Islamic Organization for Food Security
l'Organisation Islamique pour la Sécurité Alimentaire
المنظمة الإسلامية للأمن الغذائي

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Leveraging Animal Breeding and Genetics to Mitigate Risks and Enhance Resilience in the Livestock Sector in face of Climate Change and other Challenges.

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If a quick answer is needed: Upgrade farmers' practices to reach the level of the scientific rationality

1. Farmers choose their animals to be parents of future generations based on their phenotypes or performances.

   Help them to do it based on animals genotypes or Breeding Values

2. Farmers mate selected parents based on observations

   Help them to mate the best males with the best females based on their Breeding Values

3. Farmers use their feelings to keep or cull animals

   Help them to cull the poorest animals based on their Breeding Values and replace the culled ones with the young generation coming from the mating of the best with the best

Addressing Challenges in Animal Genetics Implementation

Nearly four decades of professional history contributing to advancement in animal genetics:

- Building expertise capabilities through training and research (local, regional, world)
- Empowering Farmers and Livestock Owners via Transfer of applied research results
- Establishment of Tunisia's National Gene Bank
- Working with Regional and International Organizations

Challenges Despite Achievements:

- **Animal productivity remains suboptimal**
- **Native breeds crossed randomly with imported exotic breeds creating genetic erosion**

Barbarine Fat-Tailed Sheep: A Vital Genetic Resource in Tunisia

- **Significance**: Barbarine sheep, introduced 3000 years ago by the Phoenicians, are crucial in all agro-ecological zones, from temperate to desert environments.
- **Unique Adaptation**: Barbarine can store 5 to 8 kg of fat in their tails, vital for survival in harsh conditions.

Trait	Lambs	Average	SD
BW (kg)	92341	4,32	0,51
W30 (kg)	90491	8,43	2,11
W70 (kg)	72488	14,11	3,41
W90 (kg)	55334	16,63	3,89
ADG030 (g/j)	89935	138,22	56,45
ADG3070 (g/j)	72146	139,76	45,83
ADG3090 (g/j)	55035	135,08	41,69

Ben Abdallah, I. PhD Thesis 2022
Data source: OEP, MOA

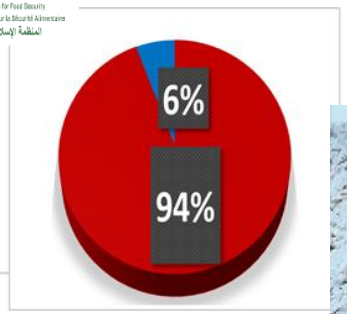
With all of the above:

Barbarine lambs have lost 6 kg on average at 90d, since the sixties !!!

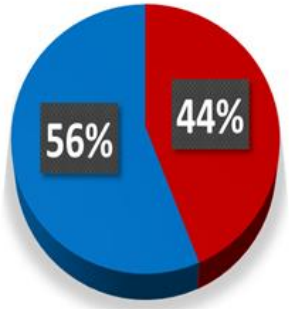
« A weak Breeding Strategy »

Importing Exotics and Cross Natives: The Dilemma !

1974

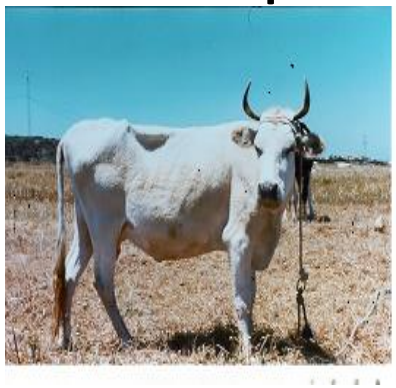


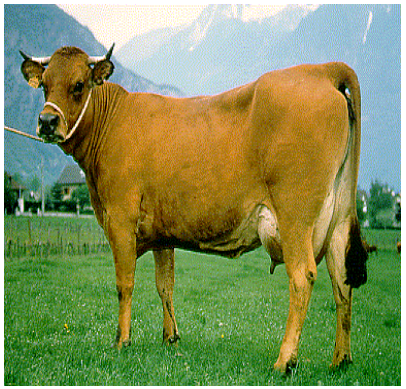
2022



Brune de l'Atlas

Blonde du Cap Bon





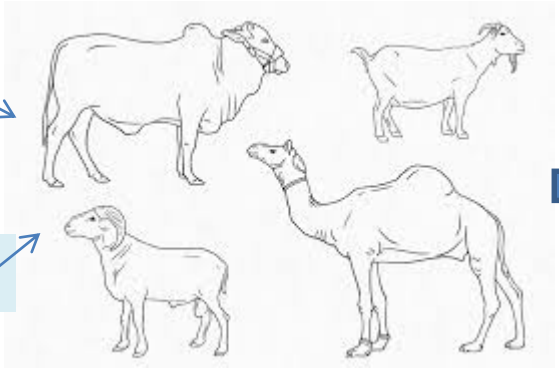
Livestock resilience, adaptation, productivity are of great concern to International Organizations for production of food and food security

Breed-Animal-Genotype

Non **genetic** factors

Environment

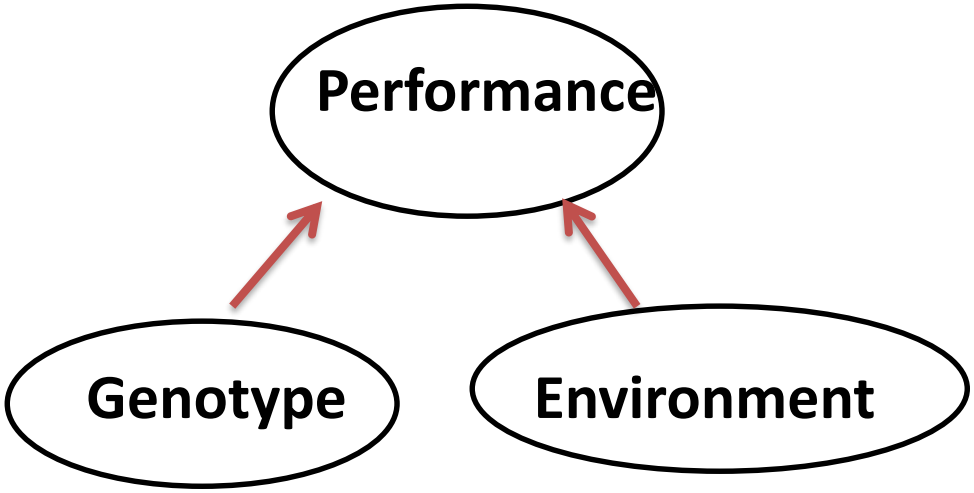
Mangement (feeding-Nutrition, Health, Reproduction, Housing), Year, Season…



Productivity

Market

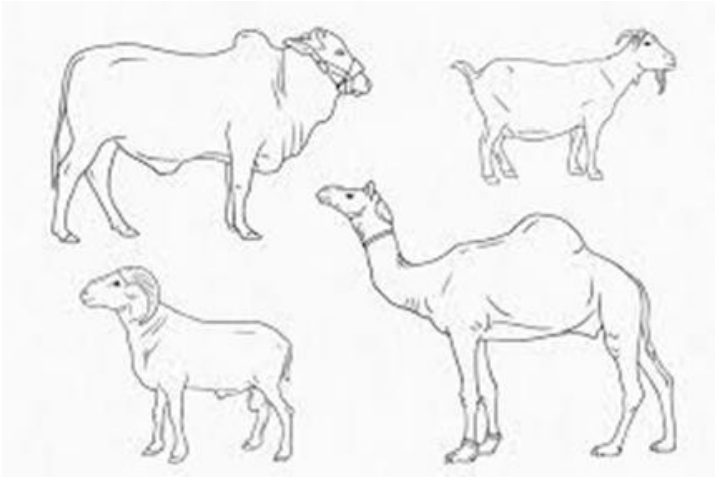
Principle 1. Animal performances are a result of their genes and the effect of the environment: The power of P=G+E



$$P = G + E$$

$$P = \underbrace{A + D + I}_{} + E$$

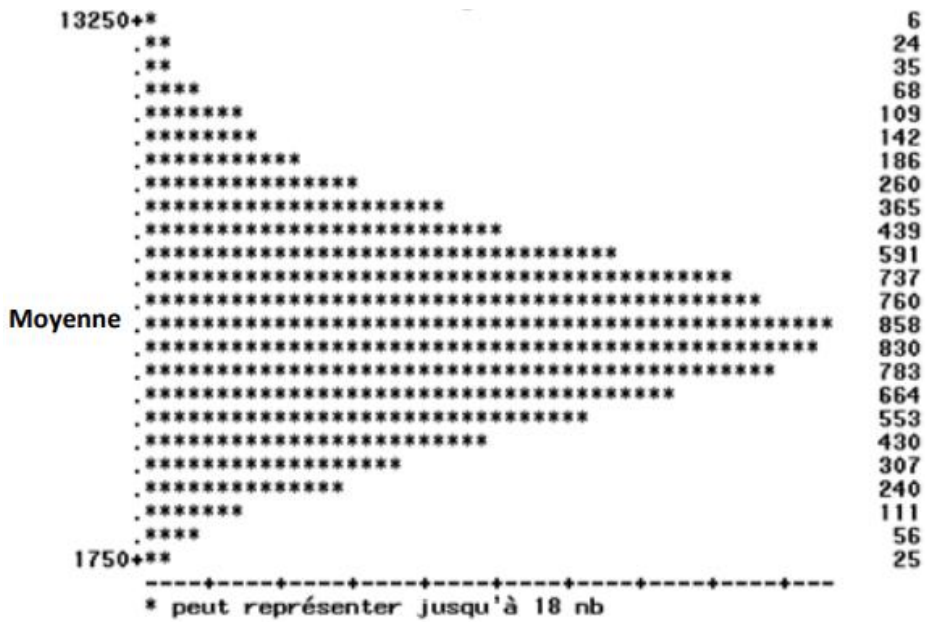
½



progeny

$$\hat{A} = P - E$$

Principle 2. Recognizing the Breed as Individuals



Variation within a single breed

Phenotype = Genotype + Environment

Breed should be seen as a composite of unique individuals,
not a singular entity.

•***Impact:*** Misunderstandings contribute to suboptimal breeding practices, hindering the realization of full genetic potential.

The Key: A**<u>nimals within a breed must be individually evaluated against herd or flock mates.</u>**

Principle 3. Essential Ingredients of Animal Genetic improvement Programs

1. Animal Identification and Traceability:

- Establishing individual identity for each animal in the breeding program.
- Enables accurate record-keeping, pedigree tracking, and monitoring of individual performance over time.

2. Performance Recording:

Data Collection: Systematic recording of individual animal performance metrics.

3. Genetic Evaluation:

- *Analytical Process:* Utilizing statistical models to assess the genetic merit of individual animals.
- ensuring the pairing of individuals with desirable traits for enhanced offspring performance.

4, **Dissemination of Superior genes**

5. Collaborative Livestock Organizations:

- *Formation:* Livestock owners should come together to create collaborative organizations.
- *Objectives:* Facilitate breed promotion, knowledge exchange, and collective decision-making.

Livestock Resilience, adaptation, productivity, sustainability, and Animal Breeding and Genetics"

Assets of any Domestic Animal Genetic Resource:

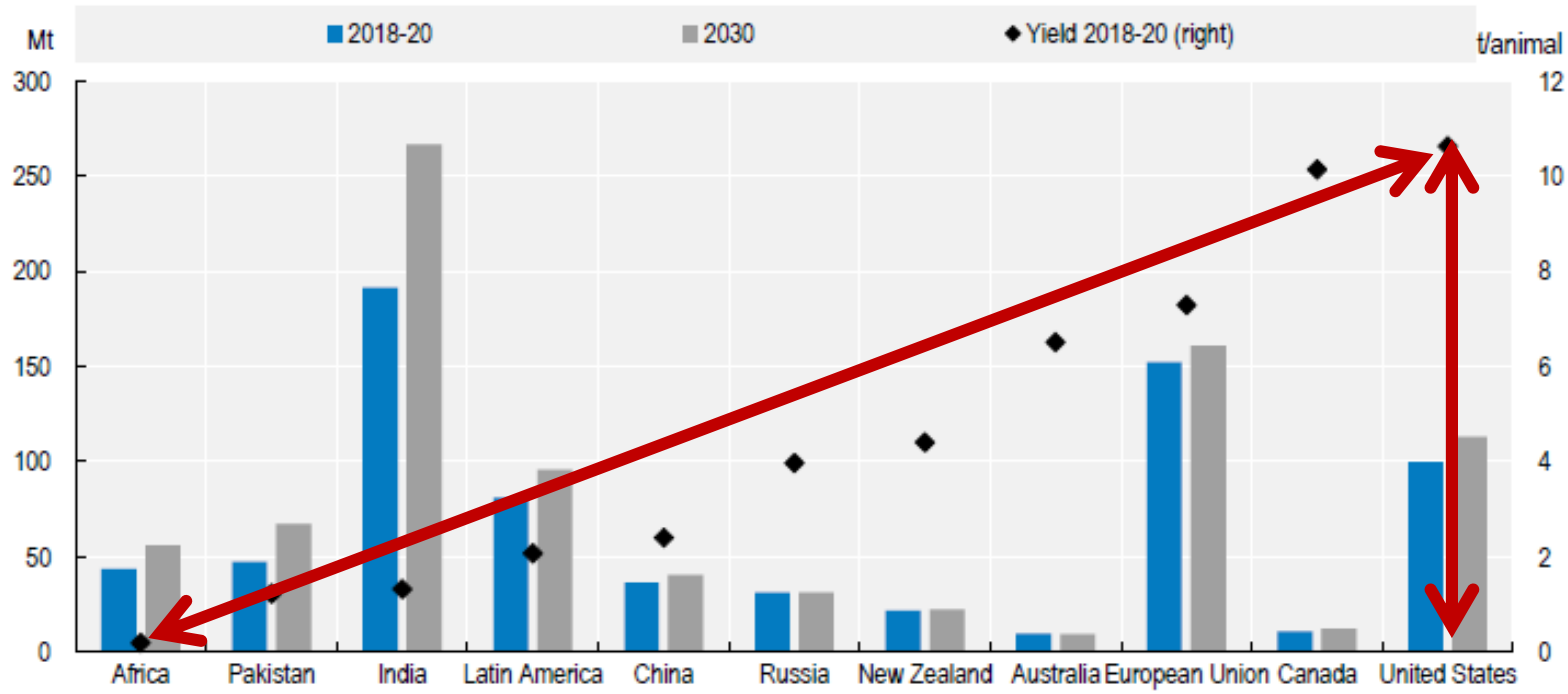
Dynamic Variability

Adaptation is a result of (Dynamics and Variability) in a given Environment:

Performance = Genotype + Environment

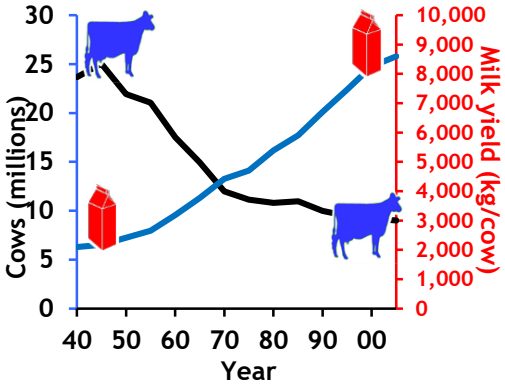
Sustainability ← **Knowledge and Organization**

Animal productivity Improvement: The secret is in the genes



OECD-FAO Agricultural Outlook 2021-2030

USA Dairy Cattle

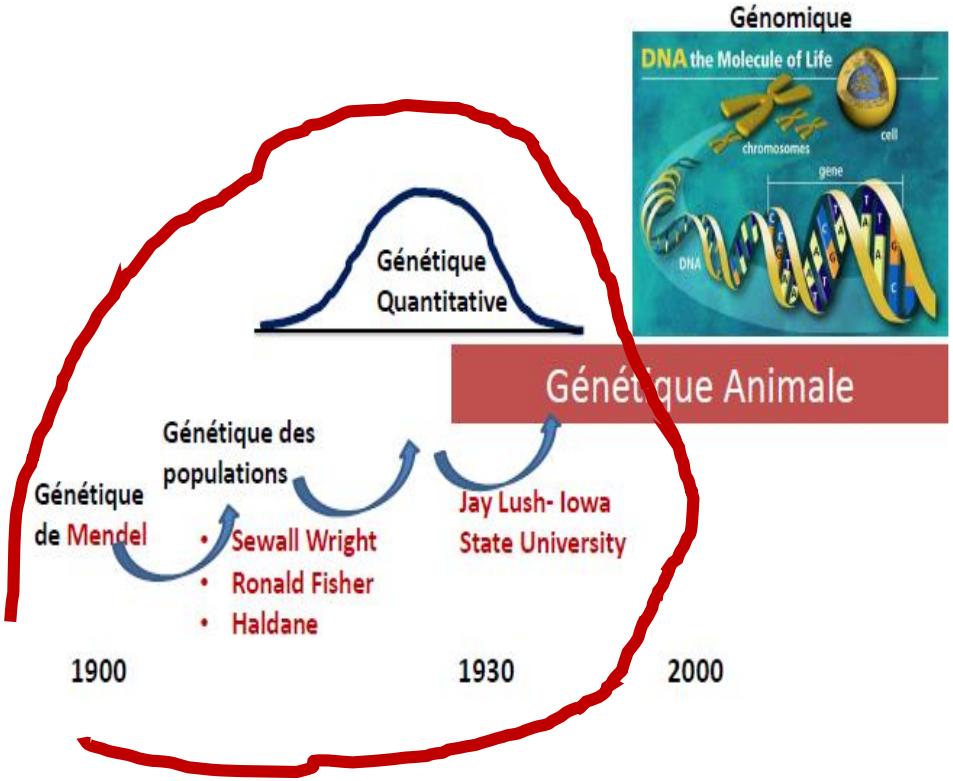


Unlocking Animal Productivity Potential: Examining the Role of Genuine Animal Breeders in Low-Productivity Countries

1. Low-productivity countries may lack genuine animal breeders, or their full potential remains underutilized.

2. Majority of animal science students lean towards less mathematically intensive disciplines, hindering the capacity of developing countries to implement reliable breeding strategies.

3. Many animal genetics PhDs specialize solely in genomics, neglecting holistic genetic breeding strategies.



Risk: Weakens the ability to implement sustainable breeding strategies in developing countries.

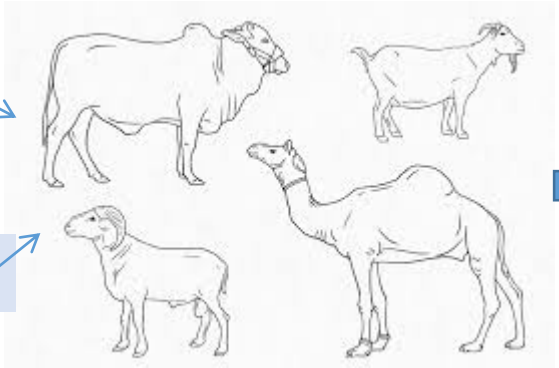
Animal Productivity is not only « Genetics » !

Breed-Animal-Genotype

Non **genetic** factors

Environment

Mangement (feeding-Nutrition, Health, Reproduction, Housing), Year, Season…

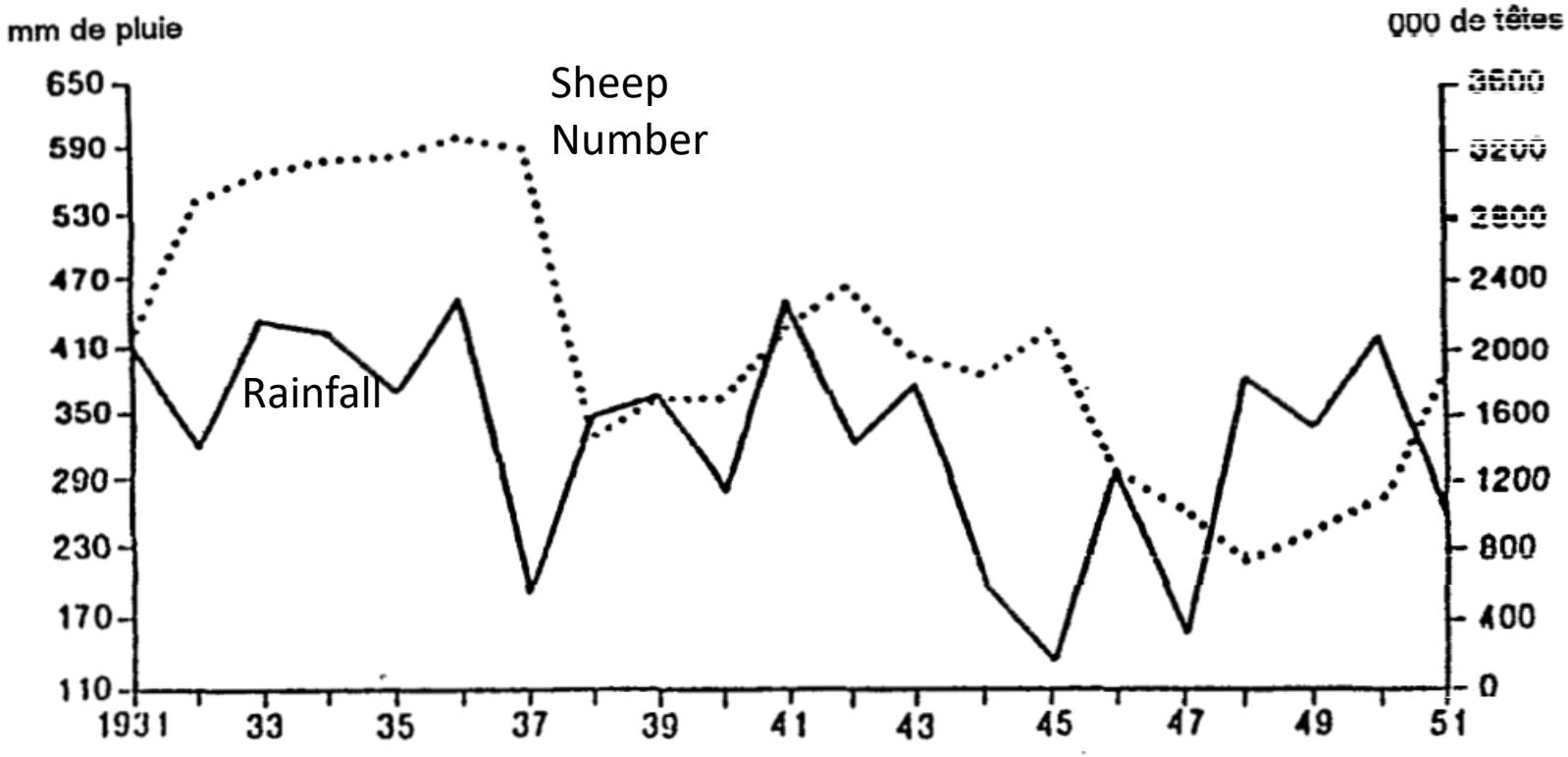


Productivity

M a r k e t

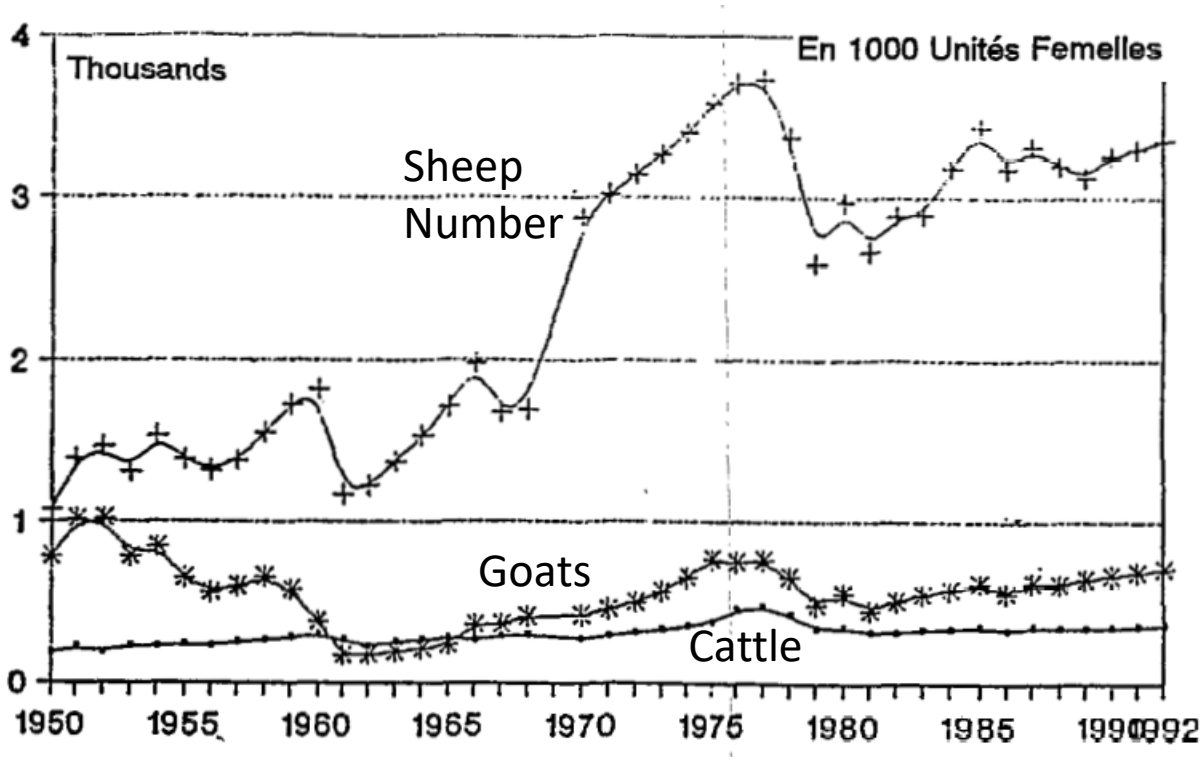
Feeding system: Variation of sheep populations in Nothern Tunisia and the rainfall (1931-1951) (Natural equilibrium)

Ben Dhia-CIHEAM, 1995



Mutations of Feeding and Feeding systems (1950-1992)

Ben Dhia-CIHEAM, 1995



Farmers Orgnizations

- The professional organization (producer associations, breed associations) is practically nonexistent.
- Farmers are fragmented, resistant to working together.
- The administration should play its role as a facilitator to set up Breed Associations

Saving a threatened dairy sheep breed by Farmers organization, research and Market: The exampe of the Sicilo-Sarde dairy sheep breed

Adoption of livestock populations governance model

Governance Model:

1. Inventories & Characterization
2. Conservation
3. Sustainable Use
4. Organization
5. Building Capacity

Conservation:

- *In Situ*
- *Ex Situ* (Live)
- Gene Banks

Sustainable -Use:

Selection/Genetic gain/Productivity

1. Breeding Goals
2. Recording
3. Genetic/genomic Evaluation
4. Dissemination of superior genes

*Crossing-Planned

Organization:

- Nucleus
- Multipliers
- Serving the remaining population
- Breed Organization

Reducing the GAP in Genetic Evaluation tools

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Phase 1	Phase 2

AIM HIGH

QUICK SPEED-Reduce the Gap –Building Capacity

2024

2025

<= 2009

Phenotype & Pedigree Genetic Evaluation Models

2009 -2023

Phenotype & Pedigree & Genomics + Genetic/Genomic Evaluation Models

+ Reliable Animal Breeding Strategies

n

Networking: Key Collaborative Strategies for Sustainable Livestock Development

- **Partnerships**: International and regional collaboration among funding agencies and livestock development bodies:
  1. Formation of the IOFS Animal Breeders Network
  2. Organize Regional training workshops
  3. Establish Regional and National Action Plans for Sustainable Use of Farm Animal Genetic Resources

- **Experiences Exchange**: Foster exchanges among livestock stakeholders

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