

agricygen



Genomic Studies of Small Ruminants, Plants and Microbes under Cyprus Conditions for sustainable production of Halloumi cheese



**Dr Georgia Hadjipavlou, Project Coordinator,
Agricultural Research Institute, Ministry of Agriculture, Cyprus**
ARI Team Members: Dr D. Fasoula, Dr M. Omirou, Dr I. Ioannides



Semaine Européenne des Races locales des Massifs

Oloron-Sainte-Marie

« PASTORALISME & RACES LOCALES »

16-17-18 septembre 2018



PRESENTATION OUTLINE

- ❑ The Cyprus Small Ruminant Sector
- ❑ The Halloumi cheese production and value chain
- ❑ The AGRICYGEN project
 - Vision
 - Consortium
 - Research Priorities Pertaining to Climate Change
 - Focus on securing Halloumi cheese PDO
 - Impact

CYPRUS AT A GLANCE



Cyprus is located in the Eastern Mediterranean and Middle East region

- Around 1 million inhabitants
- Total land area 9240 km²
- Mediterranean, semi-arid climate
- 12% of the land is used for agriculture
- 2% of agricultural land is suitable for grazing
- Increase in agricultural output is among the highest in the EU (~5% in 2015)
- Animal production contributes 49% to total value of agricultural production

REGIONAL CLIMATIC CONDITIONS AND TRENDS

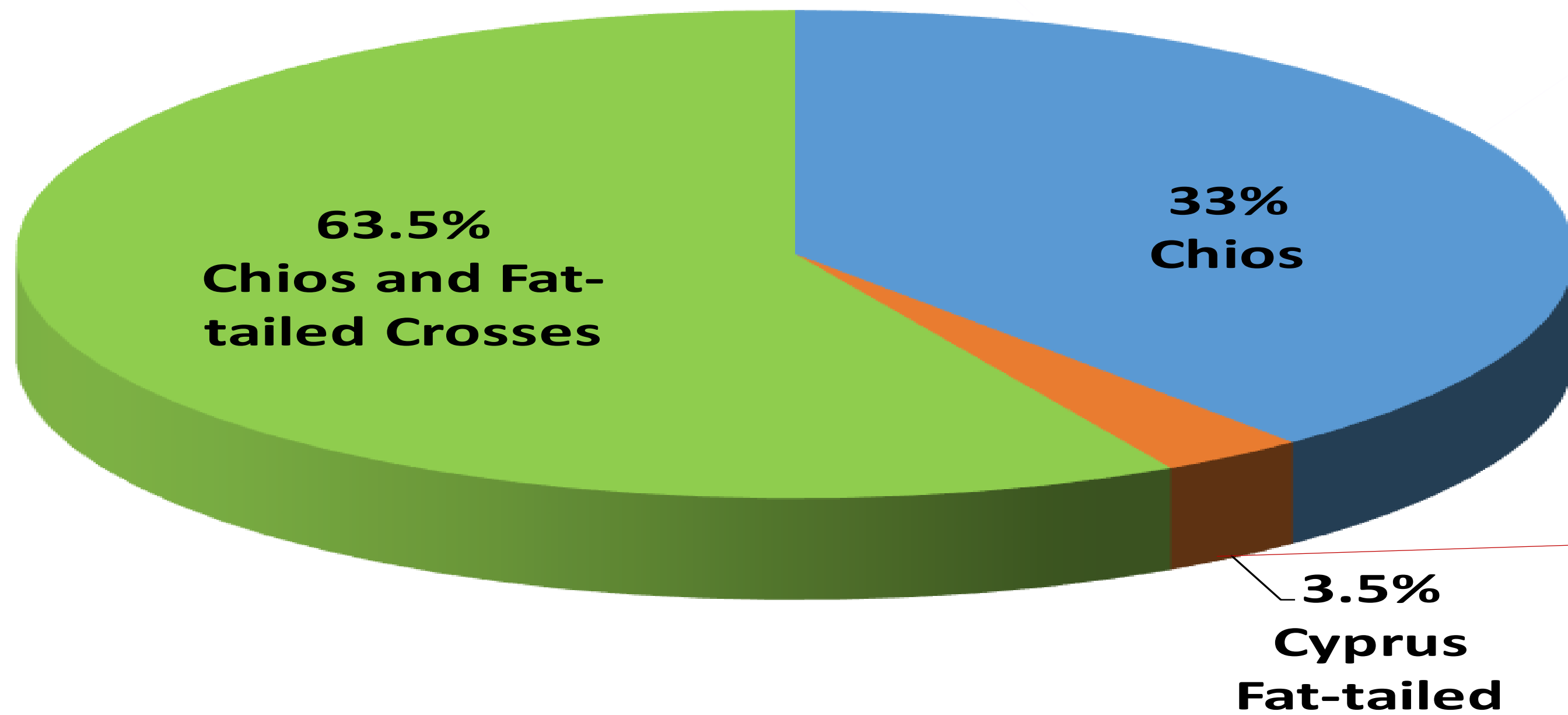
- The Eastern Mediterranean and Middle East region is an evolving climate change hotspot
 - ❖ Significantly **drier and warmer climate** conditions expected in the years to come
- Mean temperature expected to rise by:
 - ❖ 1-3°C in the next 3 decades; 3-5°C by 2050; 3.5-7°C by 2100
- Ongoing decrease in rainfall in last 3 decades
 - ❖ In Cyprus, **10 droughts events in the last three decades**, five of which in last 10 years, three of which in last 5 years
- Additional reduction in rainfall by 10-15% expected over the 2020-2050 period

SMALL RUMINANT SECTOR

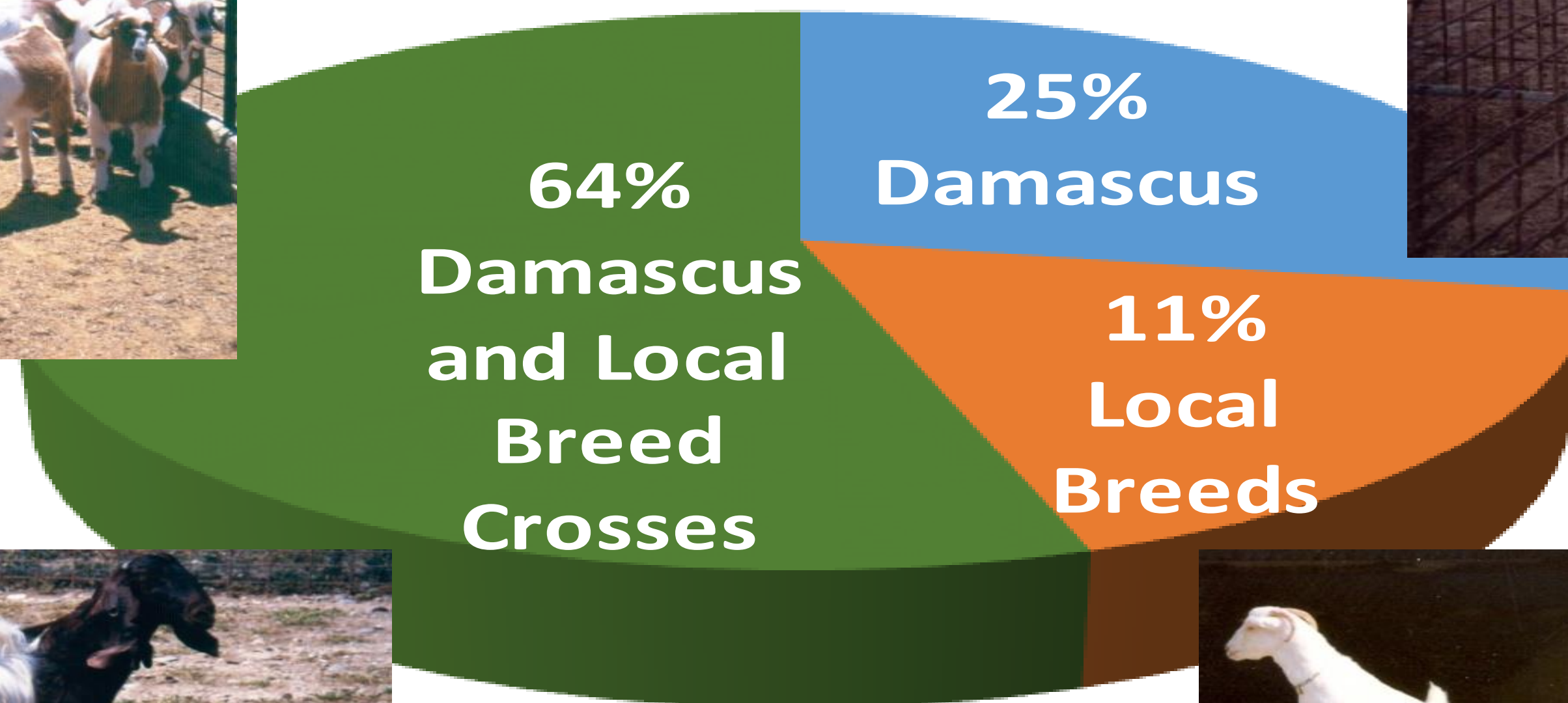
General Information

- **297,000 sheep** (206,000 breeding ewes) (DAG, 2015)
- **234,000 goats** (147,000 breeding goats) (DAG, 2015)
- **50,000 tons of sheep and goat milk** produced yearly in 2010-2015
- A total of 2 215 farms -1315 have more than 50 animals
- Substantial differences in milk productivity based on farm size
- About **10% of milk is processed on farm** (within region variation)
- 40% of farms keep both species, 30% only sheep, 30% only goats

SHEEP BREED COMPOSITION



GOAT BREED COMPOSITION



CYPRUS CHIOS SHEEP

CYPRUS DAMASCUS GOATS

- **Dual purpose breeds**
 - High milk production
 - High fecundity
 - Early reproductive maturation
 - Satisfactory growth rate



SMALL RUMINANT BREEDING STRUCTURE

- Three tiers: Closed nucleus flocks, multipliers, commercial producers
- Since 1980s, most efforts concentrate on genetic improvement of pure-bred Cyprus Chios sheep and Damascus goats
- Mating is done mainly via natural service (individual hand mating in nucleus flocks)
- Government nucleus flocks maintain a total of 800 Cyprus Chios ewes and 700 Damascus goats
- 10-20 multiplier flocks take part in milk recording and genetic evaluations in recent years



TRAIT MEANS IN 1980 AND TODAY



Trait	Cyprus Chios sheep		Cyprus Damascus goats	
	1980	2014-2015	1980	2014-2015
Yearly milk production (kg)	267 (220 days)	429 (251 days)	306 (235 days)	491 (235 days)
Fecundity (number born per litter)	1.8 lambs	2.10 lambs	1.9 kids	2.0 kids
Litter Weaning weight (kg)	21.5	23.2	17.8	24.7
Post-weaning growth rate (kg per day)	0.22	0.31	0.14	0.22

MAIN MILK PRODUCTS

Halloumi cheese (S, G or S&G)

Yogurt (Sheep)

Anari (whey cheese) (S&G)

Trahanas (Goat)



THE HALLOUMI CHEESE

A traditional product with strong links to Cyprus's history and culture

- First historical records date back to 1554 and first export records to the 1800s
- Sold fresh or mature; made from curds produced by curdling milk with rennet
- White to light-yellowish colour; easily sliced; eaten raw, grilled, fried etc.
- **Second most exported product in Cyprus** -15,000 tons exported to 42 countries



THE HALLOUMI CHEESE

Pivotal for the Future of the Cyprus Sheep and Goat Sector

Pending PDO application (EU 2015/C 246)

Specifications pertaining to sheep and goat milk:

- Must correspond to >50% of milk quantity used to make halloumi cheese
- **Must originate from pure-bred local Cyprus small ruminant breeds and historical crossbreeds of these breeds**
- At least 50% of the fodder used for small ruminants must be produced locally
- 10-year transitional period to fully meet PDO requirements (deadline: July 2024)

ISSUES / OPPORTUNITIES

- ❖ Currently, majority of milk used for halloumi cheese comes from dairy cattle
- ❖ Must **increase sheep and goat milk production to abide to PDO specifications**
- ❖ Take into account climate change effect on soil, on crop production and on animal production
- ❖ **Efficient genetic improvement of the local breeds on their production systems**
the only sustainable approach to achieve increased milk production in a definite, permanent and prompt manner



AGRICYGEN VISION

Local Conditions

Climate Change

Animal Production
Crop Production
Agricultural Microbiology

Efficient Production & Quality

Future Demands

Cutting-edge Technologies and **Expertise**

Unique Approach for Sustainable Agricultural Development



RESEARCH THEMES AND SCIENTIFIC EXCELLENCE

AGRICYGEN overarching scientific goal:

To exploit and enhance the power of Genomic Evaluation and Selection in animal and plant breeding programmes, in order to accelerate genetic gain and biological discovery, and improve the productivity of the whole system



Animals

Crops

Microbes



AGRICYGEN

**World Class Centre
for Agricultural Genomic Studies**

**Leading Service Provider
for Local & Regional Stakeholders**



Cyprus Agricultural Genomics Centre

**Continuous Strategic Growth
through People & Public Engagement**

**Valuable Research Partner
in Cutting-Edge Research Projects**



www.agricygen.eu ; www.facebook.com/agricygen

AGRICYGEN CONSORTIUM (Cyprus partners)

ARI (Coordinator)



- Unique, valuable genetic resources and research stations
- Successful breeding programmes for small ruminants and crops
- Research across animals, crop plants, microbial communities

Cyl



- Largest regional High Performance Computing (HPC) Facility
- Highly successful R&I Management and Support Office
- Research-oriented Graduate studies and training portfolio

CING



- Leader in functional genomics and high-throughput DNA analysis
- Newly established Bioinformatics group through EC funding
- State-of-the-art computational methodologies and processes

TALOS RTD



- Project management experience for >50 European research projects
- Expertise on market research, business and financial analyses
- Extensive network of SMEs and other stakeholders

AGRICYGEN CONSORTIUM (European partners)

UEDIN (UK)

- The 19th Best University in the World
- Received €122M in funds from FP7 EC research projects
- Roslin Institute is a world leader in Animal Genetics and Genomics

IPK (Germany)

- Ranks among international leaders in plant science research
- Hosts the largest crop plant genebank in EU28
- Leader or partner in international crop consortia and networks

IDELE (France)

- National technical reference and normative body in livestock farming
- Applied research, technical assistance and technology transfer
- Support to Ministry of Agriculture

INRA (France)

Public institute, ranked 5th worldwide in animal & plant sciences

- Pioneers in research & implementation of S&G genomic evaluations
- Experts in Agroecology, soil biodiversity and metagenomics



GENOMICS AND BREEDING IN A CHANGING CLIMATE

- **Breeding for resilience and adaptation traits, such as heat or drought tolerance, in addition to other economically important traits**
- **The only sustainable approach to decidedly address climate change effects on agriculture and animal production**

Requirements:

- ❖ Identification and extensive collection of relevant phenotypes in crops and animals
- ❖ High-throughput genomic and metagenomic studies to identify the genetic loci and processes involved in adaptation mechanisms
- ❖ Understanding how environmental shifts alter soil composition and affect crop performance
- ❖ Efforts for expedited genetic improvement must take into account local conditions and projected climate change effects on animal and crop production

AGRICYGEN IMPACT

The Centre's Strategic Plan focuses on **pursuing innovative activities** and on **achieving research outcomes of high economic and societal value for Cyprus**

Initial Focus: **Halloumi cheese production and value chain**

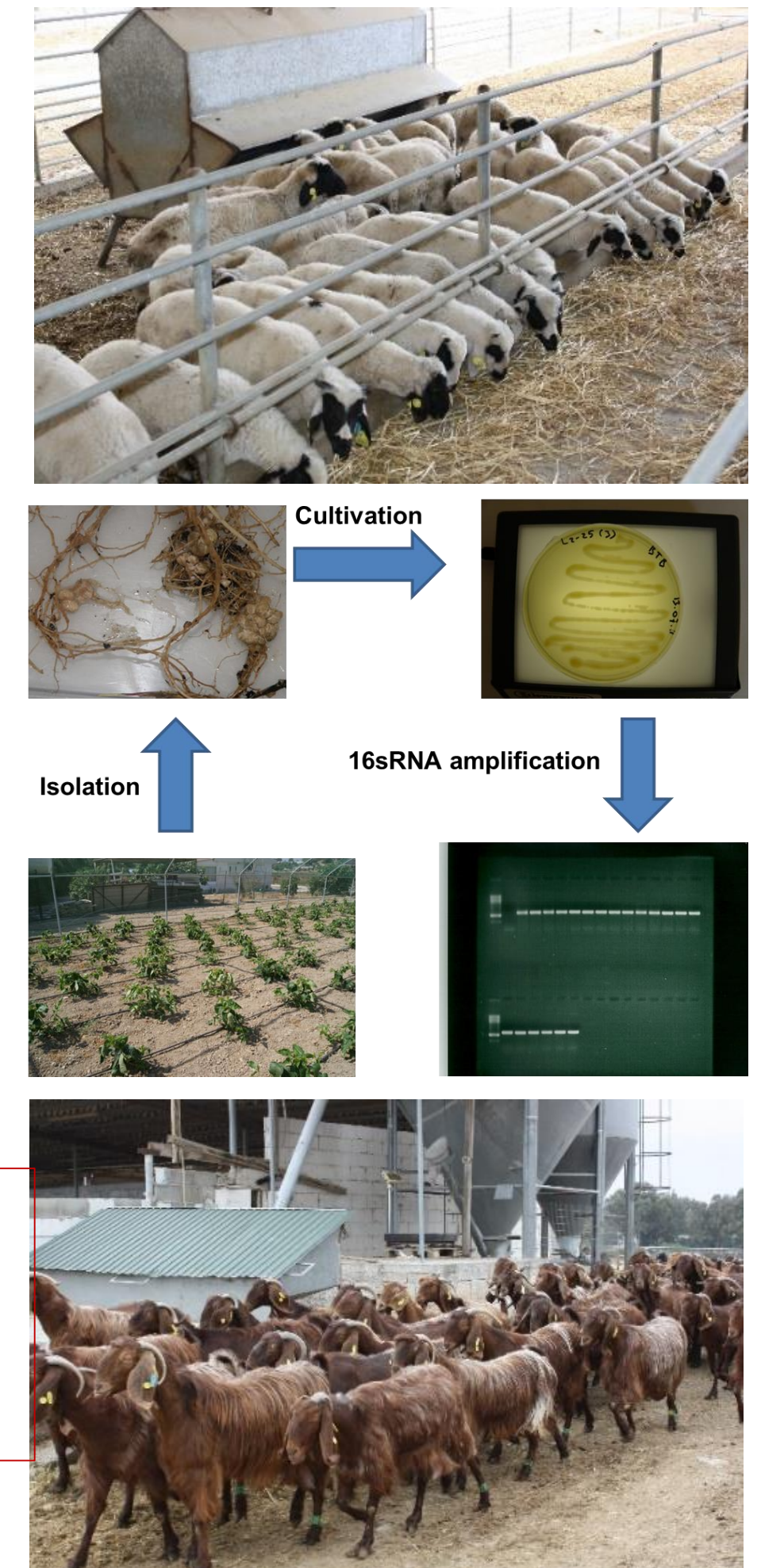
Outcomes of Economic Value

1. Increased production of sheep and goat milk from local breeds
2. Increased yield and nutritive value of local feedstuff
3. Ecological approaches to enhance Cyprus soil productivity

Whole system approach for sustainable improvement and progress through genomics and breeding



agricygen



ACKNOWLEDGEMENTS



The Cyprus Ministry of Agriculture, Rural
Development and Environment

The Cyprus Ministry of Finance
(in particular DG EPCD and RPF)

All AGRICYGEN team members:

ARI, Cyl, CING, UEDIN, INRA Toulouse,
INRA Dijon, IDELE, IPK, TALOS RTD



This project has received funding from
the European Union's Horizon 2020
Research and Innovation Programme
Under Grant Agreement No 763700