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EXPLORING ADOPTION FACTORS, AND PREFERENCES TO THE USE OF BEEF GENETIC TOOLS IN NORTHERN AUSTRALIA.

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SUMMARY

Genetic improvement of beef cattle has emerged as a fundamental priority in Northern Australia. This study aims to identify the factors that influence decision-making regarding the use of genetic tools by Northern Australian beef farmers. The genetic tools considered are BREEDPLAN estimated breeding values (EBVs), TACE, IGS, Leachman, Ingenity and genomic profiles, as well as indices that integrate these genetically assessed traits, such as $Indexes. Australia beef farmers. Surveys were collected from beef farmers across Northern Australia and logistic regression analyses and Chi-square tests were performed. Age was the only demographic factor that had a significant effect on the adoption of genetic tools for seedstock and commercial farmers. For seedstock farmers, each additional year of age increased the odds of adopting genetic tools by 6.4%. however, for commercial farmers, each additional year decreases the odds by 5.2%. For commercial farmers who collect phenotypic data, the likelihood of their adoption of genetic tools increases. Understanding genetic tools and the impact on their business is a key motivation for adoption.

INTRODUCTION

Beef farmers in Northern Australia have historically been slower to adopt genetic tools than their southern counterparts. This region faces several challenges such as extreme climate, poor market access and exposure to ticks that influence production, and economic viability of livestock enterprises (Bell and Sangster 2023). The size of farms in remote areas alongside low connectivity also challenges technology adoption. Genetic improvement offers a solution to some of these production challenges. Despite recent RD&E efforts promoting their use among northern Australian farmers (Bell and Sangster 2023; Greenwood *et al.* 2018; MLA 2022; NABRC 2022), adoption of genetic tools and technology remains a priority. To address this, the diffusion of existing technologies through participatory extension programs with farmers (Nettle *et al.* 2022; van der Werf 2023) is an opportunity to increase awareness and adoption of genetic improvement in commercial herds. This research aims to enhance the understanding of the factors that motivate northern Australian beef farmers to use genetic improvement tools in their herds and to identify their data collection preferences.

MATERIALS AND METHODS

This research was conducted during 2024 through online surveys in Qualtrics with seedstock and commercial farmers from Northern Australia. This research was approved by the CQUniversity Australia Human Research Ethics Committee (approval number 24882). The survey comprised 32 questions and responses were anonymous. The survey targeted Northern Australian beef farmers segmenting commercial and seedstock producers. To determine the sample size that achieved representativeness across Northern Australia, the formula proposed by Daniel and Cross (2018) was used $n=[(z^2.p.q)/d^2]$, where n= sample size, z = desired confidence level, p = proportion of a characteristic of the population to be sampled, the number of beef farmers related to the total number of farms in northern Australia, q= (1-p), and d= desired precision. Farmer proportions were extracted from the Australian Bureau of Agricultural and Resource Economics and Sciences (2023) and

Government of Western Australia (2021). This corresponds to p values of 0.675 and q of 0.325. Considering a 90% desired precision (d=0.1), the sample size to be collected should be 84 across Northern Australia. Seedstock and commercial beef farmers were classified according to the use of genetic tools in their herds into two sub-categories, Adopters (A) and Non-Adopters (NA).

Statistical analysis. Firstly, binary logistic regressions were used to identify the variables that influence the adoption of genetic tools by beef farmers. The dependent variables are qualitative and categorised (Adopter; Non-Adopter). Commercial farmers were classified as "Adopters" if, within the past five years, they engaged in breeding programs, purchased heifers with genetic evaluations, or acquired bulls or used AI from genetically evaluated bulls, provided they also met the first two criteria. Seedstock farmers were deemed "Adopters" if they participated in breeding programs (e.g., BREEDPLAN) and sold bulls or heifers with EBV data. It is proposed to follow the model used by Quddus (2022) $Y=Logit(p)=Ln(p/(1-p))=\alpha+Z'\delta$., where Y takes the value of one if the beef cattle farmer uses genetic tools in their herd (Adopters); the probability that the farmer adopts any of the genetic tools being p, (1- p) is the probability that the farmer does not use genetic tools (Non-Adopters), Z is the vector of the independent variables, δ is the coefficient to be estimated and α is a constant. The independent variables used in the model were demographic and productive factors (e.g. age, gender, education level, role on-farm, number of employees, herd size, breeding systems, breeding methods, tropical/temperta breed and data collection). The odds ratio (*Exp(B))* quantifies the change in the odds of the dependent event occurring for a one-unit increase in the predictor variable. Secondly, Chi-square tests were performed to analyse the relationship between the adoption of genetic tools and preferences regarding data recorded on farms; and reasons for using them within each group of farmers (commercial and seedstock). The survey data was managed in a Microsoft Excel spreadsheet. For logistic regression, Chi-square test and descriptive analysis, the Statistical Package for Social Sciences (SPSS version 28.0.0.0 (190)) was used.

RESULTS AND DISCUSSION

The survey was completed by 97 producers that met the conditions required for this study. A total of 116 postcodes were registered, distributed between QLD (86.2%), NT (12.9%) and north WA (0.9%). Of the participants, 55.67% answered that the main focus in their enterprise was commercial, followed by seedstock (44.33%). Therefore, the sample was biased towards seedstock, since in Northern Australia the proportion of seedstock producers is significantly lower than that of commercial farmers. The ratio between Adopters/Non-Adopters differed for each group of producers, being 69.77/30.23% and 48.15/51.85% for seedstock and commercial, respectively This study had a higher representation of commercial farmers who were classified as non-users of genetic tools and provides new information on potential users of genetic tools that could be used in the design of an extension activity.

Adoption of genetic tools. Results from logistic models considering demographic variables suggest that gender, level of education and the role on farm did not have any effect on the adoption of genetic tools. Age was the only demographic factor that had a significant effect on the odds ratio of adopting genetic tools. The fit quality of the models for age was similar across farmer groups, 14.9% and 14.1% of the variance in the dependent variables (Adopter/Non-Adopter) for seedstock and commercial producers respectively. The odds ratio *(Exp(B))* for age was 1.06 for seedstocks, indicating that for every one-year increase in age, the odds of adopting genetic tools increased by 6.4%. Conversely, the odds ratio (*Exp(B))* for the predictor was 0.95 for commercial producers, indicating that for every one-year increase in age, the odds of adopting genetic tools decreased by 5.2% (Table 1). Age is a factor that has shown inconsistencies in several studies of technology adoption processes (Montes de Oca Munguia and Llewellyn 2020). Furthermore, Martin-Collado *et al*. (2021) found that age did not generally affect farmers' attitudes towards breeding in all the breeds analysed, but it was significant for certain breeds and breeding systems. This is important to consider, as our analysis does not consider a breed effect.

The results of the logistic regression of productive variables suggest that on-farm data collection differs between producer groups. Data collection on commercial farms had a statistically significant effect (P=0.005) and explained 32% of the variation in genetic tool adoption levels in this group. The odds ratio (*Exp(B)*) indicates that the odds of the event occurring were 21.66 times higher when data was collected than when it was not. Sales weight, structure, conformation and appearance data are the phenotypic traits that commercial adopting breeders prefer to record. However, scrotal circumference, weaning weight and 200-400-600 daily weights are the traits that seedstock farmer adopters prefer to record. Data collection is crucial for identifying improvement opportunities and tracking progress (Bell and Sangster 2023). However, Northern Australia's challenging environment, including remote distances, large properties with low stocking rates, and poor connectivity, makes data collection difficult.

Table 1. Logistic regression parameters of age and data Collection on farm and their effect on the adoption of genetic tools (EBVs and genomic profile) by seedstock and commercial farmers

	n	Nagelkerke R^2	B	S.E.	Sig	Exp(B)	95% C.I. for EXP(B) Lower	Upper
Seedstock farmer								
Age	43	0.15	0.06	0.03	**0.05***	1.06	1.00	1.13
Data Collection	43	0.07	1.43	0.98	0.14	4.20	0.61	28.92
Commercial farmer								
Age	53	0.14	-0.05	0.02	**0.03***	0.95	0.90	0.99
Data Collection	54	0.32	3.08	1.09	**0.005***	21.67	2.57	182.74

*Level of significance: P<0.05

Table 2. Frequencies and Chi-square test results for the association between adopting genetic tools (Adopter; Non-Adopter) and reasons for using genetic tools (EBVs and genomic profile) by farmer's group

Variable, n (%) [a]	**A n(%)**	**NA n(%)**	**p-value**
Seedstock farmer	**(n =30)**	**(n = 12)**	
I understand the genetic tool	24 (85.7)	4 (14.3)	**0.009[2]***
It's easy to use	11 (73.3)	4 (26.7)	1.000[2]
I can see the impact of using it in my herd	25 (71.4)	10 (28.6)	1.000[2]
The cost/benefit ratio is appropriate	11 (78.6)	3 (21.4)	0.719[2]
Other farmers are using genetic tools	8 (88.9)	1 (11.1)	0.247[2]
It is important for the business	24 (88.9)	3 (11.1)	**0.001[2]***
I have received advice on how to use it	9 (100.0)	0 (0.0)	**0.041[2]***
Commercial farmer	**(n =25)**	**(n = 24)**	
I understand the genetic tool	20 (69.0)	9 (31.0)	**0.004[1]***
It's easy to use	12 (52.2)	11 (47.8)	1.000[1]
I can see the impact of using it in my herd	18 (58.1)	13 (41.9)	0.244[1]
The cost/benefit ratio is appropriate	11 (45.8)	13 (54.2)	0.572[1]
Other farmers are using genetic tools	2 (40.0)	3 (60.0)	0.667[2]
It is important for the business	22 (64.7)	12 (35.3)	**0.005[1]***
I have received advice on how to use it	8 (53.3)	7 (46.7)	1.000[1]

[a]Dummy variable. Only the values for which the option was selected are displayed. A: Adopter. NA: Non-Adopter. [1] Pearson's Chi-squared test, Level of significance: P<0.05; [2] Fisher's exact test, Level of significance: P<0.05.

Producer's preferences. For the seedstock farmer group, 88.37% of participants reported that they recorded data, however, only 42.1% selected recording birth weight. Associations were found between the adoption of genetic tools and on-farm recorded data such as scrotal circumference (P=0.031), birth weight (P=0.002), weaning weight (P=0.012) and 200/400/600-day weight (P<0.001). The reasons for using genetic tools that are related to the level of adoption (Adopters and Non-Adopters) are that they understand the genetic tools (P=0.009), that they are important for their business (P=0.001) and have received advice on how to use them (P=0.041). This could be an indication of the crucial and positive effect that extension activities and training systems have had in recent years in Northern Australia (MLA 2022).

For commercial famers, 74.1% indicated that they record traits on farm. However, only the structure/conformation and appearance record showed a relationship (P=0.01) with the adoption of genetic tools. For this group of farmers, the main reason for adopting genetic tools (Table 1) was that it was important for their business (69.4%, P=0.005), followed by they saw the impact on their herd (63.3%) and had an understanding of the genetics tool used (59.2%, P=0.004).

CONCLUSION

The results analysed showed that there are differences between groups of farmers in factors such as age and on-farm data collection in the probability of adopting genetic tools. Other variables analysed had no effect on the probability of adopting genetic tools. The results also show that the reasons for adopting genetic tools are associated with understanding economic motivations and the traits of the animals that farmers prefer. It is crucial to design extension strategies that consider the collection and interpretation of data on economically important traits, differentiating between commercial and stud farmers. Future research could be undertaken to determine the preferences regarding the training and extension systems preferred by farmers.

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