ICAR-Interbull conference April 26th-April 30st, 2021.

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COUNCIL ON DAIRY CATTLE BREEDING

Improving dairy feed efficiency, sustainability, and profitability by impacting farmer's breeding and culling decisions.

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Introduction

- Increases in consumption of dairy products and population will translate into a need for approximately 600 billion kg more milk in 2067, compared with today's production

- This growth in global consumption of dairy products might be constrained primarily by environmental challenges

- Need of tools that farmers and their advisers can use to achieve their environmental sustainability goals in an economically viable and socially sustainable manner

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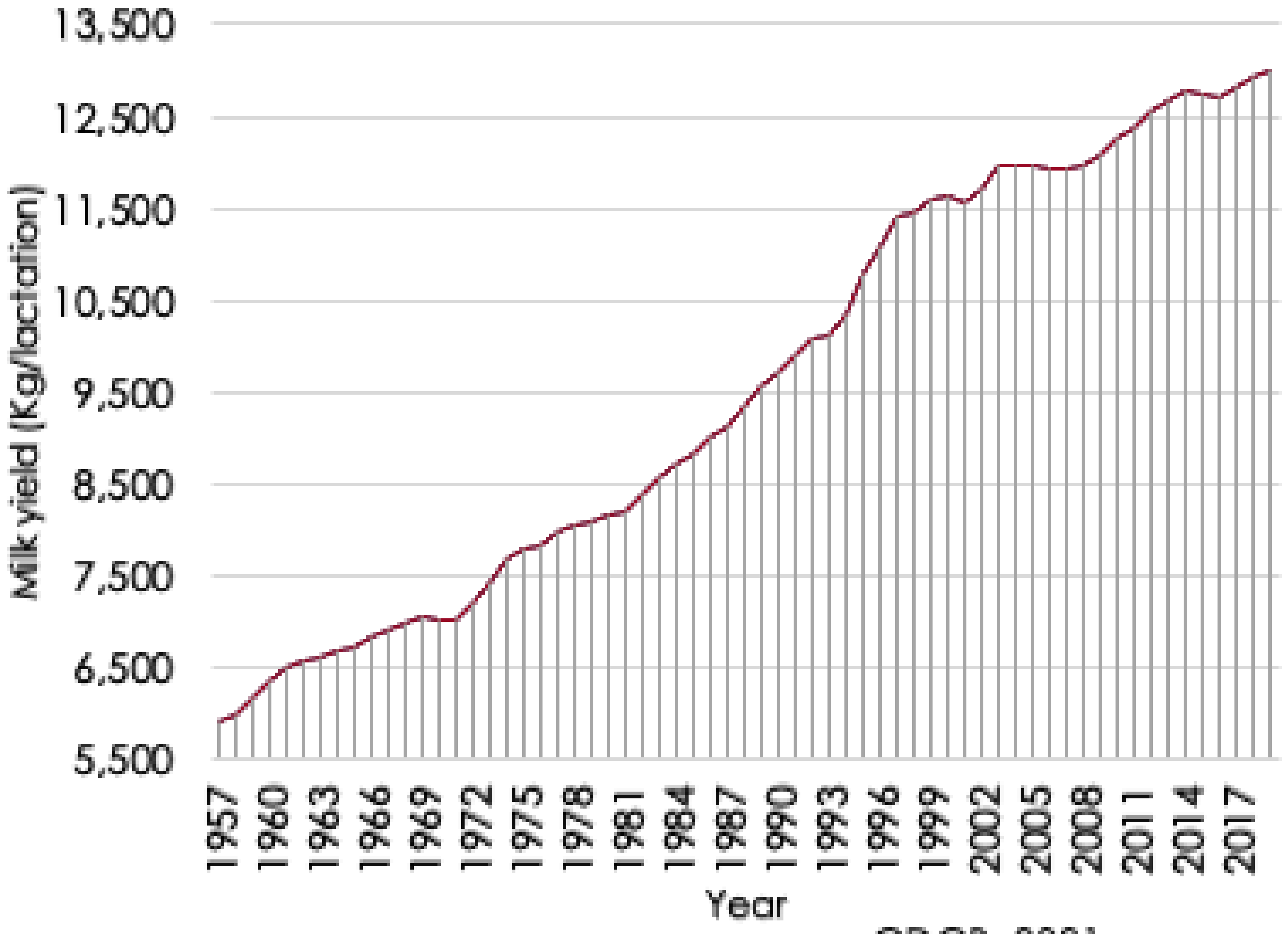
- Genetic selection: remarkable and permanent gains in the yield and efficiency in livestock production.

- US Holstein cows born in:
  - 1957 = 5,904 kg/lactation
  - 2019 = 13,015 kg/lactation



CDCB, 2021.

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Introduction

Genetic selection has been revolutionized by genomic selection coupling:

Low cost animal genotyping stored in large repositories housing thousands of DNA samples from dairy bulls

with

Milk-recording databases with millions of performance records from their progeny

Genetic progress in dairy cattle has increased dramatically over the past decade

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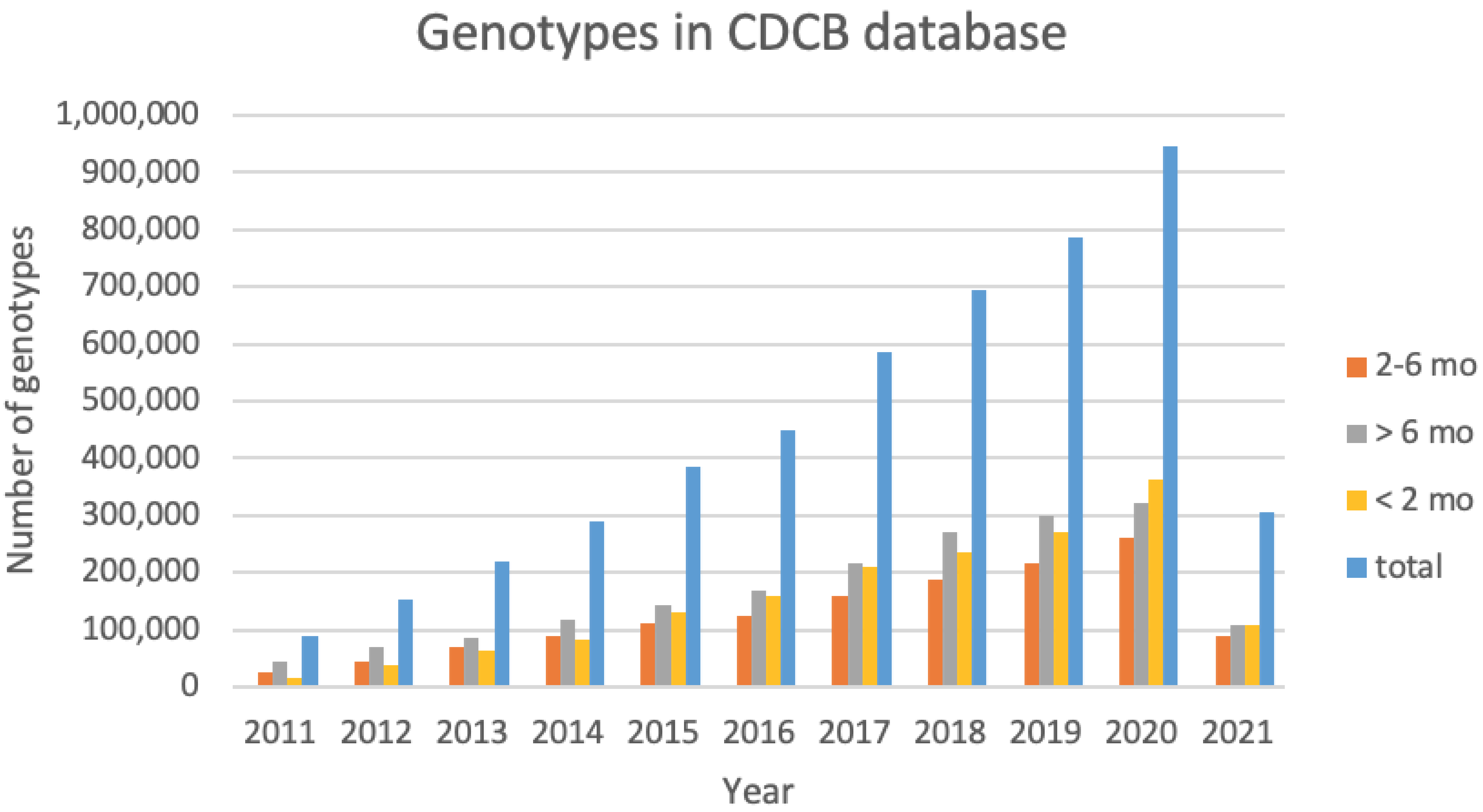
Introduction

- US dairy farmers use genomic testing on >40,000 calves per month.
- CDCB database, contains more than 5 million dairy genotypes.



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Improving feed efficiency through breeding programs

Reference population:
Performance data + Genomic testing data

\+

Genotypes from the national population with genomic test results but without performance data for feed efficiency

↓

Prediction equations

↓

Genomic Estimated Breeding Values (GEBV)

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Introduction

- Genetic selection for higher milk production has increased efficiency of energy utilization in dairy cattle. However, variation among cows in the ability to digest and metabolize nutrients and perform maintenance functions has not been exploited in genetic improvement programs yet,

- Residual Feed Intake (RFI) has been identified as an indicator of feed efficiency that could be used in genetic improvement programs

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Introduction

- Residual Feed Intake (RFI) is a measure of the amount of feed energy a cow consumes each day relative to her expected energy requirement,

- Recent studies show that selection for Residual Feed Intake (RFI) is feasible, and that low RFI values selection might impact feed costs and farm profitability.

Davis et al. 2014; and Yao 2016

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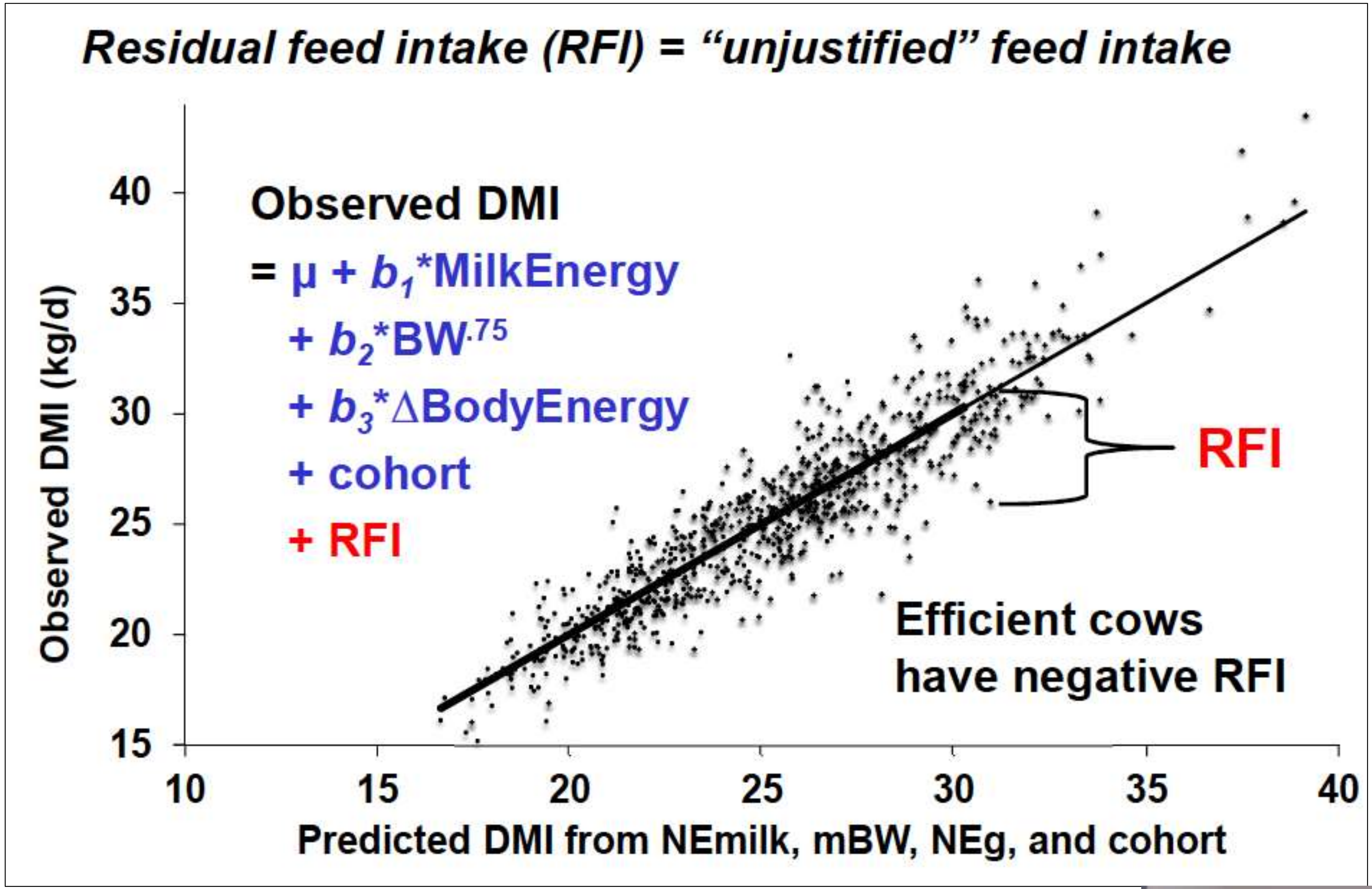
Residual Feed Intake

RFI is a measure of the amount of feed energy a cow consumes each day relative to her expected energy requirement.
where the latter is computed from Dry Matter Intake (DMI), secreted milk energy, Body Weight (BW), and BW change measured over a period of time.



Vandehaar M J, et , al. 2016..

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introduction

- Preliminary analysis of genomic evaluation of feed efficiency for US Holsteins:

"The Top 20 % cows require 635 kg of feed less per lactation than the bottom 20%, hence RFI has economic value".

RFI has economic value

VanRaden et al., 2018; Yao 2016

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Introduction

- RFI heritability ~ 0.16 → RFI can improve feed efficiency.

- Reliability for RFI Estimated Breeding Value (EBV) =
    - 34% (phenotyped cows)
    - 13% (genotyped cows)

- Increasing prediction reliability for RFI requires collecting more feed intake data

Tempelman et al., 2015, Hardie et al., 2017, Lu et al., 2015, 2018 and 2020; VanRaden et al., 2018

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Project Goal

- The overall goal of this project is to increase the efficiency and sustainability of milk production

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Overview of Project Aims

More cows with high impact genetics on research farms

Aim 1: 3600 new DMI phenotypes

Better GEBV for feed efficiency and inclusion in Net Merit

Aim 2: Sensor and milk spectra data on >3000 cows

Aim 3: Long-term strategic planning

Long-term increases in feed efficiency and profitability

Aim 4: Estimates for methane emissions on >300 cows

Long-term increases in US dairy farm sustainability

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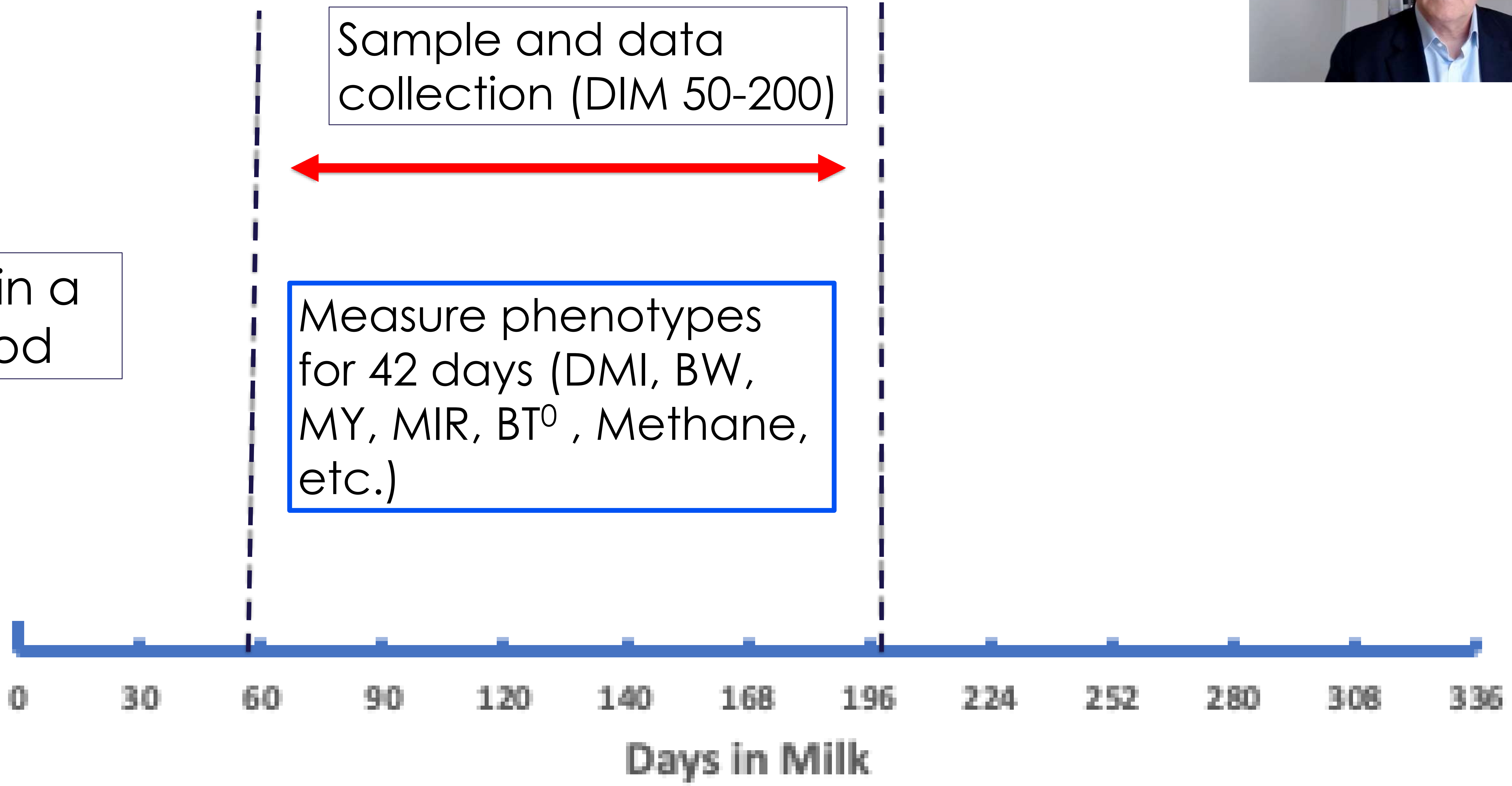
Experimental protocol

Sample and data collection (DIM 50-200)

3600 cows in a 5-year period

Measure phenotypes for 42 days (DMI, BW, MY, MIR, BT^0 , Methane, etc.)



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Results

- Up to March 2021 the CDCB-FFAR project has collected 1824 feed intake phenotypes in AGIL-USDA and in four universities participating in the project.

- Official predicted transmitting abilities (PTA) for Feed Saved in Holsteins were released by the Council on Dairy Cattle Breeding (CDCB; Bowie, MD) in December 2020.

- As of the December 2020 evaluation, 6,221 phenotypes of residual feed intake (RFI) were included from 5,023 Holsteins born from 1999 to 2017.

- Methane emissions for were measured in 81 cows .

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Results

- Publications on J. Dairy Science
- Extension articles
- Presentations and conferences
- Visibility activities (popular articles, webinars etc.)

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USDA
National Institute of Food and Agriculture

MICHIGAN STATE UNIVERSITY

FFAR
Foundation for Food and Agriculture Research

IOWA STATE UNIVERSITY

Thank you

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