# Key drivers of profitability within north Australian beef breeding businesses

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## Introduction

Profitability of Northern Australia beef breeding businesses is highly variable and influenced by many factors, including seasonal conditions, markets, location, and management decisions. Understanding the impact different factors have on profit helps producers make confident decisions that improve business performance and build resilience. Historically, these relationships have often been estimated using herd models. Bush AgriBusiness assists beef businesses to systematically capture business and herd performance data, critically analyse it, and provide insights for improvement. This paper presents the results from a machine learning approach to identify the key drivers of herd income from annual business performance data across 42 northern beef breeding enterprises.

## Methods

Long term annual performance data from 42 northern beef breeding enterprises (27 with >10 years and 15 with 6–9 years of consecutive data) were analysed. Key variables included enterprise size (animal equivalents, breeders, total herd), herd dynamics (annual change in female, male, and total herd numbers), purchase and sale parameters (average liveweight, price, and number of animals by sex), reproductive rate, mortality, and herd productivity. Annual business income (gross profit per animal equivalent) was used as the dependent variable. Gross profit is the net income of the enterprise; annual sales of the enterprise, less purchases plus/minus the value of the herd increase/decrease each year. Gross profit per animal equivalent is effectively a measure of income generated for each unit of grass consumed. LASSO regression was employed to identify the variables most strongly associated with enterprise income while controlling for multicollinearity among predictors. The impact of identified income drivers were subsequently re-estimated using ordinary least squares (OLS) and a fixed-effects panel data model to obtain unbiased coefficient estimates and assess within-enterprise effects over time. All statistical analyses and model estimations were conducted in R (version 4.4.1).

## Results

LASSO regression identified nine key parameters for breeding herd income. Using these variables, the fixed-effects panel regression model demonstrated strong explanatory power ($R^2 = 0.85$, $p < 0.001$) across the 42 businesses. Productivity (kg/AE) was the strongest predictor of income ($p < 0.001$). Male sale price ($p < 0.001$), female sale price ($p < 0.001$), and proportion of male sales ($p < 0.001$) were highly significant drivers. Reproductive performance, male sale weight, and the change in male sales proportion also positively influenced income, while female purchases and male purchase weights showed negative associations with herd income. Mortality was strongly correlated with productivity and was included when productivity was excluded from the model.

## Discussion and conclusion

These results demonstrate that productivity (kg/AE) is the paramount driver of income in northern beef breeding businesses, emphasising the importance of efficiently converting feed resources into saleable product. Reproduction was highlighted as a fundamental determinant through its effect directly, and indirectly via male sale volumes. Price realisation for both males and females emerged as critical factors, highlighting the significance of marketing decisions and market timing. The negative association between female purchases and income highlights the financial cost of herd rebuilding, reinforcing the importance of maintaining land condition and feed resources to avoid destocking breeding females during adverse conditions. These findings identify key areas for management focus to improve business profitability and long-term sustainability.

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