



**Genome architecture:**  
its expression in  
phenotypes  
and populations

XVII Latin American Congress of Genetics,  
XLVII Argentine Congress of Genetics,  
LII Annual Meeting of the Society of Genetics of Chile,  
VI Congress of the Uruguayan Society of Genetics,  
V Latin American Congress of Human Genetics and  
V Latin American Symposium of Cytogenetics and Evolution

# Challenges of implementation of Access and Benefit Sharing measures in livestock sector: animal breeding, research and genebanking



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# Content

European Project n° 677353

- New ABS legal landscape
- Specific characteristics of AnGR
- Gene flow of AnGR
- Impact of ABS measures
  - animal breeding
  - conservation of AnGR & genebanking
  - research
- Conclusions





# ABC of the Nagoya Protocol



- **Access**

- to GR and TK (**PIC**)
- (or no access regulations)

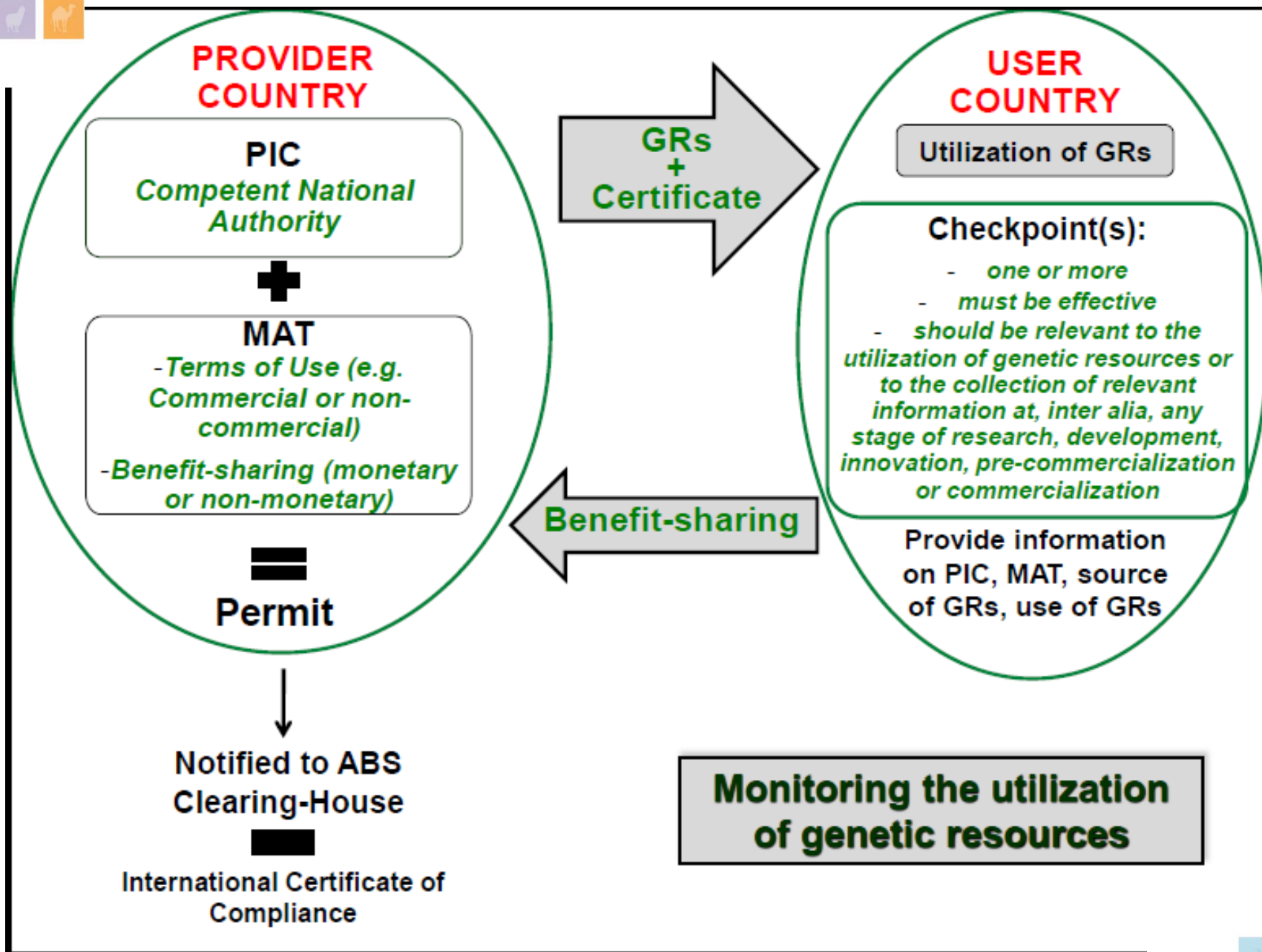
- **Benefit Sharing**

- **bilaterally: according to MAT**
- the GMBSM?
- monetary/non-monetary

- **Compliance**

- national legislation
- IRCC / checkpoints
- checks on users

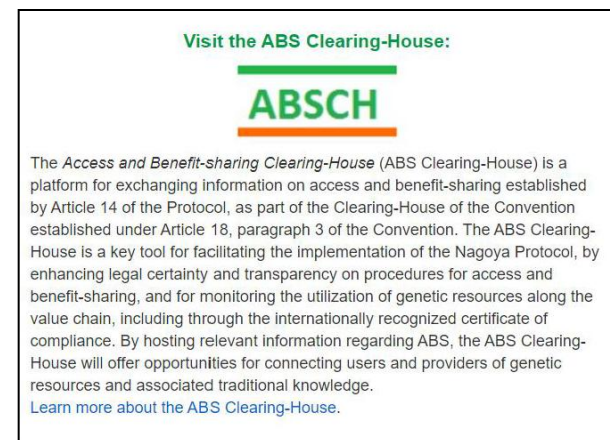






# Nagoya Protocol: implementation

- Adopted 12 October 2010
- Came into force 12 October 2014
- As for 7th October 2019
  - Parties: **119 + 3**
  - CNA: **110**
  - National legislation: **244** acts by **73** countries
  - IRCC: **1109** certificates issued by **18** countries
  - Checkpoints: **52** by **25** countries



# ABS Clearing House

Access and Benefit-Sharing Clear x +


absch.cbd.int

**ABSCH** THE ACCESS AND BENEFIT-SHARING CLEARING-HOUSE

Convention on Biological Diversity

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The Access and Benefit-Sharing Clearing-House (ABSCH) is a platform for exchanging information on ABSCH and a key tool for facilitating the implementation of the Nagoya Protocol. ⓘ



JS map by amCharts Disclaimer

**119** Parties to the Nagoya Protocol

**3** Ratified, not yet Party ⓘ

**79** Non-Parties

### National Records

- 173** ABS National Focal Point
- 110** Competent National Authority
- 244** Legislative, Administrative or Policy Measure
- 8** ABS Procedure
- 1** National Model Contractual Clause
- 1109** Internationally Recognized Certificates of Compliance
- 47** National Websites or Databases
- 52** Checkpoint

?

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17:25 07.10.2019



# Specific characteristics of AnGR

## **Diverse breeding systems:**

- pastoralists – sometimes collective ownership with customary law
- small-scale subsistence farmers and smallholders - individual ownership of livestock
- centralized breeding systems with breeding organizations - private companies or cooperatives

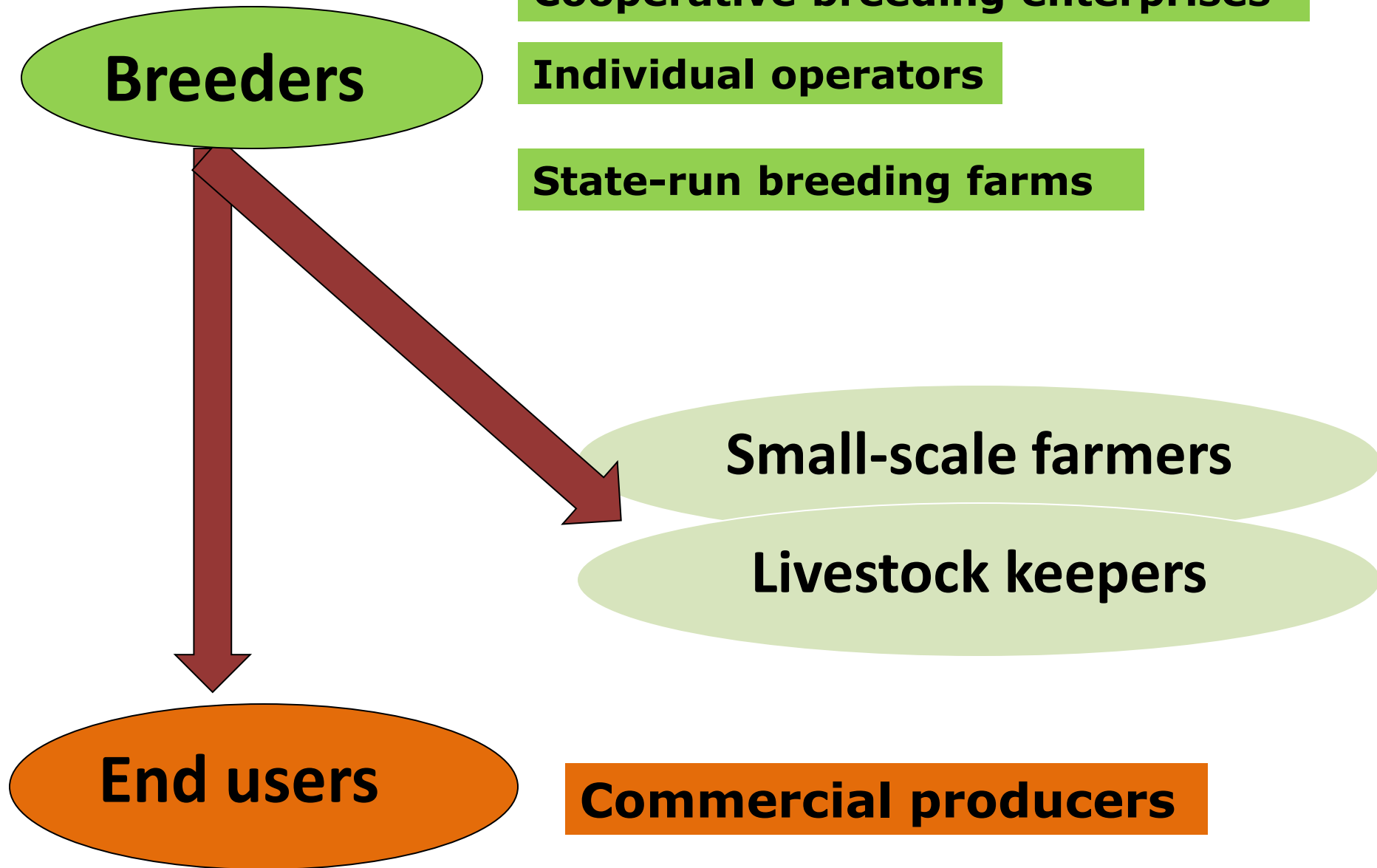
## **Open market:**

- domestic and international exchange by private-private transaction
- contracts from very simple to very sophisticated
- price according to the phenotypic/genetic value of animals

## **Information standards on transfer germplasm set by:**

- WTO: Sanitary and Phytosanitary measures (SPS)
- EU zootechnical legislation (pedigree, genetic value)







# Agro-biodiversity: sectoral differences

	PGR	AnGR
Ownership	public genebanks	private
Value of individual	low	high to very high
Exchange	S→N	N→N and N→S
Trading	farmers'/breeders' rights	bilateral agreements
Genetic progress	new varieties	continuous, selection in purebred populations
Inbreeding	used extensively	not desirable
Breeding/testing costs	inexpensive	expensive
GM	possible/efficient	difficult/not accepted
Patentability (TRIPS)	varieties	breeds not patentable
Centres of origin	well defined	multiple domestication

Adapted from Hiemstra et al. 2006





# Specific characteristics of AnGR

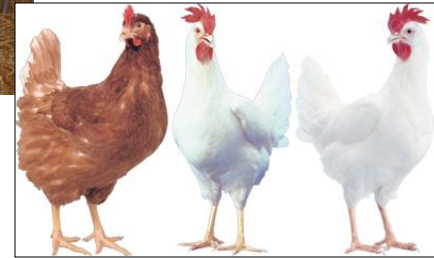
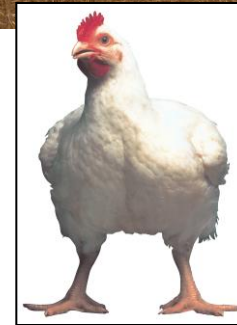
- Private ownership
- Small part of AnGR in public domain
  - breeding/research stations
  - genebanks





# Gene flow of AnGR

- Major gene flow:  
 $N \rightarrow N$  and  $N \rightarrow S$  supporting enhancement of livestock production in developing countries „the Livestock revolution”
- Very limited  $S \rightarrow N$
- Rare examples on successful introgression of exotic AnGR to mainstream breeds (e.g. Meishan pig: early maturity, high litter size but slow growth and high fat level)
- Use of wild species almost negligible





# Gene flow of AnGR

- Growing **S** → **S** flow

Artur Mariante, 2013

Potentially will be most affected

by the Nagoya Protocol  
and national ABS  
legislation

3 years of negotiations  
between authorities  
of Brazil and India

## RECENT EXCHANGE AGREEMENTS

- ❑ After the last ban that forbid the importation of zebu cattle from India in 1962, Brazil and India re-started the discussion about Animal Genetic Resource exchange in 1998.
- ❑ Recently, Brazil and India signed two Agreements:
  - ❖ Agreement to import embryos from India
  - ❖ Agreement to export semen from Brazil





# Awassi sheep

Primitive fat tail sheep  
from Arabian Peninsula





# Israel, ARO Volcani Center

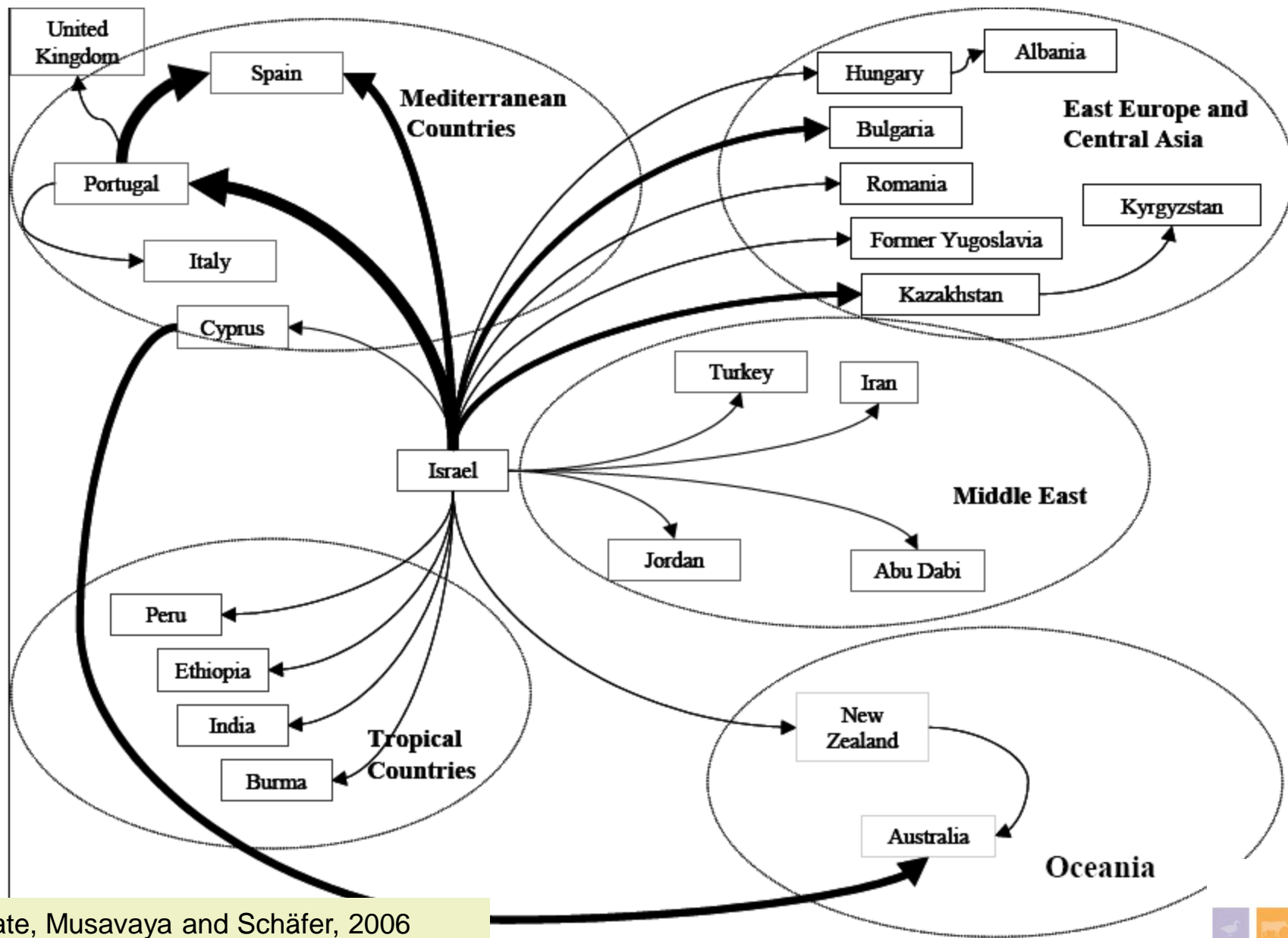
Assaf:5/8 Awassi 3/8 East Friesian



Gootwine, 2008



# Gene flow of Awassi and Assaf





# Why do we exchange AnGR?

Welsch, E. J., Anim. Breed. Genet. 129 (2012)

For the livestock sector, there are three integrated contexts in which genetic resources are exchanged and used that may be affected by a new ABS regime:

- Market (breeding, multiplication, production, conservation)
- Research
- Culture

**Exchange of AnGR is beneficial and smoothly running**





# Commercial trade in AnGR



# American Breeders Service

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# The Pig Site

**EuroTier Digital**  
Out November 2014  
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## Strategic Porcine Multiplication Agreement in China

22 September 2014



**CHINA - Genus plc has a new strategic agreement with River Stone Farm (Shandong) Co., Ltd to become the Group's first commercial multiplier in China.**

Riverstone is a joint venture between Black River Capital Partners Food Fund Holdings (Singapore) Pte Ltd ('Black River') and Pipestone System, a leading US pig management company.

Under the terms of the multi-year agreement, Genus's porcine genetics division, Genus PIC, will exclusively stock and sustain Riverstone's new pig production project

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# PIC in China

## PIC China makes milestone shipment to Shennong

RESEARCH AND INNOVATION

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by 5m Editor  
3 October 2017, at 12:00am

Yunnan Shennong Agricultural Industry Group (Shennong) has recently imported more than 1,000 elite, high-health great grandparent (GGP) from The PIG Improvement Company (PIC).



The shipment of elite pigs is a major milestone in PIC China's partnership with Shennong, an integrated pork producer and one of the most progressive pig farming companies in China. It involved transporting 1,000 GGP gilts from PIC's genetic nucleus facilities in North America and delivering them to Shennong's facility. The animals recently completed a 45-day period of quarantine and are now being integrated into Shennong's nucleus herds.

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# PIC in China

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U.S.-China trade war continues to escalate

AUG 09, 2019

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Genus plc partners with BCA to progress PRRSv resistant pigs in China

The initial phase of the collaboration is expected to take several years and focuses on the research, development and regulatory approval in China of PRRSv resistant pigs.

May 16, 2019

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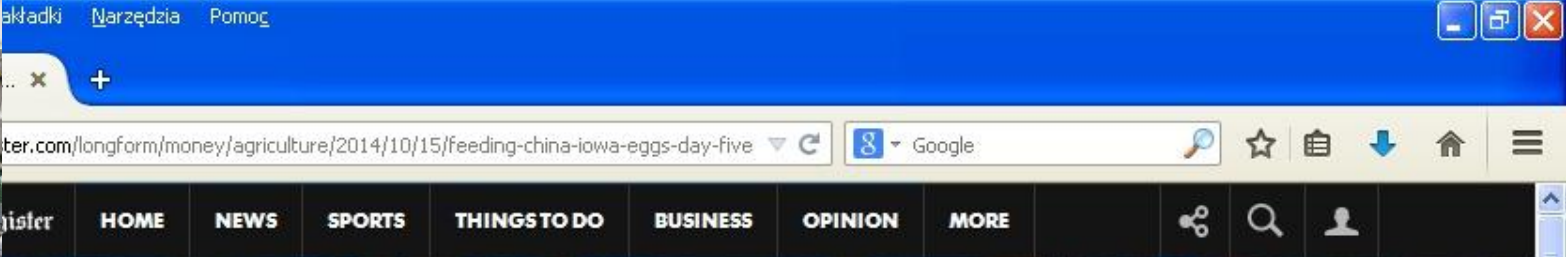
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PRRS: Porcine reproductive and respiratory syndrome

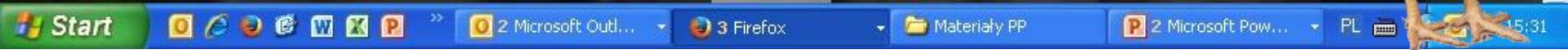


# Feeding China: Iowa firm helps hatch egg industry expansion

WEST DES MOINES-BASED HY-LINE INTERNATIONAL HOPES TO PLAY BIG ROLE AS CHINA MOVES TOWARD U.S.-STYLE MEGA-OPERATIONS.

*Lynn Hicks, lhicks@dmreg.com*

**Every year, about 250,000 chicks make a 7,000-mile journey from central Iowa to China.**





# Sells all over the world

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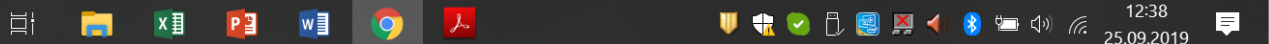
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25.09.2019





# US trade value of AnGR in 2018 (USD)

AnGR	IMPORT	EXPORT
Purebred breeding cattle: live	3,556,520	<b>76,960,782</b>
Cattle semen	<b>37,025,000</b>	<b>190,306,369</b>
Purebred breeding pigs: live	666,770	13,876,109
Chicken below 185g	8,746,680	<b>203,491,176</b>
Turkeys below 185g	<b>24,739,975</b>	12,607,230
Fertilised eggs for incubation: chicken	19,790,373	<b>315,184,649</b>
Fertilised eggs for incubation: other poultry species	26,420,068	9,649,282
<b>TOTAL USD</b>	<b>120,975,386</b>	<b>819,075,598</b>

In 2011, the USA exported **\$664 million** worth of breeding stock and genetic material

<https://comtrade.un.org/data>



# Import of semen to the USA: 37,025,000 USD

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comtrade.un.org/data

UNITED NATIONS » DEPARTMENT OF ECONOMIC AND SOCIAL AFFAIRS » STATISTICS DIVISION » TRADE STATISTICS

UN Comtrade Database Extract data Data Availability Metadata Reference Knowledge base API portal

Period	Trade Flow	Reporter	Partner	Commodity Code	Trade Value (US\$)	Netweight (kg)	Qty Unit	Qty	Flag
2018	Export	Mexico	USA	051110	\$7,804	1	Weight in kilograms	1	0
2018	Export	Australia	USA	051110	\$202,098	0	No Quantity	0	4
2018	Export	Canada	USA	051110	\$32,833,274	0	No Quantity	0	4
2018	Export	Czechia	USA	051110	\$2,929	1	Number of items	250	0
2018	Export	Denmark	USA	051110	\$54,357	0	Number of items	0	4
2018	Export	France	USA	051110	\$1,444,272	0	Number of items	0	4
2018	Export	Germany	USA	051110	\$189,559	7	Number of items	44,170	0
2018	Export	Hungary	USA	051110	\$31,893	9	Number of items	31,893	0
2018	Export	Ireland	USA	051110	\$6,687	54	Weight in kilograms	54	0
2018	Export	Israel	USA	051110	\$2,000	0	No Quantity	0	4
2018	Export	Italy	USA	051110	\$55,320	4	Number of items	3,503	0
2018	Export	Netherlands	USA	051110	\$1,365,760	5,567	Number of items	242,063	0
2018	Export	New Zealand	USA	051110	\$163,526	0	No Quantity	0	4
2018	Export	Norway	USA	051110	\$211,946	30	Weight in kilograms	30	0
2018	Export	Slovakia	USA	051110	\$7,083	1	Number of items	6,000	0
2018	Export	Sweden	USA	051110	\$43,394	0	Number of items	7,901	4
2018	Export	Switzerland	USA	051110	\$32,033	4	Number of items	66	4
2018	Export	United Arab Emirates	USA	051110	\$16,089	25	Weight in kilograms	25	0
2018	Export	United Kingdom	USA	051110	\$187,307	217	Number of items	18,785	0
2018	Export	United Rep. of Tanzania	USA	051110	\$10,757	97	Weight in kilograms	97	0

Showing 1 to 20 of 20 entries

First Previous 1 Next Last

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16:24 24.08.2019



# Commercial trade in AnGR

- When selling animal genetic resources (breeding animals, semen, embryos, fertilised eggs for incubation...)
  - the value of this material as a genetic resource is reflected in its price
  - the buyer usually is free to use it for further breeding and research
- **The price** of animals in fact **includes a benefit-sharing agreement**: the breeder/breeding company gets money in exchange for providing genetic material to user
- In some case parties may agree on restrictions on the further use of breeding material and its transfer to third parties, either through contracts or through “gentlemen’s agreements”.





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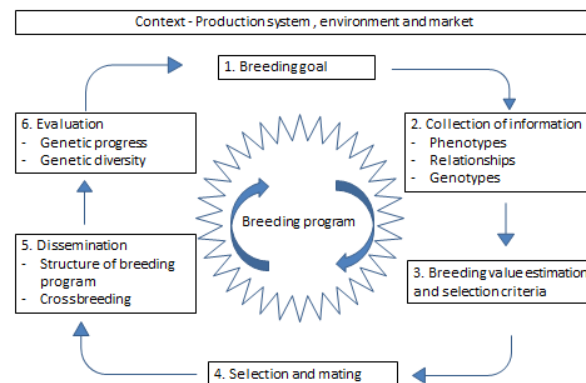
# Impact of the ABS measures



# When ABS legislation becomes relevant?

Introduction of AnGR from a country regulating access!

- New breeds/lines
- Individual breeding animals
- Any type of germinal material



Adapted from: H. Mulder, Animal Breeding and Genomics Centre, Wageningen University and Research

Users have to comply with national legislation  
of the Provider country!  
and obligations arising from their national law (EU ABS law)



# Impact of ABS measures: BREEDING

- **North:** Breeding industry, cooperatives, national breeding programmes: Genetic improvement for mainstream breeds carried out within their selected populations

At present no need for exotic AnGR from the **South**

BUT

- Transboundary breeds or imported breeds may require influx or exchange of breeding material
- Important to facilitate a gene flow from **South** to **South**
- Future needs? Resistance to diseases /adaptation to climate

Some European countries introduced access legislation but livestock GR is exempted from access measures (FR & ES)





# Impact of ABS measures: CONSERVATION

In case of **endangered transboundary breeds**

- If there are national ABS measures in one country where the breed is present
  - Access to breeding stock / reproductive material might be more difficult
  - Collection of samples for *ex-situ* conservation might be more difficult
  - Developing joint strategies for conservation might be more difficult

**AnGR conservation activities** are usually undertaken and implemented **at the national level**, so potentially only single difficult cases





Svalbard  
Norway



# Impact of ABS measures: GENEBANKS



BioBank Norway





# AnGR GENE BANKS

- Animal genebanks: high management requirements
  - ✓ Type of genetic material
  - ✓ Storage requirements/costs
- Still a limited number of operational national genebanks (in public domain) to conserve AnGR in comparison with PGR
- Animal genebanks are recently growing in number
- Ownership of the genetic material
  - Stays with the owner of the donor animal (AU, FR)
  - Transferred to the genebank (NL, PL)





# Impact of ABS measures: GENE BANKS

Need to:

- **Document source of material** that is introduced to the genebank
- Store this information and **make it available for users**
- **Develop protocols and procedures for exchange** of biological material
  - between genebanks
  - transfer from genebank to users
- Adopt and implement voluntary best practices, that include:
  - Standard MAA **Material Acquisition Agreement**
  - Standard MTA **Material Transfer Agreement**

ERFP on AnGR: guidelines for MAA and MTA development





# Exchange of AnGR for RESEARCH

- Exchange of AnGR is usually governed by scientific cooperation contracts
- Some research organisations developed own model contracts
- Each party keeps the property of its inputs in the project
- No other use allowed than specified in the project
- Confidentiality required
- The scientific results, publication and potential IPRs are shared
- Remaining genetic material taken care of (give back or destroy options)

Global research community considers the facilitated exchange of research material between countries of a major relevance





# Impact of ABS measures: RESEARCH

Research projects often require AnGR from countries regulating access to GR, including AnGR

The User:

- Need to follow requirements on ABS of the Provider country: it often require time and efforts
- Need to respect domestic ABS legislation (compliance measures) and the EU ABS Regulation, if relevant

**Countries facilitating access/exempting AnGR from ABS measures will become attractive partners in research projects**

**The ABS legislation will have a highest impact on the farm animal research sector**





# Conclusions: the NP and AnGR

## AnGR Genebanks

## Live animals/germinal products

### Access

Relatively easy to regulate

Difficult to regulate! Ownership and extent of transactions

### Benefit sharing

Unclear:

- ✓ Bilateral arrangements?
- ✓ Benefits towards the Funding Strategy of the GPA?

At present:

- ✓ Bilateral private contracts
- ✓ Price of AnGR reflects its value
- ✓ No requests for additional benefits

### Compliance

Subject to national legislation, check points and monitoring - **feasible**

Subject to national legislation, check points and monitoring - **difficult**



# Different rules for different breeds?

## Global trade in international, mainstream breeds:

- Contributes to enhancement of livestock production, supports Livestock revolution, especially in developing countries
- Profitable for buyers, enhances profitability
- Breeding companies do not expect additional benefits arising from utilisation of their breeding stock
- The price and ability to sell „products“ provides benefits

## Exchange of native and locally adapted breeds that may have:

- desirable traits for future breeding needs
  - unique cultural /social value
- } might be a subject of ABS measures

It may restrict research and **S**  **S** exchange of these breeds



**Thank you for your attention**

