Uue Ida- ja/või Euroopa genoomselektsiooni konsortsiumi loomise eeluuring. Eesti piimaveiste genoomaretusväärtusel põhineva hindamissüsteemi ettevalmistamine

III etapi aruanne. Analüüs uue piimaveiste genoomselektsiooni konsortsiumi moodustamisest huvitatud riikide aretusorganisatsioonidest, konsortsiumi asutamise/ühinemise tingimustest, selle juriidilistest eripäradest

Koostaja: Haldja Viinalass, Eesti Maaülikool

Tellija: MTÜ Piimaklaster

Euroopa Maaelu Arengu Põllumajandusfond: Euroopa investeeringud maapiirkondadesse

Tartu 2019

Sisukord

Piimaveiste geneetiline hindamine ja geneetilist hindamist läbi viivad organisatsioonid

Rahvusvaheline Jõudluskontrolli Komitee (ICAR) on kehtestanud jõudluskontrolli ning loomade aretusväärtuste määramise rahvusvahelised nõuded ja standardid. *Interbull* on ICARi alamkomitee, mis kehtestab piimaveiste geneetilise hindamise meetodite rahvusvahelised standardid ja korraldab rahvusvahelist hindamist. Eesti on ICARi ja *Interbull*i liige alates 1995. aastast. Eestis viib piimaveiste jõudluskontrolli ja geneetilist hindamist läbi Eesti Põllumajandusloomade Jõudluskontrolli AS (endine Jõudluskontrolli Keskus).

*Interbull*i piimaveiste geneetilises hindamises osaleb 32 riiki (Tabel 1), kusjuures Saksamaalt, Šveitsist ja USA-st edastab geneetilisse hindamisse andmeid mitu organisatsiooni.

Tabel 1. *Interbull*i piimaveiste (holsteinide) geneetilises hindamises osalevad riigid ja organisatsioonid

No.	Country	Organization Name	Org. code
1.	Argentina	Asociación Criadores de Holando Argentino	ACHA
2.	Australia	Australian Dairy Herd Improvement Scheme	ADHIS
3.	Austria	ZuchtData EDV-Dienstleistungen GmbH	ZUCHTDATA
4.	Belgium	Gembloux Agro-Bio Tech - Animal Breeding and Genetics group	GEMBLOUX
5.	Canada	Canadian Dairy Network	CDN
6.	Croatia	Croatian Agricultural Agency	HPA
7.	Czech Republic	Czech Moravian Breeders' Corporation	PLEMDAT
8.	Denmark	NAV	NAV
9.	Estonia	Estonian Animal Recording Centre	ARC
10.	France	Institut de l'Elevage	INRA
11.	Germany	Bavarian State Research Center for Agriculture, Institute of Animal Breeding	LFL
		United Data Systems	VIT
12.	Hungary	Central Agricultural Office	MGSZH
13.	Ireland	Irish Cattle Breeding Federation	ICBF
14.	Israel	Israeli Cattle Breeders' Association	ICBA
15.	Italy	National Association of Holstein Breeders	ANAFI
16.	Japan	National Livestock Breeding Centre	NLBC
17.	Korea, Republic of	Korean National Institute of Animal Science	NIAS
18.	Latvia	Agricultural Data Centre	LDC
19.	Lithuania	Ministry of Agriculture	LIETUVA
20.	Netherlands	GES Netherlands+Flanders	GES
21.	New Zealand	Dairy NewZealand	DNZ
22.	Norway	GENO	GENO
23.	Poland	National Institute of Animal Production	NIAP
24.	Portugal	ANABLE	ANABLE
25.	Slovakia	The Breeding Services of the Slovak Republic	PSSR
26.	Slovenia	University of Ljubljana, Zootechnical department	BFRO
27.	South Africa	SA Studbook	SASB

28.	Spain	Confederation of Spanish Holstein Associations	CONAFE
29.	Switzerland	Holstein Association - Switzerland	HACHE
		Qualitas AG	QUALITAS
30.	United Kingdom	Scottish Agricultural College	SAC
31.	United States	AIPL - USDA	CDCB
		Holstein Association, USA	HAUSA
32.	Uruguay	Instituto Nacional de Investigacion Agropecuaria	INIA

Allikas: Interbulli koduleht

Genoomselektsiooni alane olukord

Piimaveiste genoomselektsiooni rakendasid esmakordselt 2009. aastal Ameerika Ühendriigid ja Kanada. Neile järgnes rida teisi riike ning käesolevaks ajaks on piimaveiste genoomselektsioon kujunenud standardseks piimaveiste aretuses kasutatavaks meetodiks maailmas. Genoomselektsiooni kasutuselevõtt on väga oluliselt muutnud ja mõjutanud piimaveisesektorit maailmas. Suuremat aretusedu on saavutanud eelkõige suured riigid, kus on arvukas holsteini tõu populatsioon ning kes on ühinenud genoomselektsiooni läviviimiseks referentspopulatsioonide suurendamise eesmärgil konsortsiumitesse.

Selleks, et erinevates riikides ja erinevate organisatsioonide poolt hinnatavad genoomaretusväärtused oleksid omavahel võrreldavad, on *Interbull* sarnaselt klassikalisele aretusväärtuse hindamisele töötanud välja metoodika genoomaretusväärtuste usaldusväärsuse kontrollimiseks ning nende samale skaalale teisendamiseks (GMACE). Genoomaretusväärtus (*Genomic enhanced breeding value*, GEBV) on genotüpiseeritud DNA-piirkondade kogumõju ehk otsese genoomaretusväärtuse ja klassikalise aretusväärtuse kaalutud summa). Otsene genoomi väärtus või otsene genoomaretusväärtus (*Direct genomic value*, DGV) on kõigi genotüpiseeritud ja analüüsitud SNP-de summaarne mõju, mis tänu sellele, et tegu ongi vaid valitud DNA piirkondadega (kuigi varieeruvamate ja seeläbi ka aretusväärtusesse enam panustavate DNA piirkondadega), ei hõlma kogu genoomi aditiivgeneetilist mõju.

Lähtuvalt Interbulli kodulehel toodust (Tabel 2), on käesolevaks ajaks genoomselektsiooni kasutusele võtnud USA, Kanada, Austraalia, Uus-Meremaa, Jaapan, Prantsusmaa, Itaalia, Hispaania, Suurbritannia, Holland, Saksamaa, Belgia, Šveits, Soome, Rootsi, Taani, Poola ja Sloveenia, Iirimaa, Tšehhi ja Austria. Seejuures on Põhjamaad (Soome, Rootsi ja Taani) koondunud ühte organisatsiooni (*Nordic Cattle Genetic Evaluation*) ning Saksamaa ja Austria on koondunud kolme tõu hindamiseks.

Rahvusvahelise hindamise tarvis saadavad Interbullile piima-, rasva- ja/või valgutoodangu genoomaretusväärtusi 22 ettevõtet 20 riigi 40 veisepopulatsiooni kohta.

Tabel 2. GEBV-testi läbinud populatsioonid

Populatsioon	Tõug	Viimase valideerimise aeg	Piim	Rasv	Valk	Andmeid edastav organisatsioon
AUS	HOL	201402	Y	Y	Y	Australian Dairy Herd Improvement Scheme (ADHIS)
AUS	JER	201302		Y	Y	Australian Dairy Herd Improvement Scheme (ADHIS)
BEL	HOL	201809	Y	Y	Y	Faculté Universitaire des Sciences Agronomiques - Groupe de Génétique et Amélioration Animales
CAN	BSW	201302	Y	Y	Y	Canadian Dairy Network (CDN)
CAN	HOL	201501	Y	Y	Y	Canadian Dairy Network (CDN)
CAN	JER	201302	Y	Y	Y	Canadian Dairy Network (CDN)
CAN	RDC	201302	Y	Y	Y	Canadian Dairy Network (CDN)
CHE	BSW	201608	Y	Y	Y	Qualitas AG
CHE	BSWi	201307	Y	Y	Y	Intergenomics
CHE	HOL	201608	Y	Y	Y	Qualitas AG
CHE	RHO	201302	Y	Y	Y	Qualitas AG
CZE	HOL	201509	Y	Y	Y	Czech Moravian Breeders' Corporation (PLEMDAT)
DEA	BSW	201601	Y	Y	Y	Bavarian State Research Center for Agriculture (LfL)
DEA	BSWi	201307	Y	Y	Y	Intergenomics
DEU	HOL	201901	Y	Y	Y	Vereinigte Informationssysteme Tierhaltung w.V (vit)
DEA	SIM	201601	Y	Y	Y	Bavarian State Research Center for Agriculture (LfL)
DFS	HOL	201803	Y	Y	Y	Nordic Genetic evaluation (NAV)
DFS	JER	201612	Y	Y	Y	Nordic Genetic evaluation (NAV)
DFS	RDC	201612	Y	Y	Y	Nordic Genetic evaluation (NAV)
ESP	HOL	201809	Y	Y	Y	Confederation of Spanish Holstein Associations (CONAFE)
FRA	BSWi	201307	Y	Y	Y	Intergenomics
FRA	HOL	201701	Y	Y	Y	France Génétique Elevage
FRA	MON	201501	Y	Y	Y	France Génétique Elevage
FRA	NMD	201501	Y	Y	Y	France Génétique Elevage
GBR	HOL	201507	*Y*	*Y*	*Y*	*Scotland's Rural College (SRUC)*
HUN	HOL	201707	Y	Y	Y	Central Agricultural Office (MgSzH)
IRL	HOL	201108	Y	Y	Y	Irish Cattle Breeding Federation
ITA	BSWi	201307	Y	Y	Y	Intergenomics

Populatsioon	Tõug	Viimase valideerimise aeg	Piim	Rasv	Valk	Andmeid edastav organisatsioon
ITA	HOL	201406	Y	Y	Y	Associazione Nazionale Allevatori Frisona Italiana (ANAFI)
ITA	SIM	201901	Y	Y	Y	Associazione Nazionale Allevatori Pezzata Rossa Italiana (ANAPRI)
JPN	HOL	201509	Y	Y	Y	National Livestock Breeding Centre
NLD	HOL	201807	Y	Y	Y	Genetic Evaluation Sires (GES)
NZL	HOL	201007			Y	Livestock Improvement Corporation
NZL	JER	201007			Y	Livestock Improvement Corporation
POL	HOL	201510	Y	Y	Y	Polish Federation of Cattle Breeders and Dairy Farmers
SVN	BSWi	201307	Y	Y	Y	Intergenomics
USA	BSW	201612	Y	Y	Y	Animal Improvement Programs Laboratory (AIPL-USDA)
USA	BSWi	201307	Y	Y	Y	Intergenomics
USA	HOL	201409	Y	Y	Y	Animal Improvement Programs Laboratory (AIPL-USDA)
USA	JER	201409	Y	Y	Y	Animal Improvement Programs Laboratory (AIPL-USDA)

Allikas: http://www.interbull.org/ib/gebvtest

*Interbull*ile esitatud genoomhindamise informatsioon holsteini tõu kohta

Tabelis 3 toodud teave on kogutud riikide kaupa Interbulli kodulehelt leitavatelt GENO vormidelt (https://interbull.org/ib/nationalgenoforms) 2019.a maikuu seisuga. Teave kajastab seisu, kuidas riigid on andmeid esitanud või viimati neid uuendanud.

Tabel 3. Holsteini tõul genoomhinnatavad tunnused, kasutatavad geenikiibid ja referentspopulatsioonide suurus riigiti

Riik	Tunnused	Kasutatav geenikiip	Veiseid referentspopulatsioonis
Australia	Production (HOL) Conformation (HOL)	Illumina 50K1 and 2, 3K, 9K Illumina 50K	3416 males, 9604 females, total 13020; various countries Males; 1745; various countries
Belgium	Production (HOL) Conformation (HOL) Udder Health (HOL) Longevity (HOL) Calving (HOL) Fertility (HOL)	Illumina BovineSNP50 BeadChip (version 1, 2, 3), EuroG10k (imputed to 50K), Illumina Bovine HD, GeneSeek Illumina BovineSNP50 BeadChip (version 1, 2, 3), EuroG10k (imputed to 50K), Illumina Bovine HD, GeneSeek Genomic Profiler HD v2, ICBF International Dairy and Beef v3	All genotyped males and females with age cutoff YYYY-15 : 9095 animals
Canada	All traits (ALL BREEDS)	Evaluation is based on the 50K panel. But many other chips are used	All males with an official proof genotyped using at least a 50k panel. Cows with a domestic proof and genotyped using at least a 6K panel are also included in the reference population
Czech Republic	Production (HOL)	Illumina 54K v1 or v2	All genotyped animals.

Denmark & Sweden & Finland	Production (ALL BREEDS) Conformation (ALL BREEDS) Udder Health (ALL BREEDS) Longevity (ALL BREEDS) Calving (ALL BREEDS) Fertility (ALL BREEDS) Workability (ALL BREEDS)	Illumina 50K and from lower density imputed on the 50K chip	Denmark, Sweden, Finland, Germany, Netherlands, France, Spain, Poland, 31,800 males, 14,900 DFS females
France	Production (ALL BREEDS) Conformation (ALL BREEDS) Udder Health (ALL BREEDS) Longevity (ALL BREEDS) Fertility (ALL BREEDS) Workability (ALL BREEDS)	Genotypes from Illumina50K SNP Chip or from lower density imputed on the 50K chip	30700 bulls from the Eurogenomics consortium
Germany & Austria	Production (HOL) Conformation (HOL)	Illumina Chip BovineSNP50 and >26 low, middle or high density chips	Genotyped Holstein bulls with daughter information from EuroGenomics countries (Germany, France, The Netherlands, Nordic countries, Spain and Poland) and USA and Canada are included in reference population. Genotyped females with qualified phenotype records in Germany are considered in the training set as well. The total number of Holstein reference bulls reached 38,772 and reference cows 130,960 by April 2019 based on phenotypic information of milk yield. Genotyped Holstein bulls with daughter information from EuroGenomics countries (Germany, France, The Netherlands, Nordic countries, Spain and Poland) and USA and Canada are included in reference population. Genotyped females with qualified phenotype records in Germany are considered in the training set as well. The total number of Holstein reference bulls reached 37,737 and reference cows 109,857 by April 2019 based on phenotypic information of stature.

	Udder Health (HOL)		Genotyped Holstein bulls with daughter information from EuroGenomics countries (Germany, France, The Netherlands, Nordic countries, Spain and Poland) and USA and Canada are included in reference population. Genotyped females with qualified phenotype records in Germany are considered in the training set as well. The total number of Holstein reference bulls reached 38,770 and reference cows 130,960 by April 2019 based on phenotypic information of somatic cell scores.
	Longevity (HOL)		Genotyped Holstein bulls with daughter information from EuroGenomics countries (Germany, France, The Netherlands, Nordic countries, Spain and Poland) and USA and Canada are included in reference population. Genotyped females with qualified phenotype records in Germany, passing a waiting period of 250 days from first calving to date of evaluation, are considered in the training set as well. The total number of Holstein reference bulls reached 37,964 and reference cows.
	Calving (HOL)		Genotyped Holstein bulls with daughter information from EuroGenomics countries (Germany, France, The Netherlands, Nordic countries, Spain and Poland) and USA and Canada are included in reference population. Genotyped females with qualified phenotype records in Germany are considered in the training set as well. The total number of Holstein reference bulls reached 32,214 and reference cows 147,550 by April 2019 based on phenotypic information of maternal calving ease.
			Genotyped Holstein bulls with daughter information from EuroGenomics countries (Germany, France, The Netherlands, Nordic countries, Spain and Poland) and

	Fertility (HOL) Workability (HOL)		USA and Canada are included in reference population. Genotyped females with qualified phenotype records in Germany are considered in the training set as well. The total number of Holstein reference bulls reached 35,605 and reference cows 123,028 by April 2019 based on phenotypic information of Non-Return rate cow. Genotyped Holstein bulls with daughter information from EuroGenomics countries (Germany, France, The Netherlands, Nordic countries, Spain and Poland) and USA and Canada are included in reference population. Genotyped females with qualified phenotype records in Germany are considered in the training set as well. The total number of Holstein reference bulls reached 29,476 and reference cows 85,679 by April 2019 based on phenotypic information of milkability RZD.
Great Britain	Production (HOL) Udder health (HOL) Longevity (HOL) Calving (HOL)	Illumina 50K v1&v2 and 800K	Males only GBR, USA and CANADA 6452 bulls Males only GBR, USA and CANADA 6452 bulls Males only GBR, USA and CANADA 6452 bulls Males only GBR, USA and CANADA 5491 bulls for DC and 2519 bulls

	Fertility (HOL)		Males only GBR, USA and CANADA 5013 bulls for CI and 4869 bulls for NR56
Hungary	All Traits (HOL)	Illumina 60K chip and Illumina BovineSNP50 BeadChip.	Males
Ireland	Production (HOL)	Illumina Bovine SNP50 BeadChip	5095 males as of November 2010
Italy	Production (HOL)	Illumina 50K v1, Illumina 50K v2, Illumina 3K, Illumina HD, Illumina LD, GeneSeek Genomic Profiler,GeneSeek Genomic Profiler 80K, GGP-Super, EuroG10K,Illumina LD v1.1, GGP-GeneSeek Genomic; GeneSeek Genomic Profiler HD-80K; GeneSeek Genomic Profiler 2; GeneSeek Genomic Profiler 2; Zoetis MD; EuroG10K; Illumina Infinium BovineLD v1.1 BeadChip; GeneSeek Genomic Profiler 3; Zoetis LD2; Zoetis MD2; GeneSeek Genomic Profiler HD-150K; GeneSeek Ultra LD; GeneSeek Genomic Profiler 4; Zoetis LD4; Affymetrix Axion OviCap Medium Density	Males, ITALY, USA, CANADA and GREAT BRITAIN (26184 bulls)
	Conformation (HOL)		Males, ITALY, USA, CANADA and GREAT BRITAIN (22941 bulls)
	Udder Health (HOL)		Males, ITALY, USA, CANADA and UNITED KINGDOM (25845 bulls)
	Female Fertility (HOL)	Illumina Infinium BovineSNP50 v1 BeadChip, Illumina Infinium BovineSNP50 v2 BeadChip, Illumina Golden Gate Bovine3K BeadChip, Illumina Infinium BovineHD BeadChip, Illumina	Males, ITALY, USA, CANADA, GREAT BRITAIN and SWITZERLAND (32747 bulls)

		Infinium BovineLD BeadChip, GeneSeek Genomic Profiler LD, GeneSeek Genomic Profiler HD-80K, GeneSeek Genomic Profiler 2, Zoetis LD, Zoetis MD, EuroG10K, Illumina Infinium BovineLD v1.1 BeadChip, GeneSeek Genomic Profiler 3, Zoetis LD2, Zoetis MD2, GeneSeek Genomic Profiler HD-150K, GeneSeek Ultra LD, GeneSeek Genomic Profiler 4, Zoetis LD4, GeneSeek MD, GGP Bovine 9K, Zoetis LD5, Illumina Infinium BovineSNP50 v3 BeadChip, Affymetrix Axion BovMD, EuroG10K Version 7, Axion STGen100 GenVis MD	
Japan	Production (HOL) Conformation (HOL) Udder Health (HOL)	Illumina's 54K SNP Chip	3906 males
New Zealand	Production (HOL)	Illumina's 54K SNP chip	May 2010: 2626 HOL
Poland	Production (HOL) Conformation (HOL)	Illumina BovineSNP50 Genotyping BeadChip	Genotyped Holstein bulls from the Euro Genomics reference population. The total number of reference animals: 29 668 for milk yield, 29 682 for fat yield, 29 612 for protein yield. Genotyped Holstein bulls from the Euro Genomics reference population. The total number of reference animals: stature (29 008), body depth (27 844), angularity (25 044), chest width (27 915), rump angle (29 205), rump width (29 124), rear-leg set (29 220), rear leg rear view (27 117), foot angle (27 014), fore udder attachment (28 368), rear udder height (28 194), udder support (29 000), udder depth (29 202), front teat placement (29 188), front teat length (29 179), rear teat position (27 495), overall conformation score (25 519), overall udder score (29 172), overall feet and legs score (27 757.

	Udder Health (HOL) Fertility (HOL)		Genotyped Holstein bulls from the Euro Genomics reference population. The total number of reference animals for the somatic cell score is 29 524. Genotyped Holstein bulls from the Euro Genomics reference population. The total number of reference animals: non return rate for heifers (27 566), non return rate for cows (26 918), interval from calving to first insemination (28 233), days open (27 063)
Spain	All traits (HOL)	Illumina BovineSNP50 chip & LD Euro10K	Genotyped Holstein bulls from EuroGenomics countries (Spain, Denmark, Finland, France, Germany, The Netherlands, Sweden) are included in reference population.
Switzerland	Production (HOL) Conformation (HOL) Udder Health (HOL) Longevity (HOL) Calving (HOL) Fertility (HOL) Workability (HOL)	Illumina BovineSNP50 BeadChip (v1 and v2) and various low density chips	HOL/RED, Swiss Fleckvieh and SIM males; 6100 males (March 2016) HOL/RED, Swiss Fleckvieh and SIM males; between 2500 and 4500 males (March 2016) depending on trait HOL/RED, Swiss Fleckvieh and SIM males; 6000 males (March 2016) Males with a official progeny proof (domestic or MACE) HOL/RED, Swiss Fleckvieh and SIM males; 4100 - 4400 males (March 2016) HOL/RED, Swiss Fleckvieh and SIM males; 2400 males for temperament and 4100 males for milking speed (March 2016)

The Netherlands	Production (HOL)	Illumina 60K chip ands Illumina BovineSNP50 BeadChip.	Males and females
United States	Production (ALL BREEDS) Conformation (HOL) Udder Health (HOL) Longevity (HOL) Calving (HOL) Fertility (HOL)	Illumina Bovine SNP50 3K HD, LD, LD2, GeneSeek Genomic Profiler, GGP, GHD, GP2, GP3, GH2, G7K GP4; Zoetis ZLD, ZMD, ZL2, ZM2, ZL4	Reference animals included as of April 2017. HOL: 358,630 U.S. females as well as 2,206 females from 27 other countries; 19,034 U.S. males as well as 17,117 males from 22 other countries

Genoomselektsiooni konsortsiumid

Holsteini tõu aretust silmas pidades on suured riigid koondunud kahte konsortsiumisse:

1) Põhja-Ameerika konsortsium: USA+CAN+ITA+GBR
2) EuroGenomics konsortsium: DEU+FRA+NLD+DFS+ESP+POL

Teadaolevalt ei ole kumbki konsortsium huvitatud laienemisest, st uute liikmete kaasamisest, kuna liituda soovijate holsteini populatsioonid on väikesed, mistõttu need ei suurenda oluliselt pullide referentspopulatsiooni.

Kuna ka väiksemate holsteini populatsioonidega riigid on huvitatud genoomselektsiooni alasest koostööst, sh ühiselt pullide referentspopulatsiooni suurendamisest, et oma holsteini populatsiooni puhul suuremat geneetilist edu saavutada ning teada saada oma pullide paremust võrreldes teiste riikidega, moodustus *Interbull*i osalemisel initsiatiivgrupp, et asutada uus konsortsium just nende riikide jaoks, kelle holsteini tõu populatsioonid on väikesed ning kes ei ole kaasatud ühtegi olemasolevasse genoomselektsiooni konsortsiumisse. Eeskuju võeti 2017. aastal *Interbull*i keskuse toel asutatud šviitsi tõu osas moodustatud genoomselektsiooni konsortsiumist *Intergenomics*, kuhu on ühinenud Saksamaa, Austria, Šveits, USA ja Kanada.

Selleks, et saada selgust, kas ja kes võiksid uuest initsiatiivist olla huvitatud, koostati 2017. a jaanuaris küsimustik eesmärgiga kaardistada hetkeolukorda.

Väikeste holsteinipopulatsioonide initsiatiiv Ig-HOL

2017. aastal moodustus *Interbull*i osalemisel initsiatiivgrupp Ig-Hol *„Implementation of genomic selction in Holstein*/ Genoomselektsiooni rakendamine holsteini tõus“. Riikide huvide selgitamiseks kontakteeruti huvide ja olemasoleva olukorra selgitamiseks küsimustik, mis saadeti 21 riigile.
*Interbull*i keskuse poolt kontakteeruti järgmiste riikidega:

1) Belgia
2) Horvaatia
3) Tšehhi vabariik
4) Eesti
5) Kreeka
6) Ungari
7) Iirimaa
8) Läti
9) Leedu
10) Portugal
11) Slovakkia
12) Sloveenia
13) Austraalia
14) Brasiilia
15) Iisrael
16) Mehhiko
17) Uus-Meremaa
18) Lõuna-Aafrika
19) Lõuna-Korea
20) Uruguai
21) Türgi

Punasega on märgitud need riigid, kes saadetud küsimustikule ka vastasid. Lisaks tundis ise temaatika vastu huvi Makedoonia. Küsimustikule vastanud riikide holsteini populatsioonide põhiinfo on toodud tabelis 4.

Tabel 4. Riikide põhinäitajad (veiste arv, piimalehmade arv, holsteini tõugu lehmade arv, holsteini tõugu lehmi jõudluskontrollis, jõudluskontrolli meetod)

Country	No of cattle	Dairy cows	HOL cows	Cows in MR	HOL cows in MR	Methods of MR
Belgium	1.181.385	212.465	174.221	72.803	65.374	A4
Croatia	462.448	158.876	43.857	98.567	39.513	AT4
Czech Republic	1.500.000	375.000	220.000	355.000	210.000	A4
Estonia	248.500	86.300	69.000	82.000	65.600	B4
Hungary	715.000	270.000	240.000		226.000	A4
Ireland	2.200.000	1.200.000	1.000.000	500.000	450.000	A4, A6, A8
Latvia	435.326	160.828	55.560		44.000	A4
Portugal	484.350	286.540	282.670	84.596	82.618	A4, AT4
Slovakia	194.997	134.649	96.090	111.815	68.413	AT
Slovenia	474.023	101.498	36.001	81.772	34.094	AT4
Macedonia	200.000	120.000	35.000	<10.000	<10.000	AT4
Brazil	200.000.000	20.000.000	300 – 400 K	80.000	67.500	A4
Israel	180.000	130.000		119.081	113.594	A4 (70%)
South Africa	12.000.000	420.000	250.000	60.000	30.000	B5
South Korea	3.121.000	404.000	404.000	291.000	291.000	
Uruguay	11.800.000	440.000	420.000	80.000	73.000	AT4, B4

Kõige väiksem holsteinipopulatsioon on Eestis (86,3 tuhat) ja kõige suurem Brasiilias (20 mln). ICAR-i liige ei ole ainult Makedoonia ning koos Brasiiliaga ei osale nad ka *Interbull*i poolt läbi viidavas geneetilises hindamises. Riikidevahelises geneetilises hindamises ei osale Slovakkia (Tabel 5).

Tabel 5. Liikmelisus ja osalemine riikidevahelises geneetilises hindamises (MACE-s)

Country	Member of ICAR	INTERBULL Service User	Participation in MACE
Belgium	YES	YES	YES
Croatia	YES	YES	YES
Czech Republic	YES	YES	YES
Estonia	YES	YES	YES
Hungary	YES	YES	YES
Ireland	YES	YES	YES
Latvia	YES	YES	YES
Portugal	YES	YES	YES
Slovakia	YES	YES	NO
Slovenia	YES	YES	YES
Macedonia	NO	NO	NO
Brazil	YES	NO	NO
Izrael	YES	YES	YES
South Africa	YES	YES	YES
South Korea	YES	YES	YES
Uruguay	YES	YES	YES

Selgitused:
ICAR – International Committee for Animal Recording/ Rahvusvaheline Jõudluskontrolli Komitee

MACE – Multiple Across Country Evaluation/riikidevaheline hindamine

Riikidevahelisse geneetilisse hindamisse kaasatud tunnused on esitatud tabelis 6. Reeglina alustatakse geneetilist hindamist toodangu alusel. Makedoonial ja Brasiilial on plaan liituda *Interbull*iga esmalt just toodangu geneetilist hindamist silmas pidades.

Tabel 6. Tunnused, millega riigid osalevad või kavatsevad osaleda rahvusvahelises hindamises

Country	Production	Conformation	Udder Health	Longevity	Calving	Female Fertility	Workability
Belgium	yes	yes	yes	yes	yes	yes	Not yet
Croatia	yes	plan	yes	plan	Not yet	Not yet	plan
Czech Republic	yes	yes	yes	yes	plan	yes	Not yet
Estonia	yes	yes	yes	plan	plan	plan	plan
Hungary	yes	yes	yes	yes	yes	plan	plan
Ireland	yes	yes	yes	yes	yes	yes	Not yet
Latvia	yes	plan	plan	Not yet	plan	plan	Not yet
Portugal	yes	yes	yes	plan	plan	plan	Not yet
Slovakia	yes	Not yet	yes	plan	yes	Not yet	Not yet
Slovenia	yes	yes	yes	yes	Not yet	Not yet	yes
Macedonia	plan	plan	Not yet	No yet	Not yet	Not yet	Not yet
Brazil	plan						
Israel	yes	Not yet	yes	yes	yes	yes	Not yet
South Africa	yes	yes	yes	yes	Not yet	yes	Not yet
South Korea	yes	yes	yes	Not yet	plan	plan	Not yet
Uruguay	yes	plan	plan	plan	Not yet	yes	not yet

Kolm riiki (Belgia, Tšehhi vabariik, Ungari) osalevad vastavalt kokkulepetele genotüübiandmete vahetamises (Tabel7). Jaatavalt on vastanud ka Läti, kuid siin on tegemist küsimuse valesti mõistmisega). Portugal ja Uruguai on peatanud genotüübiandmete vahetamise. Riikides, kus on kas alustatud pullide genotüpiseerimist või on riigisisene genoomhindamine, on järglaste põhjal hinnatud genotüpiseeritud pullide arv vahemikus 21-5500. Genotüpiseeritud noorpullide arv riigiti on vahemikus 13-30000. Kõige enam pulle genotüpiseeritakse Iirimaal, mis on seletatav Iirimaa riikliku genotüpiseerimise programmi tegevusega. Mitte ühtki pulli ei olnud 2017. a veebruariks veel genotüpiseeritud Eestis, Lätis, Slovakkias ja Makedoonias.

Tabel 7. Genoomselektsiooni alane olukord – pullid (veebruar 2017)

Country	Q11	Q12	Q13	No progeny bulls	No young bulls	Each year	Which chip
Belgium	yes	yes	yes	21	233	50	BovineSNP50, 150K, EuroG10K
Croatia	no	yes	yes	0	13	5 to 6	50K
Czech Republic	yes	?	yes	1500	500	100 - 150	Illumina 50K v1, v2
Estonia	no	yes	no				
Hungary	yes	yes	yes	550	1000		Illumina SD, HD
Ireland	no	yes	yes	5.500	30.000	7.000	IDB (54K designed in Ireland)
Latvia	yes	yes	no				
Portugal	Disc.	yes	yes	1.896	28	120/200	50K/75K
Slovakia	no	no	no				
Slovenia	no	yes	yes	200		50 - 100	50K
Macedonia	no	yes	no				
Brazil	no	yes	yes	230			GGP HD, GeneSeek
Israel	no	yes	yes	1.427	545	400	140K (previous 54K)
South Africa	no	yes	yes	89	65	300	Illumina 50k (proven), 7K (young)
South Korea	no	yes	yes	300		50	50K
Uruguay	Disc.	?	yes	200	65	n.a	ICBF IDBv3

Selgitused:
Q11. Kas juba osalete hosteini tõugu veiste genotüübiandmete vahetamises?
Q12. Kas olete huvitatud osalemisest rahvusvahelise koostöö projektis „Genoomselektsiooni rakendamine holsteini tõus“?
Q13. Kas olete juba genotüpiseerinud mõne holsteini tõugu pulli KS-s kasutamiseks?

Mullikaid ja lehmi ei ole genotüpiseeritud küsimustikule vastanud riikides neljas – Lätis, Slovakkias, Makedoonias, Brasiilias (Tabel 8).

Tabel 8. Genoomselektsiooni alane olukord – emasloomad (veebruar 2017)

Country	Q14	No of females till now	Each year	Which chip
Belgium	yes	976 + 3.000 (2017)	80	Bovine SNP50, IDB, EuroG10K
Croatia	yes	79	100 - 200	50K
Czech Republic	yes	800	Several thousand	Illumina 50K v1, v2
Estonia	yes	371	???	Illumina Bovina LD(276) + SNP50
Hungary	yes	Not sure		Illumina LD
Ireland	yes	50.000	25.000	IDB
Latvia	no			
Portugal	yes	845	1.500 – 2.000	50K/75K
Slovakia	no			
Slovenia	yes	3.000 (2017)	1.500 – 2.000	50K
Macedonia	no			
Brazil	no			
Israel	yes	2.635	500 – 1.000	30K
South Africa	yes	450	200	50K
South Korea	yes	700	500	50K
Uruguay	yes	800	2.000	ICBF IDB v3

Q14. Kas olete juba genotüpiseerinud holsteini tõugu emasloomi (lehmi ja mullikaid)?
Tavapäraselt viiakse *Interbull*i keskuse poolt rahvusvahelist geneetilist hindamist läbi 3x aastas (aprill, august ja detsember). Sama sagedust ja aega on kavas jätkata ka Ig-Hol hindamiste puhul. Pullide, kes osaleksid hindamises, oleksid nii seemenduseks kasutatud pullid kui noorpullid, keda kavatsetakse võtta seemendusjaama.

Ig-Hol projekt

Initsiatiivgrupp esitas Ig-Hol projekti (Genoomselektsiooni rakendamine holsteini tõus) läbiviimisel kaalumiseks kaks varianti:

1) kasutada geneetiliseks hindamiseks sama metoodikat kui šviitsi tõu puhul (Intergenomics konsortsium) või
2) rakendada uus hindamise metoodika (nt rahvusvaheline SNP mudel)

Riigid ise peavad korraldama loomade genotüpiseerimise ja otsima genotüpiseerimiste läbiviimiseks raha. Iga riik peab ise ette valmistama andmed vastavalt InterGenomic-i projekti hindamise juhendile. Kui andmed on ette valmistatud, siis saadetakse need *Interbulli* keskusse, kus viiakse läbi testhindamine 2018. a sügisel Pärast testhindamise läbiviimise saavad andmed esitanud riigid tulemused üle vaadata.

Projekti läbiviimseks kavandati järgmised etapid:

1) Osalemisest huvitatud riikide olemasolu
2) *Interbull*i keskuse toetus
3) Andmete ettevalmistamine vastavalt InterGenomic-i projekti andmefaili formaadile
4) Kasutada Intergenomics-i metoodikat väikeste holsteini populatsioonide peal
5) Viia läbi testhindamine
6) Selgitada välja rutiinse hindamise maksumus
7) Rutiinne hindamine

Genotüübiandmete esitamine Ig-Hol referentspopulatsiooni suurendamiseks

29. augustil 2017.a Tallinnas toimunud Interbulli koosolekul lepiti kokku, et riigid, kes ei kuulu ühtegi genoomselektsiooni konsortsiumisse ning kellel on olemas pullide genotüpiseerimise andmeid, saadavad need ühishindamise tarvis Interbulli keskusele nende poolt etteantud formaadi järgi. Eesmärk on kiiresti suurendada Ig-HOL referentspopulatsiooni. Esialgse hinnangu kohaselt oodati ca 1400 pulli genotüübiandmeid.

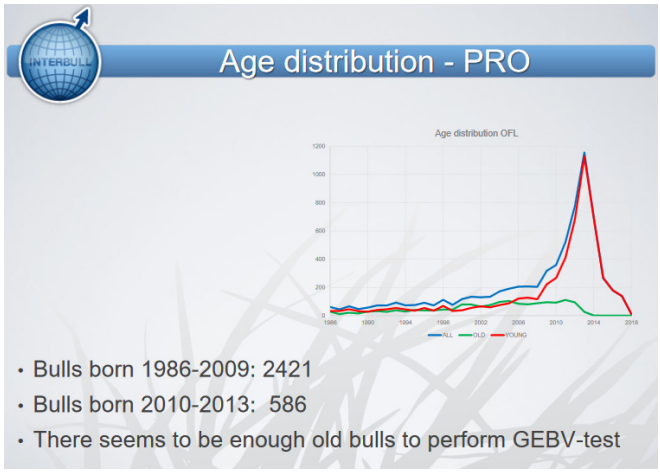
2018. a ühisel *Interbull*i/EAAP konverentsil tutvustas H. Jorjani Interbulllist esimese testi tulemusi (Tabel 9). Testhindamisse olid oma tulemused 13-st koostööst huvitatud ja kahest riigist, kes küsimustiku läbiviimise ajal veel kõhklesid, saatnud 8 riiki, kokku 7868 isas- ja 19115 emaslooma genotüübiandmed. (http://www.interbull.org/ib/2018_technical_workshop, *"International Genomic evaluation of 8 Holstein populations (IG-HOL)" by Hossein Jorjani*).

Tabel 9. Ig-HOL initsiatiivi raames *Interbull*ile esitatud isas-ja emasloomade genotüübi-andmed

Riigi ISO kood	Riik	Emasloomad	Isasloomad	Kokku
HRV	Horvaatia	173	0	173
IRL	Iirimaa	9523	3166	12689
ISR	Israel	3974	2194	6168
KOR	Lõuna-Korea	1444	605	2049
PRT	Portugal	0	831	831
SVN	Sloveenia	720	383	1103
URY	Uruguai	2790	363	3153
ZAF	Lõuna-Aafrika	491	326	817
Kokku:		19115	7868	26983

Allikas:Jorjani, H. 2018. Opportunities and challenges for small populations of dairy cattle. Presentation at 2018 Joint Interbull/EAAP meeting, August 27, 2018, Dubrovnik.

H. Jorjani esinemise põhjal on jooniselt 1 näha, et 2421 pulli, kelle genotüübiandmed esitati, on sündinud aastatel 1986-2009 ja 586 pulli on sündinud aastatel 2010-2013.



Joonis 1. Pullide vanuseline jaotus esitatud 8 riigi poolt esitatud genotüübiandmete põhjal

Allikas: Jorjani, H. 2018. Opportunities and challenges for small populations of dairy cattle. Presentation at 2018 Joint Interbull/EAAP meeting, August 27, 2018, Dubrovnik.

Lisa 1, *Interbull*'i teenuslepingu näide

SERVICE CONTRACT

Between

<CUSTOMER>, at <ADDRESS>;

<ICAR MEMBER>, at <ADDRESS>; and

INTERBULL CENTRE, Department of Animal Breeding and Genetics, Swedish University of Agricultural Science (SLU), at PO Box 7023, 750 07 Uppsala, Sweden.

Article 1

The purpose of this contract is to establish the terms for service provision of international genomic evaluation for the Brown Swiss breed.

Article 2

The <CUSTOMER> is the legal representative of the Brown Swiss breeders within <COUNTRY> having the power to decide about usage of performance, pedigree and genomic data of all sorts on behalf of these breeders.

The <ICAR MEMBER> is the organization that holds the status of full member at the International Committee for Animal Recording (ICAR) that represents the <CUSTOMER> before ICAR.

The INTERBULL CENTRE is the operational unit of Interbull currently providing routine computations of international genetic evaluations of dairy bulls, under the responsibility of the ICAR Sub-Committee Interbull and its Steering Committee. The INTERBULL CENTRE is hosted by the Swedish University of Agricultural Sciences (SLU), Uppsala, Sweden, and operates according to a contract between ICAR and SLU under Swedish law.

Article 3

The service contract is for a continuous period, commencing at the date the contract is signed by all parties.

Article 4

As part of the ICAR Sub-Committee Interbull activities, services described herein will be overseen by the Interbull Steering Committee.

Article 5

Scientific and technical direction for the project will be overseen by the Interbull Technical Committee, which will provide technical recommendations to the Interbull Steering Committee.

Article 6

In order to accomplish the purpose expressed in Article 1, the <CUSTOMER> agrees to: INTERBULL

supply genotypes of at least all genotyped bulls older than 12 months to the INTERBULL CENTRE,

provide complete pedigrees of all genotyped animals to the INTERBULL CENTRE,

participate regularly in the Interbull international genetic evaluations using linear multiple-trait across country (MACE) methodologies,

follow the publication rules established by participating organizations, given that these rules are in agreement with the Interbull general publication principles and the general agreement among the participating organizations,

provide technical expertise to monitor methods used and results generated within the realm of this contract,

pay the respective service fees as established on Appendix I and

provide access to genotypes as defined by the group of organizations participating in the international genomic evaluations which are the subject of this contract.

Article 7

The <ICAR MEMBER> recognizes the service provision described herein as an official ICAR activity.

Article 8

The INTERBULL CENTRE agrees to provide the following services:

maintain an international genotype database for the Brown Swiss breed,

carry out the international genomic evaluations for the Brown Swiss breed,

provide technical support to the <CUSTOMER> related to the activities described herein, and

deliver to the <CUSTOMER> the results of the genomic evaluation:

single-nucleotide polymorphism (SNP) effects,

direct genomic values (DGV),

genomic breeding values (GEBV),

model validation data and results, and

descriptive statistics of the estimates

Article 9

Services of genomic evaluation covered by this agreement must follow the procedures described in the Interbull Code of Practice.

Article 10

<CUSTOMER> and INTERBULL CENTRE have the right to terminate this agreement within 1 year of receipt of notice from the other party. This right of termination is not valid before December 31 2014 The INTERBULL CENTRE shall have the right to terminate the Agreement or withhold performance of services pursuant to this Agreement in the event that <CUSTOMER> is delinquent in payment by more than thirty (30) days.

Article 11

Access to the genomic data provided by the <CUSTOMER> will be granted exclusively to INTERBULL CENTRE staff with the objective of accomplishing the objective from the present agreement, expressed on Article 1. Unless explicitly authorized by the group of organizations participating in the international genomic evaluations, the INTERBULL CENTRE is not allowed to provide any individual or organization access to the data to which this agreement refers to. Under no circumstances will results on individual animals, herds or genotypes be made available for use by any of the contractors or external organizations for any purposes without advance written authority from the organization providing the data in the first instance.

When investigations demanded by the service users are carried out, research results obtained by the INTERBULL CENTRE or any other research collaborator using data supplied by the <CUSTOMER> may be published only after approval has been granted by the <CUSTOMER>.

In case of termination of the Agreement, the genotypes already provided by the <CUSTOMER> remain in the database of Interbull and may be used for the international genomic evaluation for the Brown Swiss breed. Article 11 remains valid even if the agreement is terminated by the <CUSTOMER>.

Article 12

Any dispute under this agreement which the parties cannot resolve by negotiations shall be resolved by arbitration according to Swedish Arbitration law (“lag 1992:145 om skiljeman”). The terms of this agreement shall be interpreted under Swedish Law.

Signed in 3 originals

Signed on (date) ; by <NAME> Legal representative of <CUSTOMER>

Signed on (date) ; by <NAME> Legal representative of <ICAR MEMBER>

Signed on (date) ; by <NAME> INTERBULL CENTRE Director

Appendix I – Service fees for the international genomic evaluation for the Brown Swiss breed provided by the Interbull Centre

Table 1 - Strata and respective fee per 1000 cows.

Minimum	Maximum	Fee per 1000 cows	Cumulative per stratum
1	50000	50 €	2500 €
50001	100000	20 €	3500 €
100001	200000	10 €	4500 €
200001		5 €	

Table 2 - Service fees per country composed by a fixed base (€2500) plus a variable part related to the size of the cow population.

	Number of cows[a]	Base	Variable part[b]	Base+Variable
FRA	17430	2 500.00 €	871.50 €	**3 371.50 €**
SVN	11200	2 500.00 €	560.00 €	**3 060.00 €**
USA	17765	2 500.00 €	888.25 €	**3 388.25 €**
ITA	98204	2 500.00 €	3 464.08 €	**5 964.08 €**
CHE	175629	2 500.00 €	4 256.29 €	**6 756.29 €**
DEA	226377	2 500.00 €	4 631.89 €	**7 131.89 €**
Total	**546605**	**15 000.00 €**	**14 672.01 €**	**29 672.01 €**

[a] Number of cows in 2011. This value must be updated annually. [b] Based on Table 1.