Comparing the use of dry matter intake and residual feed intake to improve feed efficiency in Holstein cattle

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Introduction

- Feed accounts for over **50%** of on-farm costs
- Animals with high genetic potential for production eat more
- More efficient cows have potential to decrease feed costs while maintaining production
- Selection on feed efficiency has been successful in other species:
  - Poultry
  - Swine
  - Aquaculture

Beever et al., 2007; Hemme et al., 2014; Connor, 2016.

Objective

Compare the use of DMI and RFI to improve feed efficiency in Holstein cattle through deterministic modeling

Scenarios

Base Index:

$$BASE = b_1(FY)+b_2(PY)+b_3(BCS)+b_4(STAT)+b_5(AFS)+b_6(FSTC)+b_7(CK)+b_8(DA)$$

DMI Index:

$$DMI = BASE + b_9(DMI)$$

RFI Index:

$$RFI = BASE + b_9(RFI)$$

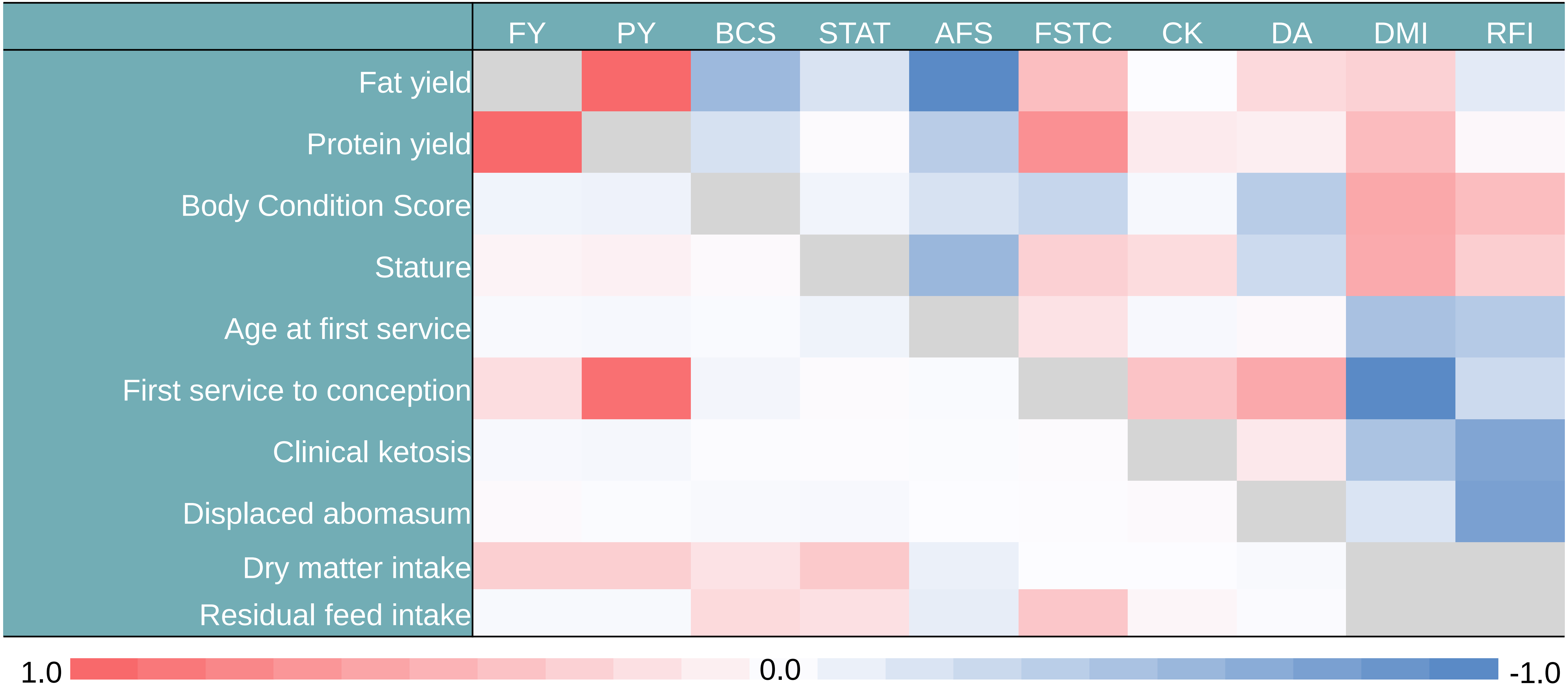
FY = fat yield, PY = protein yield, BCS = body condition score, STAT = stature, AFS = age at first service,
FSTC = first service to conception, CK = clinical ketosis, DA = displaced abomasum,
DMI = dry matter intake, RFI = residual feed intake

Parameters

Trait	Number of Records	σ_p	h^2	Genomic Accuracy
Fat yield (kg)	456,939	61.91	0.32[b]	0.80
Protein yield (kg)	456,939	47.03	0.27[a]	0.79
Body condition score (score)	391,319	0.36	0.24[b]	0.77
Stature (cm)	391,319	3.48	0.46[a]	0.77
Age at first service (days)	495,022	54.22	0.05[a]	0.69
First service to conception (days)	399,339	46.34	0.03[a]	0.74
Clinical ketosis (case)	101,374	0.21	0.04[a]	0.61
Displaced abomasum (case)	239,257	0.15	0.02[a]	0.59
Dry matter intake (kg/day)	1,909	2.45	0.49[a]	0.59[1]
Residual feed intake (kg/day)	1,595	2.25	0.28[b]	0.40[2]

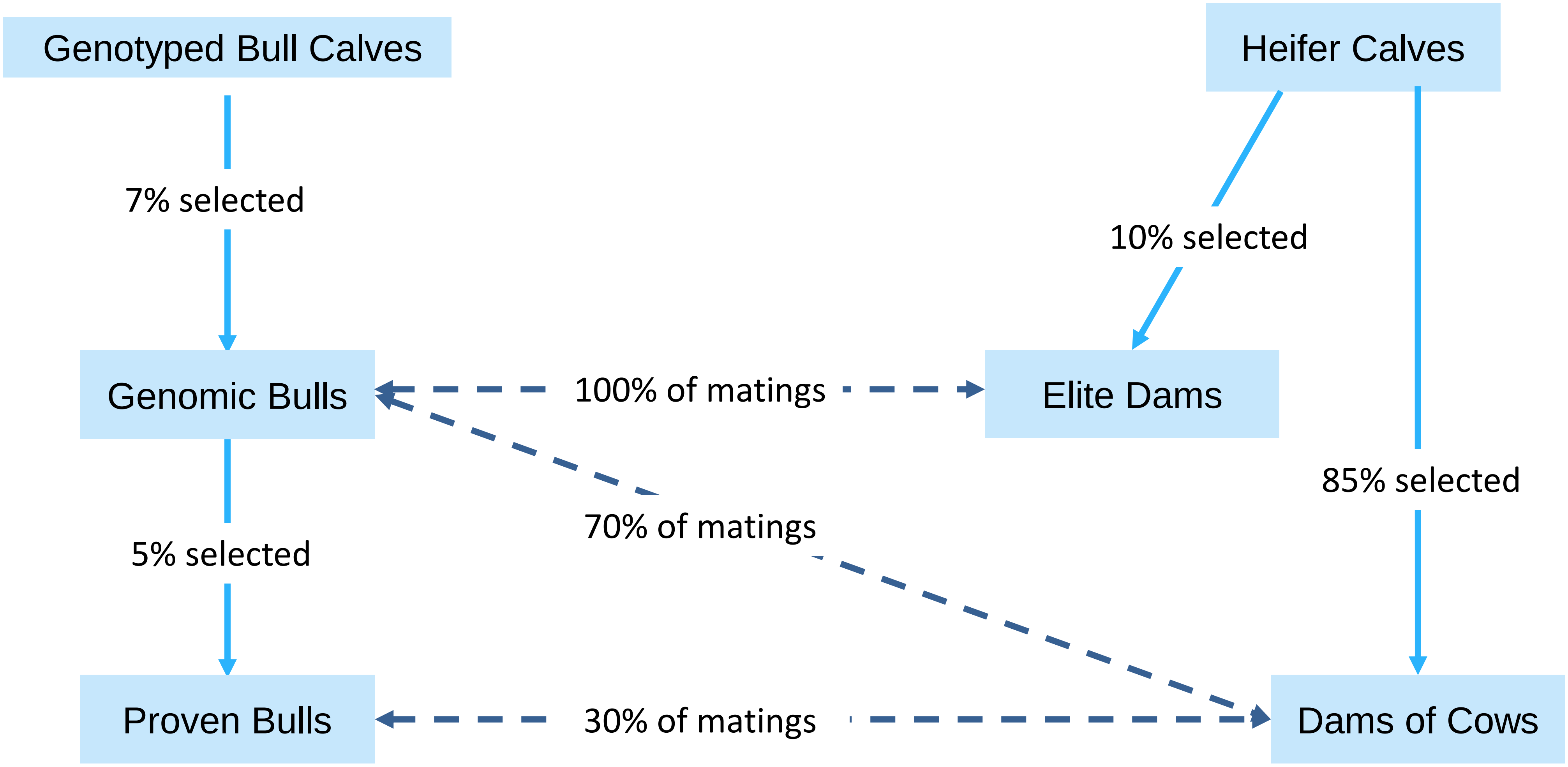
[a]Standard deviation < 0.10 [b]Standard deviation < 0.10 [1]*Miglior et al., 2018*, [2]*Pryce et al., 2014*

Correlations



Genetic correlations (above diagonal) and phenotypic correlations (below diagonal)

Breeding Structure



Trait Response to Selection

	FY kg	PY kg	BCS score	STAT cm	AFS days	FSTC days	CK case	DA case	DMI kg/day	RFI kg/day
BASE	14.68	9.44	0.00	0.05	-2.49	1.23	0.00	0.00	-	-
DMI	14.63	9.59	-0.01	0.05	-1.80	1.76	0.00	0.00	0.03	-
RFI	14.85	9.60	-0.01	0.05	-2.39	1.31	0.00	0.00	-	0.05

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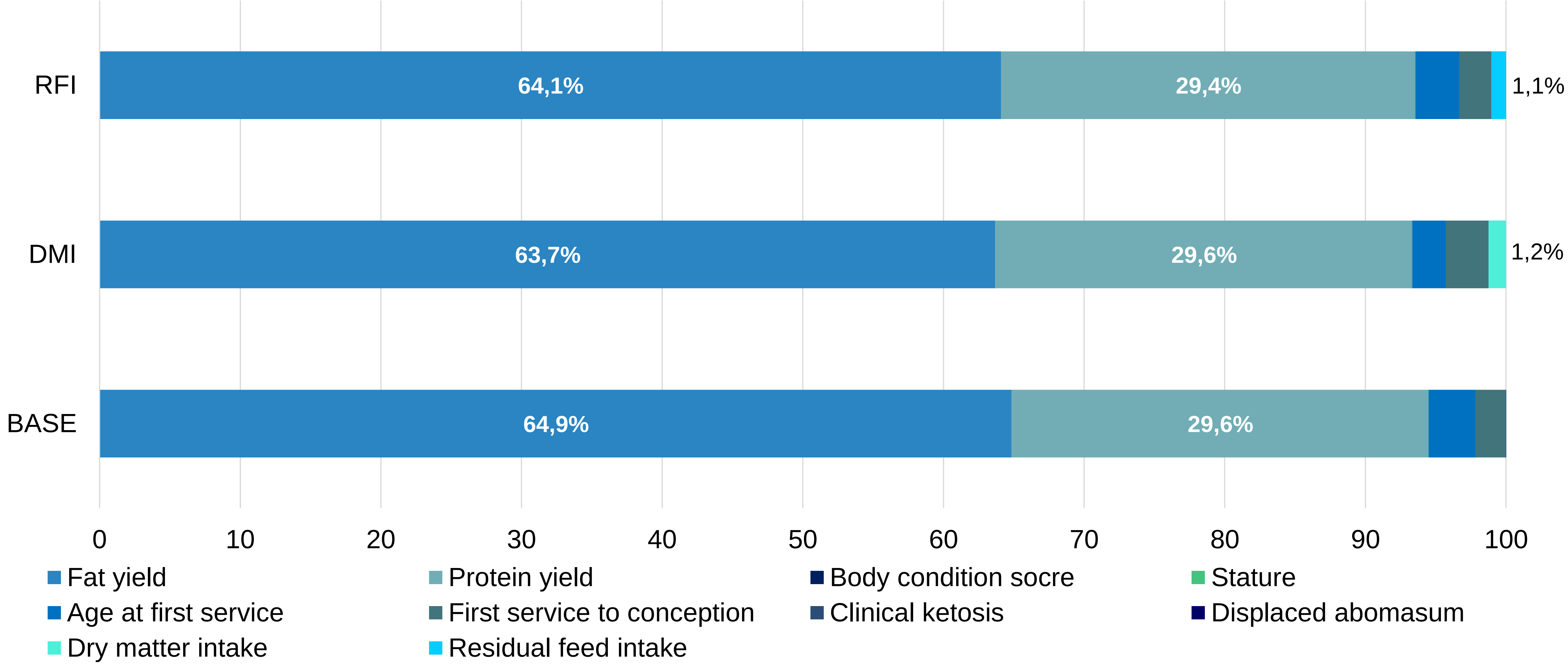
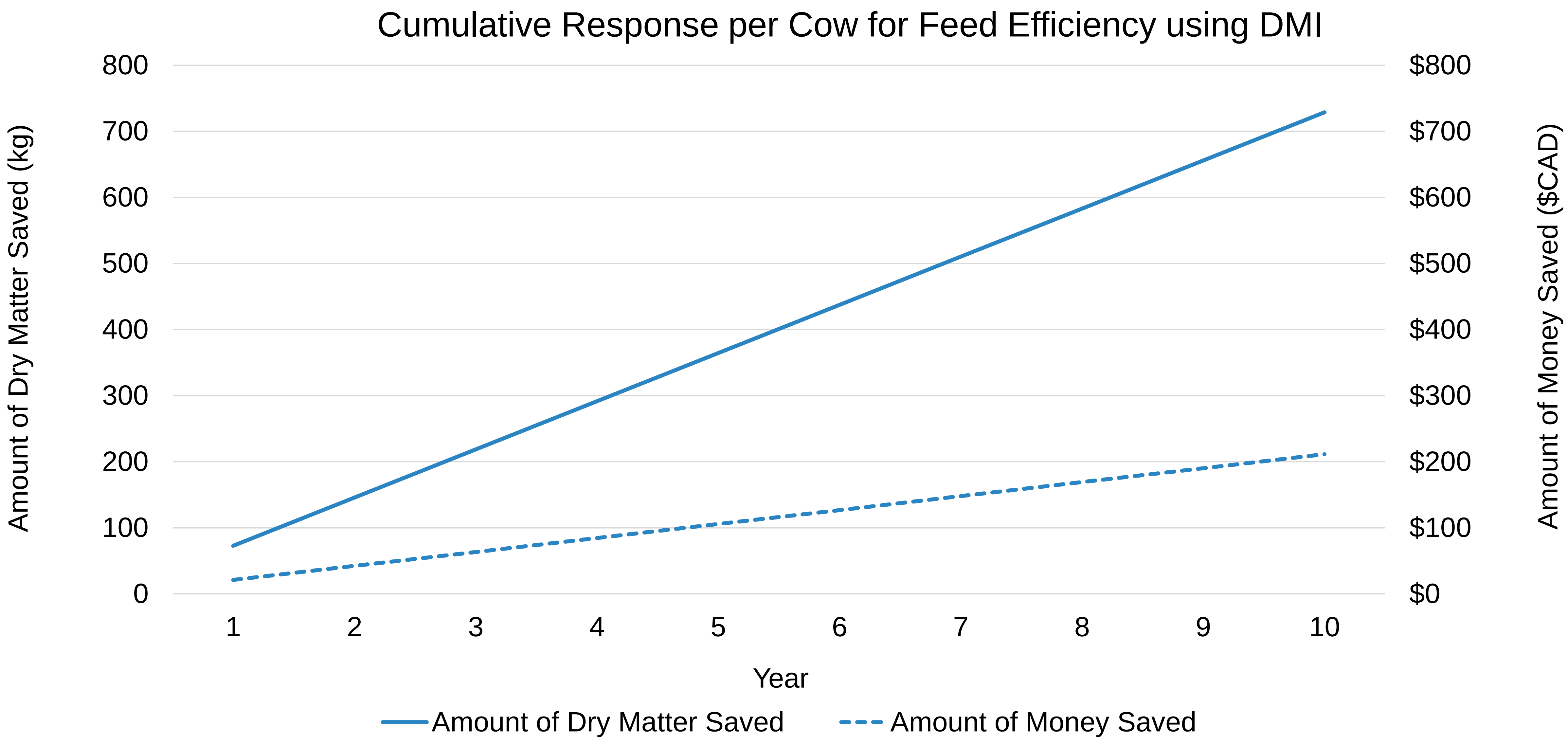
DMI = dry matter intake, RFI = residual feed intake

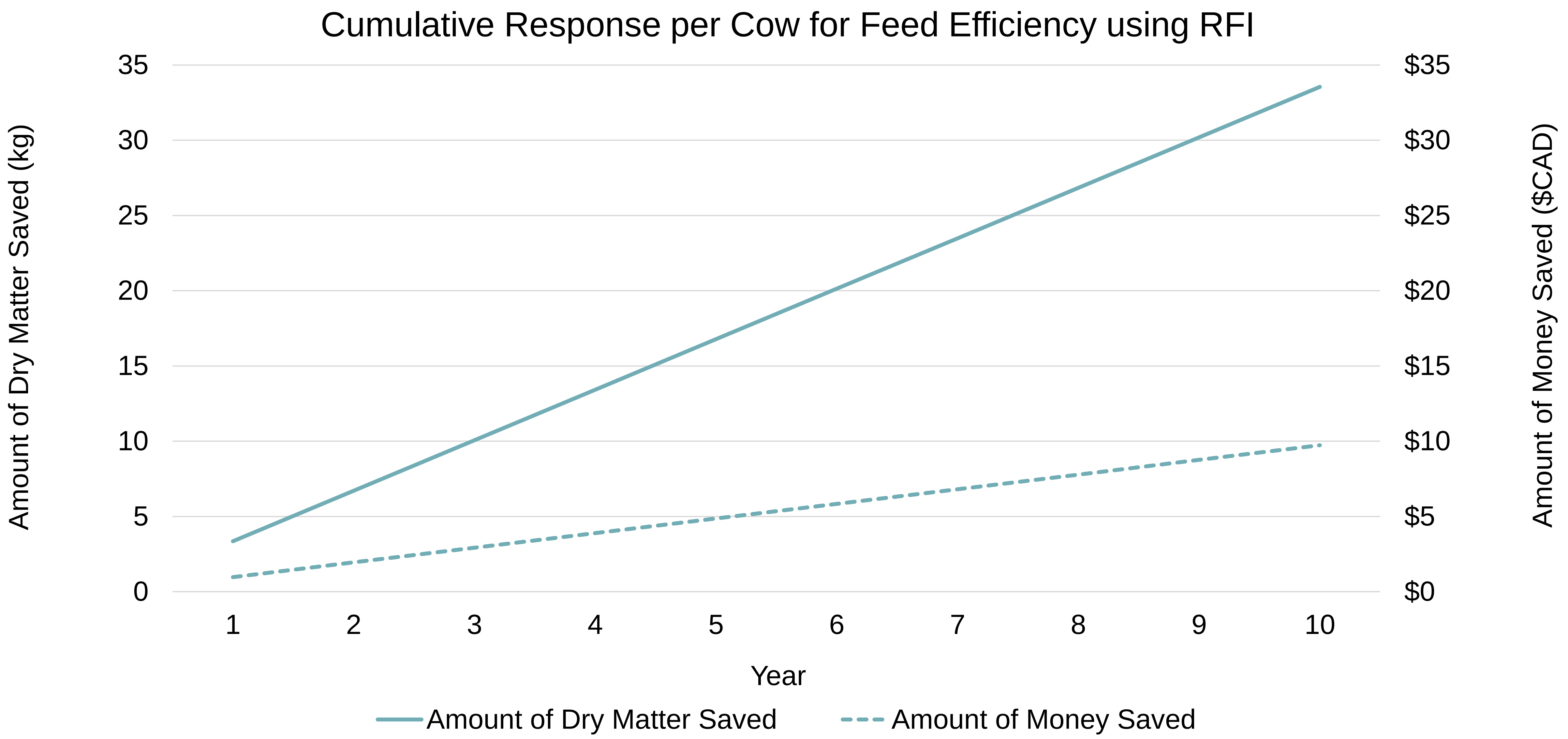
Proportion of Response to Selection



Projected Response to Selection



Projected Response to Selection



Conclusions

- Selecting on DMI or RFI will improve feed efficiency
- Improving feed efficiency does not show detrimental effects on other traits
- Increasing the weight on RFI could result in a similar response to selection as DMI

Acknowledgements

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