	n/a
Prepare scales for transport	2	14 (15 - 20)	14 (15-20)
Return yard panels and scales to storage	2 (2 veh)	12 (20 - 30)	
Return scales to storage	1 (1 veh)		9 (7-18)
Total time (minutes)		**332**	**170**

Table 1. Comparison of 2 cattle weighing procedures involving clusters of pivot-irrigated tropical pastures

This has confirmed the decision to maintain weighing at yard facilities strategically located for pivots in the three Stages groupings. Movement only of the weighing equipment is necessary (portable crush and weighbox incorporating scales). The time and motion study of weighing options had confirmed the advantage of this procedure even in the absence of central weighing in each pivot.

In the comparison (Table 1) the range of times recorded for the procedures evaluated is shown. As a standardising measure the time taken to weigh 100 cattle was recorded, to eliminate time differences due to mob size. As can be seen, the fixed yard structure provided a time advantage in cattle weighing time (48 compared with 55 minutes), being more robust and not requiring adjustment as would become necessary with the portable yards.

The activities highlighted in Table 1 record the activities responsible for the major differences between the two procedures compared.

Apart from the considerable time difference (170 compared with 332 minutes, on average) the elimination of often difficult work involving heavy components was eliminated.

It was not considered necessary to modify the equipment with regard to achieving the objectives of the project. A number of aspects involved with setting up and dismantling the equipment as supplied could be reviewed, in particular in the case of effort involved with the towing hitch and wheel removal and replacing.

5 Discussion

5.1 Grazing management recording

To best utilise the rapid growth of the irrigated tropical pasture at Pardoo, rotation grazing was employed. Grazing intervals were found to vary greatly as influenced by pasture type, previous grazing history, weather (temperature), fertiliser and water supply. A convenient method of recording cattle movements over up to 80 paddocks (cells) became essential, especially as staff turnover became relatively high. The two software programs used and evaluated were designed with this as a key feature, along with the capacity to record a range of pasture and cattle treatments.

Both programs to date have proved excellent in the recording and management of cattle grazing movements, and the subsequent paddock performance.

The evaluation is ongoing, that of the second program being in progress. The Pardoo pivot program evolved quite dramatically over the project timespan, with more complex requirements in place and presaged. Whilst the grazing recording and analysis remained of high priority, the need to incorporate data collection relating to crop production, including soil and plant tests, became of increasing relevance. Linkage to satellite data on crop and pasture attributes, together with moisture and fertility status, is seen as useful.

An aim of any data recording program accessed, if at all possible, was to bring all data together so as to more readily associate inputs and outputs relating to a diverse range of activities. With final stage feedlotting imminent and the marketing of high-grade Wagyu beef emerging, individual animal and carcase data would be included. It is not to be expected that any grazing or farm management software would accommodate the magnitude of this aim, although at this stage to the farm gate level

at least the software program AgriWebb™ shows promise of modification and has incorporated some features of value to the Pardoo enterprise. Automatic uploading of weather and irrigation data, and uploading of cattle data including treatments and weights from Gallagher equipment already in use, are seen as enabling in depth review, reporting and analysis as desired.

5.2 Cattle weighing

At the time of commencing the project, with the 6 pivots in Stage 1 the major pivot cluster, cattle wre moving into a centre yard area for water, and there was access to all 8 subdivisions available. Also, cattle mob numbers and type were similar, and grazing rotations relatively simple. To capture cattle weights in and out of this area would be convenient, with appropriate facilities, which could be moved as required between pivots. With Stage 2 and another 6 pivots in construction 5 km away, and no other yards, transport of the weighing facility would seem an efficient measure.

It became apparent very early that frequent movement of the scales and yards was time consuming and onerous, especially for female staff. To minimise the the amount of heavy equipment requiring movement(unloading from trailer, assembly, disassembly and loading) a partial fixed and robust yard portion was trialled in the central area (Fig. 6). Whilst facilitating the procedure, it was not adopted for a number of reasons. (a) It would add to the cost of the operation)b) layout of the pivots for Stage 2 and subsequent stages was being modified to better accommodate paddock machinery operation, both for pasture mulching, hay production and specialist silage cropping. (c) Water points in a central area continuously and intensively used posed a disease risk; water was relocated to pivot peripheral locations. Each of these conditions made the fully mobile concept impractical.

The construction of cattle yards within convenient access to each pivot cluster was planned and in the meantime basic interim yards to which cattle could be mustered for weighing were constructed. The only equipment to be transported was the mobile scales. The time and convenience of this was clear – 170 compared with 332 minutes on average – and onerous labour eliminated.

The incorporation of automatic walk over weighing was not available at the time of the project. It is planned to acquire and evaluate this equipment within the intensive pivot grazing program. Apart from expense there was initial reservation as to mobility between up to 20 pivots and 80 cells, and the requirements for infrastructure associated with the equipment being necessary in many locations; in addition the requirement to be in place for some time (as understood, 7 to 10 days) at any one location.

6 Conclusions/recommendations

6.1 Grazing management recording

The needs of grazing- based farming systems can be well provided for by the two software programs evaluated. In addition there exist an increasing number of such programs coming to market, indicating the demand by astute grazing animal managers. If other enterprises assume prominence in the overall business, it may not be possible for commercial programs with a grazing focus to meet all requirements, and custom designed programs considered.

6.2 Cattle weighing

Cattle weighing is an essential part of management of intensively grazed pastures. As this program is novel precedents ands critical KPI's are minimal. In the early period before cattle turnoff, weight gain in association with accurate recording of costs provides the only means of calculating beef Cost of Production a vital KPI on while to benchmark the business. It can be an indicator of pasture performance and cattle health, aberations from which are covert in earlt stages.

Movement of cattle to a number of robust, fixed, strategicly located yard facilities with scales, either permanent or mobile, was identified in the circumstances of the Pardoo operation to be the most efficient means of frequent weighing of variable cattle mob sizes and types over a 10 km location range.

For timeliness the distance to the yards should be minimised where possible With the pivot cluster arrangement as located a distance of approximately 1 km from any cell was possible with three yard locations.

The place of walk over weighing in intensively grazed pivot-irrigated pastures should be evaluated.

7 Key messages

7.1 Grazing management recording

There exist an increasing number of grazing management software programs commercially available. These are supported to varying degrees. Intensive grazing management of irrigated tropical pastures should be supported by such programs.

Where complex enterprises are involved it is not realistic to expect whole of business capability. Custom designed software would be needed. The cost involved and industry capacity to commission this has not been explored.

7.2 Cattle weighing

Regular cattle weight recording is essential in the case of grazing irrigated tropical pastures.

Mobile weighing systems are impractical where many pivots and cells are involved. Fixed facilities within one kilometre of cattle were found to be efficient.

Walk over weighing technology may have a role and could be evaluated.

8 Final Recommendation

The project has provided sufficient knowledge to demonstrate the significance to the operation of access to correct and consistent data sets regarding cattle weighing and recording as this has a direct impact on the end result for the beef quality.