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Optimization of mating plans and breeding strategies on a cattle example

Modul no. 2: Conservation and Sustainable Use of Animal Genetic Resources

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Lecture plan

1. Introduction - objectives of breeding work
2. Basic stages of breeding work
3. Basic methods of cattle improvement
   3.1. Selection
   3.2. Mate selection (mating/crossbreeding)
4. The first method of cattle improvement - selection
   4.1. Selection methods used in cattle
   4.2. Key elements of breeding programs
   4.3. Paths of breeding progress implementation
   4.4. Typical course of life and productivity of breeding bulls
   4.5. Methods for assessing the breeding value of bulls
   4.6. Selection indexes used in bull selection in selected countries worldwide
   4.7. Formula for the PF index (production, functionality) in Poland

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Lecture plan

5. Second method of cattle improvement – mate selection
    5.1. Optimization of the selection of bulls for mating
    5.2. Optimization of the number of breeding bulls used in the cattle herd
6. Consequences of conducting breeding work (improvement programs) on cattle
7. Summary

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1. Introduction - objectives of breeding work

- ***The aim of breeding work*** is to transform the genetic structure of the herd in a direction consistent with human requirements. These requirements focus on improving animals in terms of performance and purpose of use.

- ***In the case of cattle, these include:***
  - ★ milk yield
  - ★ milk chemical composition
  - ★ external conformation elements
  - ★ the quantity and quality of beef

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2. Basic stages of breeding work

- Evaluation
- Selection
- Mate selection

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3. Basic methods of cattle improvement

Breeding work with cattle is conducted at two levels:

- **At the herd level** ***(through the selection of heifers and cows),***
- **At the population or breed level** ***(through the evaluation and selection of bulls).***

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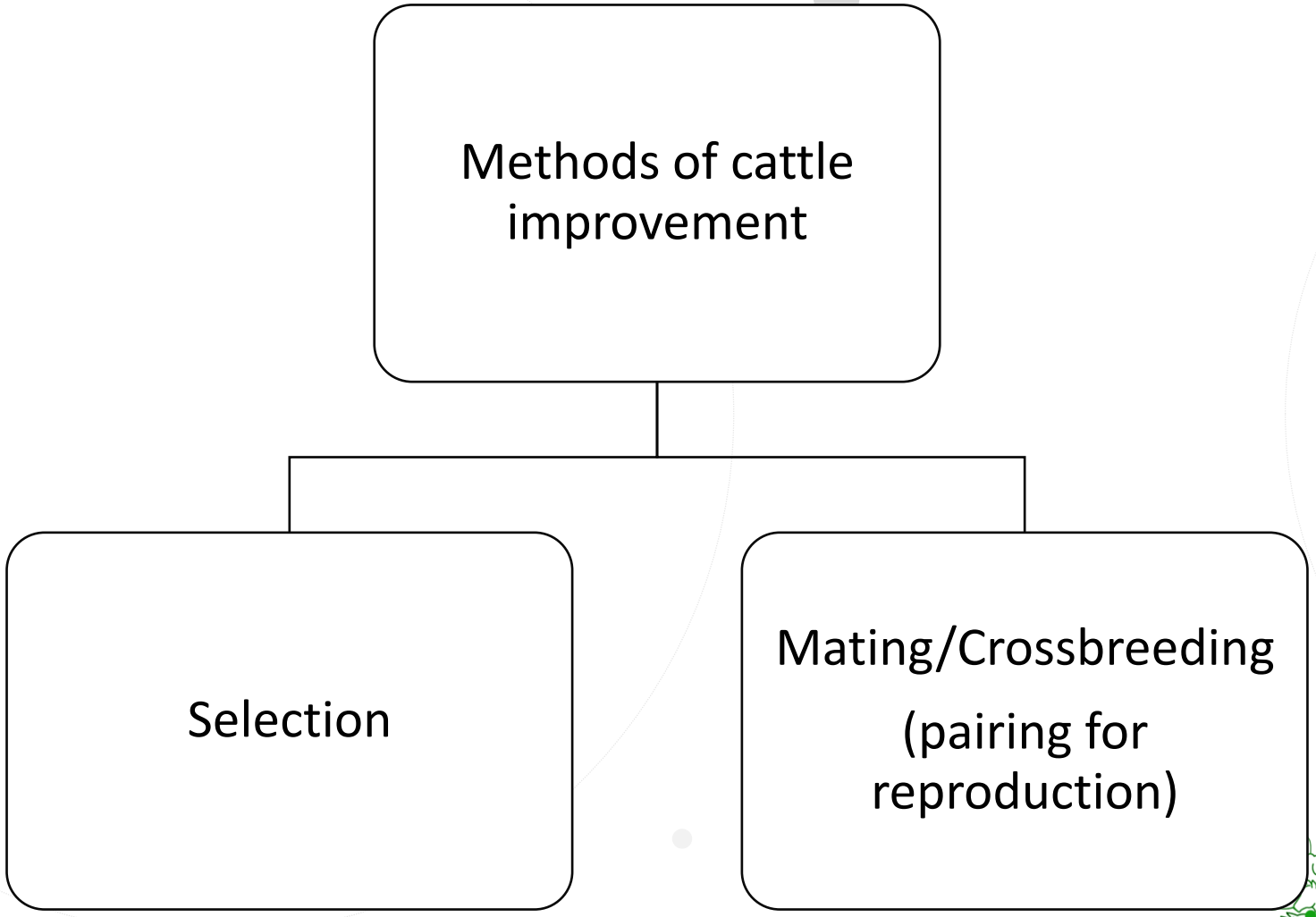
3. Basic methods of cattle improvement



Source: own elaboration

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4. Selection

The animal's genotype is formed at the time of fertilization and remains unchanged throughout its entire life.

The breeder influences it 'only' through the proper selection of the parents of a given individual.

Selection is precisely the choice of animals that will become the parents of the next generation.

Source: own elaboration

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4.1. Selection methods used in cattle

Division according to the selection criterion	Types
On the direction and intensity of selection	stabilizing
	directional
Numbers of animals subject to selection	mass
	individual
	family
The number of features taken into account in the selection	successive
	on several features at the same time
	by the total value of the features the so-called selection index

Source: own elaboration based on: Litwińczuk Z., Szulc T. (red.), 2005: Hodowla i użytkowanie bydła. Państwowe Wydawnictwo Rolnicze i Leśne, Warszawa.

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4.2. Key elements of breeding programs

- selection of bull fathers,
- selection of bull mothers,
- individual matings (father x mother bull),
- rearing of young bulls and their individual assessment (body weight, conformation),
- test insemination of approximately 800 cows: to obtain approximately 100 daughters. Semen is collected from the bull when it is 14-15 months old and used in selected herds,
- assessment of the breeding value of bulls based on daughters' performance.

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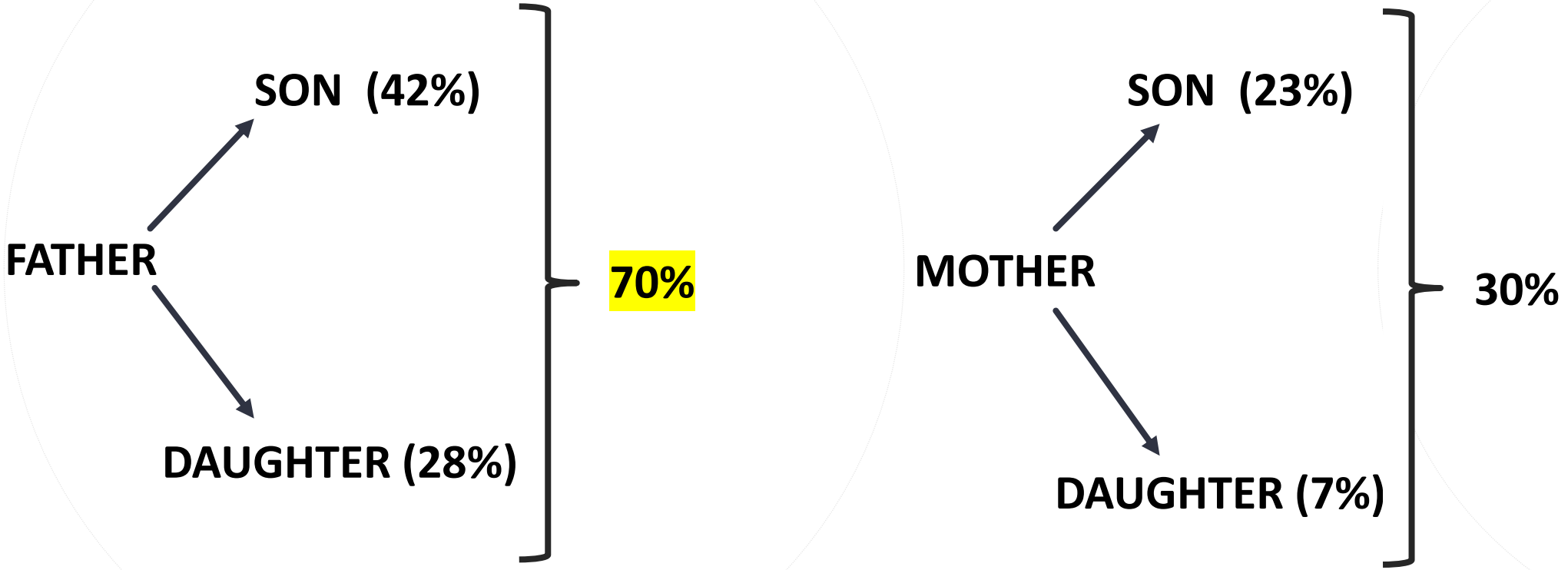
4.3. Paths of breeding progress implementation



Source: own elaboration based on: Strabel T., 2010: Programy hodowlane materiały do zajęć. Uniwersytet Przyrodniczy w Poznaniu

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4.4. Typical course of life and productivity of breeding bulls

THE BULL'S FATHER **x** **THE BULL'S MOTHER**

(meets certain criteria) x (meets certain criteria)

BULL (birth)

Rearing, evaluation and selection of bulls – from 1 month to 450 days of age (15 months)

Assessment and selection are made on the basis of:

- **own fattening capacity (weight at the age of 360 days, daily gain for the fattening period 120-360 days, height at withers at the age of 360 days)**
- **suitability for reproduction (clinical examination of reproductive organs, sexual reflexes and semen quality)**

Based on the assessment, qualifies for one of 4 classes:
A – bulls for insemination plants
C – bulls for copulation points for natural mating
T – Simmental bulls intended exclusively for commercial crossbreeding
D – bulls disqualified, to slaughter

INSEMINATION PLANTS – purchase at 450 days (15 months)

15-20 months – commencement of breeding use (test insemination)

21-70 (6 years) months semen production average 20 thousand portions per year

Over 6 years old - results of the assessment of the bull's breeding value based on the daughters' performance

Continued use until the age of 10-12 or, in the event of a negative assessment, missing

Ź Source: own elaboration

Co-funded by the European Union

4.4. Typical course of life and productivity of breeding bulls – conventional assessment

mating (sire of bulls x mother of bulls)	2013
bull birth	2014
start of the test	2015
calving of daughters	2018
bull index	2019
bull use	2019/2020
production of the second group of daughters	2023/2024

So, today is a choice results in 12 years!!!

Source: own elaboration

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4.5. Methods for assessing the breeding value of bulls

Due to the large role of bulls in genetic progress, a precise assessment of their breeding value is a very important task.

Breeding value is the genetically determined ability of an animal to transmit a specific feature or features to its offspring.

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4.5. Methods for assessing the breeding value of bulls

- Assessment based on pedigree
- BLUP Rating
- Genomic assessment

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4.5. Methods for assessing the breeding value of bulls

BLUP Rating *(BEST LINEAR UNBIASED PREDICTION)*

In the mid-1980s, due to the development of computer techniques, the BLUP method was introduced to assess the breeding value of bulls. In Poland, this assessment method has been used as the basic one since the early 1990s. In this method, the observation value for each feature is described by the following linear model :

$$Yij = ai + (qi1g1 + qi2g2 + ...qipgp) + hj + cij$$

Where :

Yij – ***deviation of the performance of the i-th cow from the population average in the j-th subclass herd-year-calving season (HYS)***

ai – ***random additive genetic effect (breeding value) of the i-th cow,***

gk – ***constant effect of the k-th genetic group (k=1,..p), p- number of genetic groups***

qik – ***coefficient (with values from 0 to 1) describing the share of the genetic group in the cow's genotype***

hj – ***constant effect of j-th herd-year-calving season***

eij – random error

The results of the breeding value of bulls are deviations from the genetic database, which in Poland is the breeding value of cb variety cows born in a selected year.

Source: own elaboration based on: Litwińczuk Z., Szulc T. (red.), 2005: Hodowla i użytkowanie bydła. Państwowe Wydawnictwo Rolnicze i Leśne, Warszawa.

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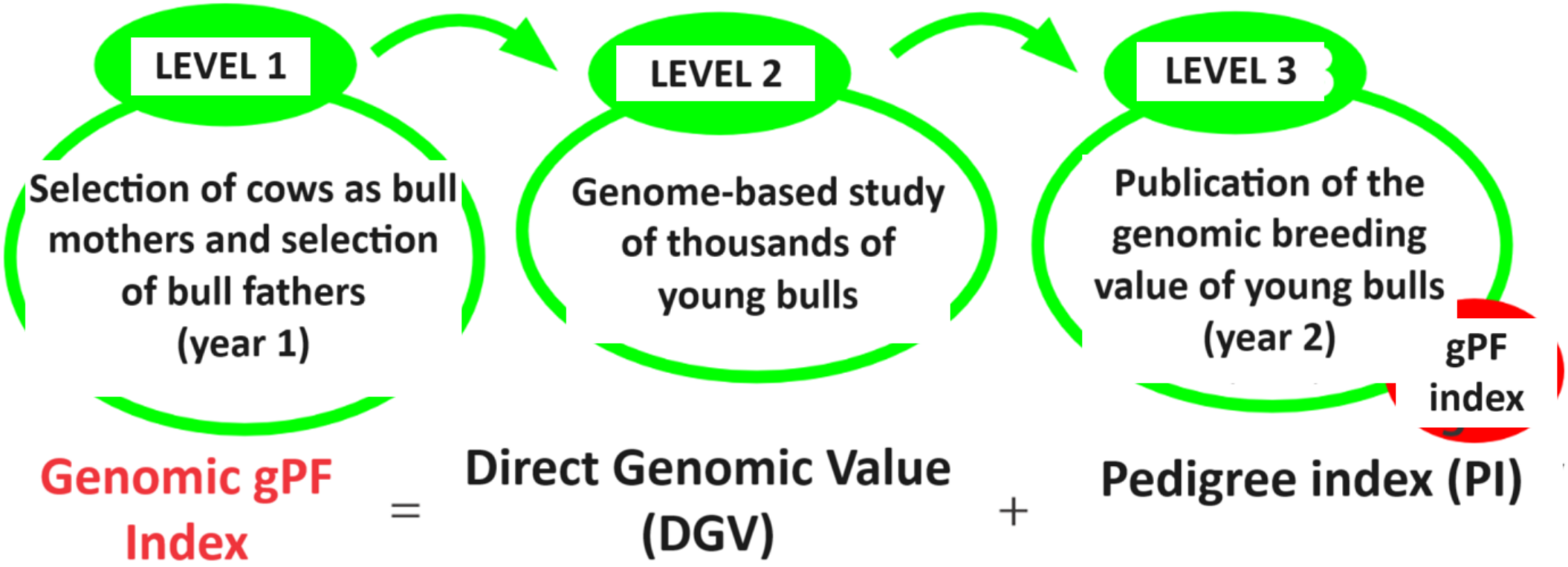
4.5. Methods for assessing the breeding value of bulls

POLISH BREEDING PROGRAM – EVALUATION SYSTEM IN GENOMIC SELECTION



Source: https://shiuz.pl/wycena-genomowa-rewolucja-w-hodowli/

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4.5. Methods for assessing the breeding value of bulls

Genomic assessment of the breeding value of bulls – advantages

- Possibility to value very young animals.
- Relatively low cost of genotyping compared to the traditional method of evaluation on offspring.
- Possibility of conducting a bull selection program without direct reference to the size of the cow population assessed for utility value, which limits the number of bulls tested.
- Increasing annual genetic progress, including: by shortening the intergenerational interval and increasing the severity of selection.
- Using the method to assess relatedness in a population or detect carriers of genetic defects.

ŹSource: own elaboration based on: Jędraszczyk J., 2010: Genomowa wartość hodowlana nowym narzędziem w doskonaleniu bydła mlecznego. Zycie weterynaryjne, 85(2), 148-150.

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4.5. Methods for assessing the breeding value of bulls

When assessing bulls based on the milk yield of offspring, the following are mainly taken into account:

- milk yield,
- fat yield,
- protein yield,
- % fat,
- % proteins,
- type and body,
- number of somatic cells.

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4.6. Selection indexes used in bull selection in selected countries worldwide

Canada

LPI (Lifetime Performance Index) = 51% Production + 34% Durability + 15% Health & Fertility

Production: Protein Yield, Protein Deviation, Fat Yield and Fat Deviation,

Durability: Herd Life, Mammary System, Feet and Legs, Hoof Health, Dairy Strength and Rump,

Health & Fertility: Daughter Fertility, Mastitis Resistance, Somatic Cell Score, Udder Depth, Milking Speed and Milking Temperament.

Source: own elaboration based on: https://lactanet.ca/en/lifetime-performance-index-lpi-formula/; https://www.dairyproducer.com/lifetime-performance-index-lpi-formula/

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4.6. Selection indexes used in bull selection in selected countries worldwide

USA

TPI (Total Performance Index) = 46% Production + 28% Health & Fertility + 26% Conformation

Production (Fat, Protein, Body Weight Composite, and Feed Efficiency)

Health & Fertility (Somatic Cell Score, Productive Life, Health Trait Index, Health Trait Index, Fertility Index, Daughter Calving Ease and Daughter Stillbirth)

Conformation (Type, Udder Composite and Feet & Legs Composite)

Source: own elaboration based on: https://www.holsteinusa.com/genetic_evaluations/ss_tpi_formula.html

4.6. Selection indexes used in bull selection in selected countries worldwide

Germany

RZG (Relativ-Zuchtwert Gesamt) = 36% Production + 18% Longevity + 18% Health + 15% Conformation + 7% Daughter fertility + 3% Calf fitness +3% Calving traits

Production (Milk yield, Fat and Protein ratio of 40% to 60%)
Longevity
Health
Conformation (20% body, 35% feet and legs, 45% udder)
Daughter fertility
Calf fitness
Calving traits

Source: own elaboration based on: opracowanie własne na podstawie: https://www.eurogenomics.com/genomic-breeding-values/german-scale.html; https://www.rind-schwein.de/brs-cattle/holstein-breeding-value-estimation-en.html

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4.7. Formula for the PF index (Production Functionality) in Poland

In Poland, the basic criterion for selecting males is the implemented new selection index PF.

The PF index formula (production, functionality) consists of:

PF = 0,4 * PI_PROD + 0,25 * PI_ POKR + 0,15 * PI_PŁOD + 0,1 * WH _KSOM +0,1 *WH_DŁUG

where:

PI_PROD – Production Index

PI_POKR – Conformation Index

PI_PŁOD – Fertility Index

WH_KSOM – Breeding Value for Somatic Cell Score

WH_DŁUG – Breeding Value for Longevity

Source: own elaboration based on: Polish Federation Cattle Breeders and Dairy Producers in Warsaw (PFCBDF), National Research Institute of Animal Production (NRIAP), 2016 – Assessment of the breeding value of PHF bulls of the black-and-white and red-and-white varieties. www.wycena.izoo.krakow.pl

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Polish list of bulls of the black and white variety ranked according to the value of the PF INDEX / rating 2023/3 (December 2023, date of publication of the rating: 06/12/2023)

Lp.	Buhaj	podindeks produkcyjny	podindeksy pokrojowe					podindeks płodności	indeks PF
		PPR	POP	PR	PSM	PNR	PW	PPŁ	IPF
1	**CHARON** DE0365122110 DEUM000365122110	154	128	112	114	112	127	116	**165**
2	**MADTIME ET** DE0542202582 DEUM000542202582	154	123	97	102	119	121	115	**165**
3	**DOLARS** DK2468006796 DNKM002468006796	141	135	108	103	114	139	116	**165**
4	**SUPERIOR** DE001269727752 DEUM001269727752	143	131	107	99	119	130	119	**164**
5	**FOKUS** NL878993871 NLDM000878993871	148	133	113	107	120	131	110	**164**
6	**DANKO CELTIC** PL005468673742 POLM005468673742	151	130	110	112	112	130	110	**164**
7	**WIL GLENN** DE000541365201 DEUM000541365201	149	136	113	113	108	141	101	**163**
8	**FACILITY** DE001505231282 DEUM001505231282	148	124	106	102	115	123	124	**163**
9	**AZURYT** NL725603252 NLDM000725603252	156	122	118	107	116	116	104	**163**
10	**SARENZO** DE000363501950 DEUM000363501950	138	143	105	108	119	146	111	**162**

Source: own elaboration based on: Polish Federation Cattle Breeders and Dairy Producers in Warsaw (PFCBDF), National Research Institute of Animal Production (NRIAP), 2016 – Assessment of the breeding value of PHF bulls of the black-and-white and red-and-white varieties. www.wycena.izoo.krakow.pl

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Polish list of bulls of the black and white variety ranked according to the value of the PF INDEX / rating 2023/3 (December 2023, date of publication of the rating: 06/12/2023)

CHARON bull - breeding value assessment results - assessment 2023/3

The best bull in the breeding value assessment in Poland in 2023

BUHAJ	
Nazwa	CHARON
Numer	DE0365122110
Numer międzynarodowy	DEUM000365122110
Data urodzenia	2022-12-03
Rasa odmiana	HO
Ojciec	RIDERCUP
Numer ojca	US003216569383
Numer międzynarodowy ojca	840M003216569383

INDEKS I PODINDEKSY	
Indeks PF	**165**
Podindeks produkcyjny	154
Podindeks pokroju ogólny	128
Podindeks ramy ciała	112
Podindeks siły mleczności	114
Podindeks nóg i racic	112
Podindeks wymienia	127
Podindeks płodności	116

Source: own elaboration based on: Polish Federation Cattle Breeders and Dairy Producers in Warsaw (PFCBDF), National Research Institute of Animal Production (NRIAP), 2016 – Assessment of the breeding value of PHF bulls of the black-and-white and red-and-white varieties. www.wycena.izoo.krakow.pl

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Polish list of bulls of the black and white variety ranked according to the value of the PF INDEX / rating 2023/3 (December 2023, date of publication of the rating: 06/12/2023)

CHARON bull - breeding value assessment results - assessment 2023/3

The best bull in the breeding value assessment in Poland in 2023

WARTOŚCI HODOWLANE

Cechy produkcyjne

	Typ oceny	Wartość hodowlana	Powtarzalność	Liczba córek	Liczba obór
Wydajność mleka [kg]	GMACE	1351	0.77	0	0
Wydajność tłuszczu [kg]	GMACE	77.5	0.73	0	0
% tłuszczu	GMACE	0.24	0.73	0	0
Wydajność białka [kg]	GMACE	60.8	0.75	0	0
% białka	GMACE	0.18	0.75	0	0
Indeks produkcyjny [kg]	GMACE	199.0			
Wydajność laktozy [kg]	GPI	54.5	0.71	0	0
% laktoza	GPI	-0.10	0.71	0	0

Source: own elaboration based on: Polish Federation Cattle Breeders and Dairy Producers in Warsaw (PFCBDF), National Research Institute of Animal Production (NRIAP), 2016 – Assessment of the breeding value of PHF bulls of the black-and-white and red-and-white varieties. www.wycena.izoo.krakow.pl

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CHARON bull - breeding value assessment results - assessment 2023/3

The best bull in the breeding value assessment in Poland in 2023

Cechy funkcjonalne

Pokrój

	Typ oceny	Wartość hodowlana		80 100 120		Powtarzalność	Liczba córek	Liczba obór
Kaliber	GPI	109	mały		duży	0.33	0	0
Typ–budowa	GMACE	119	niepożądany		pożądany	0.32	0	0
Nogi-racice	GMACE	123	niepożądane		pożądane	0.37	0	0
Wymię	GMACE	123	niepożądane		pożądane	0.56	0	0
Budowa ogólna	GPI	114	niepożądana		pożądana	0.22	0	0
Wysokość w krzyżu	GMACE	112	niski		wysoki	0.80	0	0
Głębokość tułowia	GMACE	110	płytki		głęboki	0.65	0	0
Szerokość klatki piersiowej	GMACE	118	wąska		szeroka	0.58	0	0
Ustawienie zadu	GMACE	100	uniesiony		spadzisty	0.76	0	0
Szerokość zadu	GMACE	106	wąski		szeroki	0.72	0	0
Postawa nóg tylnych – widok z boku	GMACE	76	pionowa		podsiebna	0.67	0	0
Racice	GMACE	115	długa przekątna		krótka przekątna	0.47	0	0
Postawa nóg tylnych – widok z tyłu	GMACE	117	iksowate		równolegle	0.52	0	0
Zawieszenie przednie wymienia	GMACE	120	luźne		mocne	0.64	0	0
Zawieszenie tylne wymienia	GMACE	128	niskie		wysokie	0.62	0	0
Więzadło środkowe wymienia	GMACE	106	słabe		mocne	0.63	0	0
Położenie wymienia	GMACE	120	niskie		wysokie	0.75	0	0
Szerokość wymienia	GPI	114	wąskie		szerokie	0.17	0	0
Ustawienie strzyków	GMACE	104	szerokie		wąskie	0.74	0	0
Długość strzyków	GMACE	118	krótkie		długie	0.75	0	0
Ustawienie strzyków - tył	GMACE	102	zewnętrzne		wewnętrzne	0.70	0	0
Charakter mleczny	GMACE	108	ordynarny		szlachetny	0.51	0	0
Kondycja	GMACE	115	słaba		mocna	0.62	0	0
Lokomocja	GMACE	123	słaba		dobra	0.35	0	0

Source: own elaboration based on: Polish Federation Cattle Breeders and Dairy Producers in Warsaw (PFCBDF), National Research Institute of Animal Production (NRIAP), 2016 – Assessment of the breeding value of PHF bulls of the black-and-white and red-and-white varieties. www.wycena.izoo.krakow.pl

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Polish list of bulls of the black and white variety ranked according to the value of the PF INDEX / rating 2023/3 (December 2023, date of publication of the rating: 06/12/2023)

CHARON bull - breeding value assessment results - assessment 2023/3

Płodność

	Typ oceny	Wartość hodowlana	80 100 120	Powtarzalność	Liczba córek	Liczba obór
Współczynnik zapłodnienia jałówek	GMACE	110		0.35	0	0
Współczynnik zapłodnienia krów	GMACE	116		0.55	0	0
Przestój poporodowy	GMACE	107		0.69	0	0
Odstęp międzyciążowy	GMACE	113		0.67	0	0

Zawartość komórek somatycznych

	Typ oceny	Wartość hodowlana	80 100 120	Powtarzalność	Liczba córek	Liczba obór
	GMACE	113		0.73	0	0

Długowieczność

	Typ oceny	Wartość hodowlana	80 100 120	Powtarzalność
	GMACE	128		0.17

CECHY ZDOLNOŚCI UDOJOWEJ

	Typ oceny	Wartość hodowlana	80 100 120	Powtarzalność	Liczba córek	Liczba obór
Szybkość oddawania mleka	GMACE	105		0.50	0	0
Temperament	GPI	108		0.62	0	0

PRZEBIEG PORODÓW

	Typ oceny	Wartość hodowlana	80 100 120	Powtarzalność	Liczba cieląt	Liczba obór
Przebieg Porodu Bezpośredni	GMACE	92		0.65	0	0
Przebieg Porodu Matczyny	GMACE	103		0.58	0	0
Przeżywalność Cieląt Bezpośredni	GMACE	100		0.53	0	0
Przeżywalność Cieląt Matczyny	GMACE	108		0.61	0	0

Source: own elaboration based on: Polish Federation Cattle Breeders and Dairy Producers in Warsaw (PFCBDF), National Research Institute of Animal Production (NRIAP), 2016 – Assessment of the breeding value of PHF bulls of the black-and-white and red-and-white varieties. www.wycena.izoo.krakow.pl

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5. Second method of cattle improvement – pairing for mating

Cattle mating methods

Mating - involves selecting animals within one breed for reproduction.

Crossbreeding - involves selecting animals of different breeds for breeding.

Source: own elaboration based on: Maciejowski J., Zięba J., 1982: Genetyka zwierząt i metody hodowlane. Państwowe Wydawnictwo Naukowe, Warszawa; Nowicki B., 1985: Genetyka i metody doskonalenia zwierząt. Państwowe Wydawnictwo Rolnicze i Leśne, Warszawa.

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5. Second method of cattle improvement – pairing for mating

Cattle mating methods

Mating - involves selecting animals within one breed for reproduction.

Random (productive herds) **Non-random** (breeding herds)	**Relatives** (mating related animals)	**Free** (no common ancestors up to the 5th generation)

Source: own elaboration based on: Litwińczuk Z., Szulc T. (red.), 2005: Hodowla i użytkowanie bydła. Państwowe Wydawnictwo Rolnicze i Leśne, Warszawa.

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5. Second method of cattle improvement – pairing for mating

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Cattle mating methods

Crossbreeding - involves selecting animals of different breeds for breeding.

Improving	Breed-forming	Replacing	Commercial	Interspecific (crossbreeding)
(aim: using noble breeds to enhance genotype and functional traits; up to the 2nd generation of hybrids)	(aim: creating a new cattle breed; e.g., zebu x Shorthorn beef = Santa Gertruda)	(aim: substituting genes of one breed with genes of another, e.g., Holsteinization of NCB cattle in Poland)	(aim: achieving heterosis in F1 hybrids; milk traits 0-8%; meat traits 0-5% above average)	(aim: crossing animals of two related species; in Poland, an example is the Żubroń, the result of mating a bison with cattle)

Ź Source: own elaboration based on: Litwińczuk Z., Szulc T. (red.), 2005: Hodowla i użytkowanie bydła. Państwowe Wydawnictwo Rolnicze i Leśne, Warszawa.

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5. Second method of cattle improvement – pairing for mating

In order for the offspring to meet the breeder's expectations (genetic gain), **two mating methods** can be used:

- mating the best cows with the best bulls;
- corrective mating, in which cows that are worse in terms of a given production or conformation feature are inseminated with the semen of a bull that significantly improves this feature.

Source: own elaboration based on: opracowanie własne na podstawie: Gołębiewski M., Kalińska A., Radzikowski D., 2021: Jak ocenić wartość hodowlana buhaja. Farmer. pl

5.1. Optimization of the selection of bulls for mating

The selection of parental pairs determines what our herd will be like in the future. The most important thing in this respect is the correct choice of a bull, because - depending on the size of the herd - we can obtain from several to several dozen heifers per year.

Where to start choosing bulls and what to pay attention to make the optimal choice?

1. **Analyze the pedigrees of cows to prevent mating of related animals.**
   Follow the rule that a cow and a bull used to cover it cannot have a common father or any grandparent.

Source: own elaboration based on: opracowanie własne na podstawie: Osten-Sacken A., 2004: Poradnik hodowcy krów mlecznych. Wydawnictwo Genetyka Holenderska sp. z o.o. Poznań

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5.1. Optimization of the selection of bulls for mating

Where to start choosing bulls and what to pay attention to make the optimal choice?

2. Selecting a bull based on calving ease.

Some bulls calve easily in cows covered with their semen, so they should be used for mating with heifers and cows of smaller size, as well as those that have problems with giving birth despite their older age and good growth.

Source: own elaboration based on: opracowanie własne na podstawie: Osten-Sacken A., 2004: Poradnik hodowcy krów mlecznych. Wydawnictwo Genetyka Holenderska sp. z o.o. Poznań

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5.1. Optimization of the selection of bulls for mating

Where to start choosing bulls and what to pay attention to make the optimal choice?

3. **An important indicator informing about the value of a bull is the height of the selection index.**
   Generally, the higher it is, the objectively estimated value of the bull is greater.

Note: It should be guided by the principle that the best bull is the one that 'fits' our herd, which may not necessarily align with the magnitude of the index it achieves.

Source: own elaboration based on: opracowanie własne na podstawie: Osten-Sacken A., 2004: Poradnik hodowcy krów mlecznych. Wydawnictwo Genetyka Holenderska sp. z o.o. Poznań

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5.1. Optimization of the selection of bulls for mating

Where to start choosing bulls and what to pay attention to make the optimal choice?

4. **One should take into account breeding values (so-called superiority) in relation to: milk components in daughters (e.g., % protein) as well as conformation and structure traits.**

Note: It should be guided by the principle that the best bull is the one that 'fits' our herd, which may not necessarily align with the magnitude of the index it achieves.

Source: own elaboration based on: opracowanie własne na podstawie: Osten-Sacken A., 2004: Poradnik hodowcy krów mlecznych. Wydawnictwo Genetyka Holenderska sp. z o.o. Poznań

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5.1. Optimization of the selection of bulls for mating

Where to start choosing bulls and what to pay attention to make the optimal choice?

5. One should consider functional traits: the calving ease and longevity.

Note: It should be guided by the principle that the best bull is the one that 'fits' our herd, which may not necessarily align with the magnitude of the index it achieves.

Source: own elaboration based on: opracowanie własne na podstawie: Osten-Sacken A., 2004: Poradnik hodowcy krów mlecznych. Wydawnictwo Genetyka Holenderska sp. z o.o. Poznań

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5.1. Optimization of mating pair selection - computerized mating programs

The properties of the computer program for breeding matches include:

- taking into account the breeder's breeding goal, including conformation traits,
- analyzing the entire herd considering genetics and environment,
- operating with national breeding values (in Poland, it is the PF index), where the program considers both bulls evaluated in Poland and by Interbull,
- having extensive pedigrees of cows and bulls, important for animals that do not yet have an official evaluation - pedigree breeding value (heifers and primiparous),
- considering and estimating the relatedness of future calves (inbreeding control),
- accounting for genetic defects,
- considering economic aspects, e.g., the price of semen,
- imposing restrictions, for example, on the use of a single genomic bull,
- utilizing information from the genotype of both the male and female.

Source: own elaboration based on: opracowanie własne na podstawie: Siekierska A., 2012: Program doboru buhajów do kojarzeń. Przegląd Hodowlany, 5/6, 8-10; Bonowski D., 2014: Program do kojarzeń Matasel 2.0+II. Tygodnik Poradnik Rolniczy, 1,E-F

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5.1. Optimization of mating pair selection - computerized mating programs

Determining the selection parameters:

1. Selection aimed at improving one or two features is most effective in practice, but the aim is to improve animals to the widest possible extent (remembering the correlations between different features).

2. Initially, bulls are selected that have the appropriate level of breeding values for production and functional traits.

3. The breeder influences the level of specific sub-indexes and selects priority features to improve.

Source: own elaboration based on: Siekierska A., 2012: Program doboru buhajów do kojarzeń. Przegląd Hodowlany, 5/6, 8-10; Bonowski D., 2014: Program do kojarzeń Matasel 2.0+II. Tygodnik Poradnik Rolniczy, 1,E-F

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5.2. Optimization of the number of breeding bulls used in the cattle herd

The number of bulls whose semen can be used in a dairy herd depends on:

- herd size,
- the degree of reliability of the assessment of breeding value,
- the level of risk that the breeder is willing to accept.

You should not inseminate more than 15-20% of the cows in the herd with the semen of one bull.

Source: own elaboration based on Guliński P., 2017: Bydło domowe hodowla i użytkowanie. Wydawnictwo Naukowe PWN, Warszawa

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6. Consequences of conducting breeding work (improvement programs) on cattle

- change in the breeding value of animals
- reducing genetic variance
- spread of genetic defects
- increase in homozygosity

The average level of inbreeding of Polish Holstein-Friesian cows born in 2022 was 5.96% and was 1.08% higher than the predicted expected inbreeding of offspring in 2022. This means that breeding decisions related to the selection of animals for mating result in an increase in inbreeding. greater than with random selection.

Inbreeding depression of production traits in Polish Holstein-Friesians per 1% increase in inbreeding means a decrease in milk yield in a 305-day lactation by an average of 20 kg!!!

Source: own elaboration based on: Strabel T., 2024: Metody i programy hodowli zwierząt. Wydawnictwo Naukowe PWN, Warszawa; https://www.cgen.pl/inbred/wyniki/

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7. Summary

1. **Breeding work** refers to the breeder's efforts aimed at improving the hereditary traits of animals.

2. **In cattle, the main subject of improvement** are functional features, such as: milk yield, correct structure, including the structure of the udder and the shape of teats suitable for mechanical milking, functional features and meat performance.

3. In order to carry out breeding work, i.e. improve cattle, it is necessary to know its utility and breeding value. For this purpose, the utility value of cattle is assessed by collecting information on the milk yield of cows, the chemical composition of milk, etc. On the basis of this information, selection is carried out, i.e. animals with the desired properties are selected and designated for breeding.

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7. Summary

4. **Another element of breeding strategies is the selection of pairs for mating**. For this purpose, it is necessary to know the value of both the male and the female.

5. **There are two ways of mating planns:**
   - mating the best cows with the best bulls,
   - corrective mating.

6. **The most important elements taken into account in individual mating (cow - bull) are:**
   - degree of relationship (to avoid inbreeding),
   - breeding goal in the herd (production traits, functional traits).

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Thank you for your attention!

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