BREEDING & GENETICS · METHOD

No Farm Is Average

360° Herd Analysis, Flexi-Herd Index°, and Flexi-Mating°—the AI tools behind 360° farm-specific breeding planning

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360° Herd Analysis, Flexi-Herd Index°, and Flexi-Mating° are three complementary AI tools for farm-specific 360° breeding planning. They answer three questions in a fixed order: Where does this herd stand? Which animals align with its goals? And which bull is a good match for which cow? To date, they have been implemented and further developed on five dairy farms—Holstein, Red Holstein, and Fleckvieh, ranging from 150 to 700 head of cattle, with and without genomic data, and using both milking robots and milking parlor systems. This article describes how the tools work, what they deliver, what they cannot do, and how a farm can test them for itself.

How the Tools Came to Be

It didn't start as a software project, but rather as a practical question.

A little over two years ago, a customer told me during a seminar that he was saving about forty percent of his working time thanks to AI. At that moment, I made a decision for myself: I didn't want to be a late adopter again. So I started teaching myself how to use it.

Around the same time, after many years, I bought two breeding cattle—two Holstein calves—together with a farmer friend near Bremen. This raised a very specific question: What are these animals actually worth? My first attempt, therefore, wasn't to breed them, but to estimate their market value based on pedigree and auction comparisons. The result was significantly better than I had expected.

The first real breeding-related question came from the young female farmer at that operation: "Could AI help us select the right bull when my husband isn't home?"

This led to the first prompt—a task as a sire analyst would phrase it: Analyze this female animal based on the uploaded breeding values. Compare her exclusively with the bulls from this semen stock. Identify the most significant weakness that needs to be corrected. Suggest three bulls in order of ranking, with a justification for each bull, a traffic-light rating for each trait, and an honest note where a requirement is not met. Even this first attempt included two rules that still apply today: no external data and no estimated values.

After that, things moved quickly—from the second prompt to complete breeding reports, to our own applications, to the first pilot farms.

And then we hit a wall. A process like this is only as good as the data it receives. There was no structured access to breeding data. Everything had to be compiled by hand: from catalogs, from screenshots, from PDF files in a wide variety of formats. Without a reliable data foundation, there's no learning—and without learning, there's no meaningful mating optimization.

The breakthrough came through a contact in New Zealand.

In an article on the industry portal The Bullvine, I came across Matthew Zonderop, a dairy farmer in the Waikato region with about 400 KiwiCross cows. He had set up an AI-assisted mating program on his own—not with a purchased software package, but using data from his own herd in the New Zealand herd management system MINDA. That initial contact turned into a professional exchange that continues to this day.

What was decisive here was not so much a single idea as the confirmation of a principle: Anyone who makes their own herd data readily available can use it for breeding purposes without having to wait for a ready-made product. This is precisely the point at which the development took a turn. Individual queries to a language model led to his own data extraction from PDF documents, which in turn led to an independent database—and ultimately to a workflow that runs from breeding goals to the insemination plan, rather than starting from scratch with every question. A second independent case, different tools, the same principle.

According to his own reports, the total genomic breeding value of his herd is now well above the national average, and more than half of the current calf crop comes from the top quarter of his cows. His comment on this—that it is no coincidence which animals are selected—precisely describes the difference at stake.

The tools described in this article emerged from this sequence: a practical question, an experiment, a limitation, an exchange—and subsequently, five farms that have put the whole process to the test so far. Additional farms have already expressed interest in applying and using these AI tools in their herds.

A process like this is only as good as the data it receives.

Why the Sequence Is Crucial

In practice, breeding planning almost always begins with the question: Which bull should I use next with which cow? This is understandable, since it is the only one of the three questions that leads directly to a decision. But it is actually the third question, not the first.

There are two others that come before it. Where does my herd actually stand? And where should it be headed? Anyone who starts with step three is optimizing for a goal that no one has verified. That is precisely why the three tools build on one another: Each one provides the foundation for the next.

The underlying problem is rarely a lack of information. Today, the average dairy farm has more data on its animals than ever before—

milk production records, breeding values, pedigrees, insemination data, milking robot or herd management data, hoof care reports, and, increasingly, genomic results. This data exists side by side rather than integrated. The breeding value is in the association's portal, the milking data in the robot, and the reasons for culling in the herd management program. Each source describes a different aspect of the same cow. The tools address precisely this gap.

The Process: From Farm Data to the Insemination Plan

Before we get into the individual tools, here is the practical workflow for **360°** breeding planning, as it was carried out on the pilot farms.

Step 0 – Data transfer. The farm compiles what is already available: MLP data, breeding values, pedigrees, reports from the milking robot or herd management program, and, if possible, culling reasons from several years. In practice, this takes just a few hours.

Step 1 – 360° Herd Analysis. A sober assessment of the current situation: strengths, limiting factors, culling patterns, and kinship structure.

Step 2 – Flexi-Herd Index°. Based on the analysis and a structured discussion, a measurable farm-specific breeding goal is established. Weighting of traits, mandatory criteria, exclusions, and progeny requirements. Cows, young stock, and bulls are ranked according to this goal—not according to the breed's standard breeding goal.

Step 3 – Flexi-Mating°. A well-reasoned mating recommendation with alternatives is generated for each cow.

The end result is not a data sheet, but an insemination plan—and a consolidated database of the herd, which for many farms is the first of its kind.

Tool 1 – 360° Herd Analysis

Goal: An honest assessment of the herd's status before any recommendations are made.

The herd analysis brings together what is known about each individual cow—in practice, six to eight sources that have never before been combined in a single table. Depending on the available data, the analysis examines current and lifetime production, functional traits such as fertility, health, and service life, conformation and suitability for the existing milking system, the genetic structure including cow families, sire lines, and degree of kinship, as well as culling patterns.

What the farm receives in return: an at-a-glance assessment in the form of a written evaluation report and an interactive dashboard—level, greatest strength, greatest weakness; a comparison of traits against the farm's own target values; three to five specific genetic levers for this farm; and an overview of the inbreeding situation, including risk areas and line concentration (Fig. 1).

A guiding principle here: Every statement is assigned a level of reliability. What is substantiated is labeled as such. What has been calculated is labeled as calculated. What the data does not reveal is open—not presented as a finding. Missing values appear as a dash and are never estimated. No subpopulation is considered to represent the entire herd.

From the pilot farms: A Fleckvieh farm had documented the culling of 668 cows over a period of thirteen years—not scientifically, sometimes in everyday language and dialect, but over a long period of time. The farm manager suspected that the main breeding concern lay with the legs and hooves. The systematic analysis shifted the focus more toward the udder and the suitability of individual cows for the existing milking system. Unassuming entries such as “Otherwise a good cow” proved particularly insightful. When a fundamentally high-performing cow has to be culled because individual traits do not fit the production system, this alters a breeding goal.

In another analysis, a cluster of specific problems appeared to be emerging in certain cow families. From a breeding perspective, this would have been highly interesting. Statistical cross-checking showed that the cluster could also have arisen by chance—and therefore should not form the basis for a breeding decision. Both results go hand in hand: one shows what an analysis can achieve, the other where it must remain silent.

The benefit: For the first time, the farm gains a consolidated, data-driven view of its herd’s strengths and weaknesses—not based on intuition, but on its own records. Only once the facts are identified can one assess what needs to be addressed and resolved through breeding, feeding, or management. All three approaches come at different costs.

Fig. 1: 360° Herd Analysis—interactive dashboard of a sample farm. Key metrics, RZG distribution, target conflict dispersion, and herd profile all draw on the same verified database; the navigation on the left leads from the herd overview to selection, weak points, and reports. Anonymized sample data.

Tool 2 – Flexi-Herd Index°

Goal: A ranking that reflects this farm’s breeding goal—not that of the breed.

Official overall breeding values such as RZG, GZW, or TPI combine many traits into a defined breeding goal and enable selection across an entire population. This weighting is specific to the breed. A robotic milking farm with limited rearing space and a milking parlor farm that sells breeding stock need different cows—but receive the same ranking list.

The Flexi-Herd Index° does not replace any official breeding value nor does it alter any. It takes the existing breeding values and weights them according to what the farm actually needs. Mandatory criteria act as a filter before ranking, not as a calculated weight: A bull that fails to meet a basic requirement does not appear on the list at all. It is not the animal's genetics that change—it is its significance for this farm that changes.

Applicable to three animal groups: to the farm's own cows, when deciding which animals should shape the next generation; to the farm's own young stock, when rearing spaces need to be used profitably; and to bull lists for use in the farm's own herd, regardless of the supplier.

From the pilot farms: On one farm, a very highly rated bull was found in the farm's own semen tank. According to traditional ranking, increased use of this bull would have been the obvious choice. However, for the trait that the herd analysis had previously identified as particularly relevant, he did not deliver the desired improvement. Other bulls were a better fit. This did not mean the bull was bad—it was simply a matter of two different considerations.

Two rankings of the same herd differ significantly depending on whether they are sorted by total index or by farm-specific needs. In the pilot farms, often only a few of the top twenty animals matched across the two rankings (Fig. 2).

Further testing led to perhaps the most surprising result of the work to date: of all things, the breeding values that, based on their names, should have been responsible for a farm's main problem, were not predictive there. Two completely different traits were—statistically validated and cross-checked. A breeding value is not automatically responsible for a problem simply because that is what it is called.

The benefit: The farm selects based on the traits that have been proven to be effective on its operation—rather than those that should fit based on their names. When rearing space is limited, this has an immediate economic impact: Every space occupied by one animal is no longer available to another.

ABB. 2 · FLEXI-HERDENINDEX°

Dieselbe Bullenliste, zwei Rangfolgen

Neun Bullen aus einem Bullenpool – links nach dem offiziellen Gesamtzuchtwert, rechts nach dem Zuchtziel eines Musterbetriebs.

Standard-Rangierung
sortiert nach RZG

Rang	Bulle	RZG
1	Bulle A	155
2	Bulle B	152
3	Bulle C	152
4	Bulle D	150
5	**Bulle E**	**149**
6	Bulle F	148
7	Bulle G	146
8	Bulle H	140
9	*Bulle I*	*anderes System*

Flexi-Herdenindex°
Gewichtung des Betriebs: RZR 22 % · RZS 18 % · RZM 15 % · MVH 12 % · RZN 10 % · RZG 8 %

Rang	Bulle	Score
1	Bulle A	123,1
2 ▲	**Bulle E**	**120,8**
3	Bulle D	118,6
4	Bulle C	118,6
5	Bulle F	117,4
6	Bulle B	116,7
7	Bulle G	rd. 115
8	Bulle H	rd. 111
–	*Bulle I*	*Muss-Kriterium verfehlt*

Warum Bulle E aufsteigt – seine Zuchtwerte im Kontext dieses Betriebs

Merkmal	Bulle E	Herde Ø	Zielwert Betrieb	Gewicht
RZR – Fruchtbarkeit	**117**	**107,6**	**≥ 108**	**22 %**
MVH – Melkbarkeit / Roboter	**111**	**103,5**	**≥ 110**	**12 %**
RZN – Nutzungsdauer	124	112,3	≥ 110	10 %
RZ Gesundheit	115	106,7	≥ 105	5 %
RZG – Gesamtzuchtwert	149	120,1	≥ 145	nur 8 %
Fundament	113	–	–	ohne Abzug

Bulle E ist in der RZG-Rangierung ein Mittelfeldbulle. Für **diesen** Betrieb liegt er auf Rang 2 – weil dessen begrenzende Faktoren Fruchtbarkeit und Melkbarkeit sind und der Gesamtzuchtwert hier nur mit 8 % eingeht. Die Zuchtwerte des Bullen haben sich nicht verändert. Die Frage hat sich verändert.
Anonymisierte Musterdaten. Der Flexi-Herdenindex° ersetzt keinen offiziellen Zuchtwert.

Fig. 2: The same list of bulls, two rankings. Bull E ranks 5th according to RZG—and 2nd according to this farm’s weighting. It is not the breeding values that have changed, but the question.

Tool 3 – Flexi-Mating°

Goal: To find the right bull for each individual cow without losing sight of the herd’s overall goal.

Each cow is evaluated individually: What is she lacking, what does she bring to the table, and to whom is she related? For each cow-bull combination, the system assesses the inbreeding coefficient, hereditary defects, and genetic characteristics, as well as the specific strengths and weaknesses of that cow and the farm’s requirements regarding semen type and progeny needs.

Two rules are firmly built into the system. Each cow receives several ranked suggestions with justifications—never just a single name and never the response that there is no suitable bull. And a farm-defined usage limit per bull restricts the concentration of individual lines (Fig. 3).

This second rule has a specific origin. On a Red Holstein farm, the requirements of the breeding goal had been applied so strictly as hard exclusion criteria that, in the first run, no suitable bull remained for 96 out of 101 cows. Mathematically explainable, but worthless for the farm. Today, a strict distinction is made between genuine exclusion criteria—incorrect semen type, carrier conflict, excessive inbreeding coefficient—and traits where trade-offs are considered.

What a bull's name doesn't reveal: On a pilot farm, certain combinations appeared completely unremarkable—different names, seemingly sufficient distance between the lines. Only a comparison of the ancestors revealed closer shared lineages. The ten most common ancestors together accounted for more than forty percent of the gene pool there. Kinship analysis is therefore an integral part of the mating logic and not an optional extra: an undesirable increase in inbreeding cannot be reversed in the next generation.

Born from real-world experience: A farmer objected that if the proportion of beef semen were too high, he would have no replacement heifers in two years. He was right. Today, the actual replacement need is calculated, and the proportion of beef semen is capped before insemination takes place.

The benefit: The assignment is based on clear, verifiable reasoning and can be explained right in the barn—to employees as well as to the insemination technician. A recommendation that specifies what needs to be improved, which strengths must be retained, and where the compromise lies can be technically reviewed and, if necessary, rejected with justification. A bull's name alone cannot do that.

A mathematically perfect solution is worthless if it doesn't work in the barn.

ABB. 3 · FLEXI-MATING®

Auszug aus einer Anpaarungsempfehlung

Je Kuh drei rangierte Vorschläge – mit Begründung, ausgewiesenem Kompromiss und Inzuchtprüfung für genau diese Paarung.

Musterbetrieb · Zuchtziel: funktional / robotertauglich · Reihenfolge: Betriebsprofil → Zuchtziel → Bullenauswahl → Anpaarung · Drei harte Ausschlüsse: Spermatyp, Defektträger, scharfe Inzucht – alles Übrige wird abgewogen

Kuh	Kategorie	Abzusichernde Schwäche	1. Wahl	Warum dieser Bulle	Erfüllt nicht / Kompromiss	2. Wahl	3. Wahl	Inzucht (1. Wahl)
ZUCHTSPITZE · gesext + ET								
Kuh 192 RZG 142 · RZD 91	Zuchtspitze	Melkbarkeit / Roboter	**Bulle E**	Korrigiert Melkbarkeit und Robotertauglichkeit; stark in Nutzungsdauer (RZD 115) und Fruchtbarkeit (RZR 117) – beides Zielmerkmale des Betriebs	—	Bulle B	Bulle D	● 2,1 % · grün
Kuh 180 RZG 141 · RZD –	Zuchtspitze	—	**Bulle A**	Höchster Gesamtfortschritt im Pool; stark in Zellzahl (RZS 126) und Nutzungsdauer (RZN 128)	Fundament unter dem Zielwert des Betriebs (102 statt ≥ 108) – bewusster Kompromiss, da die Kuh hier selbst stark ist	Bulle E	Bulle C	● 1,6 % · grün
ELITE-NACHZUCHT · gesext								
Kuh 103 RZG 139 · RZD 94	Elite-Nachzucht	Melkbarkeit / Roboter	**Bulle E**	Gleiche Korrektur wie oben; Einsatzlimit des Bullen im Betrieb noch nicht ausgeschöpft	—	Bulle B	Bulle D	● 2,4 % · grün
Kuh 140 RZG 136 · RZD 93	Elite-Nachzucht	Eutergesundheit	**Bulle A**	Deutlichste Verbesserung der Zellzahl im verfügbaren Pool (RZS 126 gegenüber 108 der Kuh)	Fundament unter Zielwert; Fruchtbarkeit nur auf Herdenniveau	Bulle C	Bulle F	● 4,8 % · gelb – prüfen
GEBRAUCHSKREUZUNG · gedeckelt auf den berechneten Nachzuchtbedarf								
Kuh 217 RZG 96 · RZD 88	Gebrauchskreuzung	— (keine Nachzucht vorgesehen)	**Fleischrasse**	Kuh trägt nicht zur Remonte bei; Anteil bleibt innerhalb des berechneten Limits von 35 %	—	—	—	nicht relevant

Anonymisierte Musterdaten. Jede Kuh erhält mehrere rangierte Vorschläge – nie nur einen Namen und nie die Antwort, es gebe keinen passenden Bullen. Der Fleischsperma-Anteil wird gegen den tatsächlichen Nachzuchtbedarf des Betriebs gerechnet, bevor besamt wird.

Fig. 3: Excerpt from a mating recommendation—three ranked suggestions per cow, each with a rationale, an identified compromise, and an inbreeding assessment for that specific mating.

What Connects the Three Tools

The real difference from individual evaluations lies not in the tools themselves, but in how they are linked. Each step passes its result on to the next in a structured manner: the weighting of traits, the mandatory thresholds, the areas for improvement, and the need for replacement stock. Nothing is retyped; nothing is entered twice. From the breeding goal down to the individual cow-bull combination, it remains clear why a recommendation looks the way it does.

Equally important is the separation of levels. Weighting, standardization, and ranking are calculated deterministically and reproducibly—not generated linguistically. Relative and absolute values are treated differently in this process; a simple addition would be technically incorrect. Bulls from different breeding systems are evaluated separately and marked as “transferred,” never mixed together in a common ranking list. This is the practical difference between systematic breeding planning and asking a chatbot:
“Which bull would you choose?”

Artificial intelligence plays a clear, limited role in this process. It helps consolidate large and highly diverse datasets, reveal correlations, and present results in an understandable way. It does not know the operation firsthand, it bears no responsibility, and it must not declare a conjecture to be a finding simply because it sounds plausible. The data describes the herd. The computational models structure and compare it. The breeder decides.

What the pilot farms have shown—and what remains to be seen

In four out of five farms, the analysis revealed at least one finding that no one had anticipated. At one farm, the result of the bull selection process showed that the existing semen stock largely covered upcoming needs, with a gap in only one area—so an extensive shopping list wasn’t necessary. In nearly every analysis, there were also strengths identified at the outset that the farm manager wasn’t even aware of—strengths that could be lost without notice while optimizing another trait.

Just as often, it wasn’t the farm that needed to rethink its approach, but rather the calculation logic that needed to be adjusted. One breeder felt that an exclusion rule was too strict—it would have weeded out bulls she considered suitable based on her experience. She was right; the strict minimum requirement was transformed into a target range with an upper limit. Another breeder warned against creating an increasingly uniform herd through excessive optimization. That was also true: one rule favored versatile bulls so strongly that it excluded precisely the specialists who could have corrected a specific weakness. It was replaced. A farm manager simply asked where a particular number came from—and in doing so uncovered a system that linked animals by name rather than by ear tag numbers. Since then, animals have been linked exclusively by their life numbers.

To be honest, some aspects have not yet been verified. The first calves mated using this method have not yet been born. Five farms and the observation period to date are not sufficient to make a reliable statement about additional breeding progress. That is why expectations are documented from the very beginning—otherwise, nothing can be compared later. The next step in development is validation using larger real-world datasets. Especially with AI applications in animal breeding, professional integrity requires distinguishing between what works today and what still needs to be proven.

It is not the algorithm that determines whether the method is effective. The cows show it.

Which Farms Will Benefit

Breeding Planning 360° is not only intended for farms with an obvious problem. The approach is of interest wherever existing data, breeding goals, and concrete decisions need to be more closely linked. Based on the analyses to date, three starting points can be distinguished.

- **First: unresolved issues in the herd.** Cows are culled earlier than desired, and the causes are unclear. More heifers are being raised than will be needed in the long term. Or it is unclear which animals should have a particularly strong influence on the next generation. This is the most obvious reason—and the one where a farm's own data most often reveals surprises. The Fleckvieh farm with 668 documented culls identified its main area for improvement in a different place than its own records indicated.
- **Second: operational changes.** The introduction of an automated milking system, a planned herd expansion, a shortage of rearing space, a higher proportion of sexed semen or inseminations with beef breeds, or a realignment of breeding goals. Such changes shift the demands placed on the cow—and thus the question of which genetics will suit the farm in the future. Breeding takes time: Anyone who realizes only after the transition that their breeding goal is still the old one has lost a generation.
- **Third: systematic further development.** Herds in which many bulls and lines have been used over the years—and in which pedigree, kinship, genetic concentration, and the existing semen supply should be considered in context—especially when genetics from different suppliers or breeding systems are used. And this explicitly includes farms that are already well-positioned in terms of breeding. Not every analysis has to identify a weakness. It can confirm that a strategy is working, and it can highlight strengths that the farm manager wasn't even aware of—which was exactly the case in nearly every pilot analysis. Those who recognize these strengths can consciously preserve them in their next selection decision, rather than losing them unnoticed while optimizing another trait.

Across all three starting points, the same questions ultimately arise:

- What traits actually define my best cows in terms of economic and functional performance?
- Which animals should shape the next generation—and which young cattle should I keep when space becomes limited?
- Which traits are limiting my herd, and can they even be influenced through breeding?
- Do the bulls I'm using today align with my farm's breeding goals—and does my semen supply meet future needs?
- How broad is my genetic base, and where do inbreeding risks arise?
- What kind of cow will my farm need in five or ten years?

Not every farm needs the same level of detail for this. The analysis depends on the specific questions and the data actually available. A fully genotyped herd opens up different possibilities than a herd for which primarily performance, pedigree, and culling data are available. Both can be evaluated.

The key point, therefore, is not whether a farm has a problem, but whether it wants to base its breeding decisions on a clearer, farm-specific foundation.

Seeking Additional Pilot Farms

Following the first five herds, the project is moving into its next phase. We are seeking additional dairy farms, explicitly across all breeds: in addition to Holstein, Red Holstein, and German Fleckvieh, Brown Swiss and Jersey herds are also eligible.

We are looking for completely normal farms with varying starting points, breeding goals, sizes, and data sets: farms with and without comprehensive genomics, robotic milking operations as well as conventional milking systems, breeding-oriented herds as well as traditional production farms. A farm without a single genotyped cow was one of the most challenging cases in our work to date—yet it was still analyzable because actual performance data, milking system data, pedigrees, and culling records filled in the gaps.

The farm receives a comprehensive analysis of its herd, a farm-specific breeding goal, its own ranking, and concrete mating recommendations—as well as the tools it needs to continue working independently afterward. In return, the farm's feedback is directly incorporated into further development. This is how every significant improvement to date has come about.

An initial consultation serves only to clarify the specific needs and the existing data set—before anyone even starts talking about bulls.

A GLANCE AT THE THREE TOOLS

360° Herd Analysis – Assessing the Current Situation

Where does the herd really stand? Which strengths need to be preserved, which factors are limiting it, and which of these can be influenced through breeding?

Basis: MLP, breeding values, pedigree, milking system and herd management data, culling patterns, genomic data, and other relevant information where available.

Flexi-Herd Index° – Goal Setting and Ranking

Which animals and which genetics align with this farm's breeding goal? Farm-specific weighting based on the defined herd breeding goal and official breeding values, with mandatory criteria serving as an initial filter.

Applicable to: the farm's own cows, the farm's own young stock, and bull lists regardless of the provider.

Flexi-Mating° – Individual Mating

Which bull is a good match for which cow—and why? Multiple ranked suggestions per cow with justification, inbreeding assessment per mating, and farm-specific usage limits per bull.

Factors considered: cow profile, herd goal, kinship, hereditary defects, semen type, and

progeny requirements. Independent of suppliers and breeding organizations.

Further information: www.dairytalk.info/zuchtplanung-360

ABOUT THE AUTHOR

Helmut Demmelhuber is a management consultant and Holstein breeder. His focus is on AI-supported herd analysis and breeding planning. He develops the tools Herd Analysis 360°, Flexi-Herd Index°, and Flexi-Mating° for farm-specific and provider-agnostic breeding planning.

All farm, person, and animal names in this article have been anonymized. The examples cited are taken from completed analyses from the year 2026.

www.dairytalk.info

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