iGenDec: A tool for web-based sire selection

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The global Animal Breeding and Genetics community has done a tremendous job at increasing scientific knowledge, developing selection tools, and delivering these tools to the US Beef Industry.

Despite these advancements, technology adoption is embarrassingly poor.

- < 30% of producers use EPD (Weaber et al., 2014)
Poor technology adoption is related to the sum of many underlying issues:

- Genetic prediction seems opaque
- Consultancy is often from sources other than what might be preferred
- Commercial producers do not have the needed time to excel in all areas, and focus on day-to-day animal and financial management
- Combining all partial solutions is a very cumbersome task
  - Breeding objective
  - Breeding system
  - Breed choice
  - Trait emphasis
  - Sire selection
- And all need to contemplate that which is economical and possible given environmental constraints
▪ USDA Funded CARE Grant
▪ Aim is to develop a web-based tool to aid in genetic selection decisions
▪ Initiated with an industry-wide survey in 2018
▪ Advisory board of producers (commercial and seedstock), extension faculty, breed association staff
Online Survey of Beef Producers
Fall/winter 2018-2019
1,530 respondents
- Self selected
- Nationally publicized (Breed Assn., NCBA, Extension lists, etc.)
1,161 completed survey
What is your primary position on your beef cattle operation?

- Owner: 90% of respondents
- Employee: 2% of respondents
- Manager: 7% of respondents
Age of respondents
In what kind of operation are you involved?
How many cows/heifers will you breed in 2018-2019?

![Graph showing the percentage of respondents for different ranges of cows/heifers bred. The ranges are: <25, 25-50, 51-100, 101-250, 251-500, 501-1000, >1000. The graph indicates that the majority of respondents breed 101-250 cows/heifers.](image-url)
How many bulls do you purchase each year?
State or Univ. extension specialist valuable source of genetics info?

No Response  Strongly disagree  Somewhat disagree  Neither agree nor disagree  Somewhat agree  Strongly agree

Percent of Respondents
Breed association valuable source of genetics info?

- No Response
- Strongly disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Strongly agree

Percent of Respondents
Seedstock supplier a valuable source of genetics info?

Percent of Respondents

- No Response
- Strongly disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Strongly agree
What types of information do you provide or use in selection?

<table>
<thead>
<tr>
<th>Information Type</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw measurements (actual birth weight, weaning weight, ultrasound scan data, etc.)</td>
<td>800%</td>
</tr>
<tr>
<td>Ratio data (birth weight ratio, weaning weight ratio, etc.)</td>
<td>700%</td>
</tr>
<tr>
<td>Expected progeny difference (EPh)</td>
<td>900%</td>
</tr>
<tr>
<td>Productivity of validated animals (dams, full-siblings, etc.)</td>
<td>600%</td>
</tr>
<tr>
<td>Written or verbal comments about animal by seller</td>
<td>400%</td>
</tr>
<tr>
<td>Linear marker test results NOT included in the EPD</td>
<td>300%</td>
</tr>
<tr>
<td>Selection index values</td>
<td>500%</td>
</tr>
<tr>
<td>None of the above</td>
<td>100%</td>
</tr>
</tbody>
</table>
I consider myself an early adopter of technology?
Reproduction emphasis next 5 years?

Percent of Respondents

- No Response
- Not at all important
- Slightly important
- Moderately important
- Very important
- Extremely important

Very important and Extremely important have the highest response percentages.
Carcass emphasis next 5 years?

- No Response
- Not at all important
- Slightly important
- Moderately important
- Very important
- Extremely important
Level of production data utilized

Percent of Respondents

No Response | None | Not detailed | Somewhat detailed | Very detailed

0% | 5% | 25% | 35% | 35%
What level of cost data do you maintain and use?

- No Response
- None
- Not detailed
- Somewhat detailed
- Very detailed

Percent of Respondents
How often do you use internet as source of Ag info

Percent of Respondents

- No Response
- Daily
- Less than once per week
- Never
- Once per week
- Rarely
- Twice or more daily
- Twice or more per week
Selection index provide an objective and consistent weighting of EPD enabling efficient selection among animals?
If an online decision support tool existed would you use it?

Percent of Respondents

- No Response
- Definitely not
- Probably not
- Might or might not
- Probably yes
- Definitely yes

Graph showing the distribution of responses.
I would use tool to create customized index?

Percent of Respondents

- No Response
- Strongly disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Strongly agree

No Response: 10%
Strongly disagree: 2%
Somewhat disagree: 5%
Neither agree nor disagree: 20%
Somewhat agree: 40%
Strongly agree: 25%
Selection index in a nutshell

- Tool to enable informed multiple-trait selection
- Based on:
  - Breeding objectives
  - Economic parameters
  - Relationships among traits
  - Population (herd) means
- Designed to improve commercial level profitability
Decision making process

- Develop a Breeding Objective
  - Identifies sources of cost and revenue
  - Sets goals conditioned on resources
- Identify breed(s)
- Develop a Breeding System
- Select seedstock supplier(s)
- Select bulls
  - Should align with breeding objective
Data is constantly growing
(more animals, more traits, more genotypes, sequence data)

Requires turning data into tools
This is where the global ABG community spends a great deal of time
A lot of bull sales, and a lot of bulls in each sale
Too many EPD—hard, if not impossible, to select on multiple traits simultaneously using only individual EPD
In many cases EPD are breed-specific—must convert to common base
Need to account for the value of heterosis and differences in breeds relative to average performance
Indexes exist and are provided by breed associations (and some vendors)
  Although robust they are generalizations
Increasing list of EPD

Requires turning tools into impactful decisions
Producers face the problem of obtaining the best bulls for their operation in that given setting.

‘Best’ is a relative concept.

A ‘less desirable’ bull may become the preferred choice over a ‘more desirable’ bull if his sale price discount is larger than the differential in value between the two bulls.
We have framed three possible use cases:

- Commercial buyers (genetic purchasing decisions based on firm-specific breeding objectives)
- Seedstock sellers (matching sale offering to individual customers)
- Seedstock buyers (matching genetic purchasing decisions to specified goals)
Components of customized index

- (co)Variances—literature
- Cost/revenue pricing—industry averages or user-defined
- Breed information—user defined
- Phenotypic means—industry averages or user defined
- Breeding objectives—user defined
- EPD—Uploaded (user or seedstock seller), secure API breed association
Use case

Breeding objective

Herd-level parameters

Identification of breeds/breeders

Individual selection
Nuances

- Tiered layer of input
  - Essentially generalized index
  - Reasonable knowledge of unit cost of production
- Discounted gene flow
- Discounted expression rates
- Planning horizon
- Can be used to create generalized indexes with ability to further “tweak” by members/users
Current status

▪ Alpha version with grant team
▪ Next steps
  ▪ Version to advisory board
  ▪ Key training sessions (extension personnel, breed association staff)
The impetus for this project is not the belief that currently available selection indices are so inherently flawed that they are of little value.

We believe that allowing beef cattle producers to take part in the creation of their own selection index has the potential to increase the rate of technology adoption.

The other primary improvement is in the ability to combine multiple partial solutions (e.g., additive and non-additive genetic effects) to enable sire selection across breeds in an economic framework.
Thank you