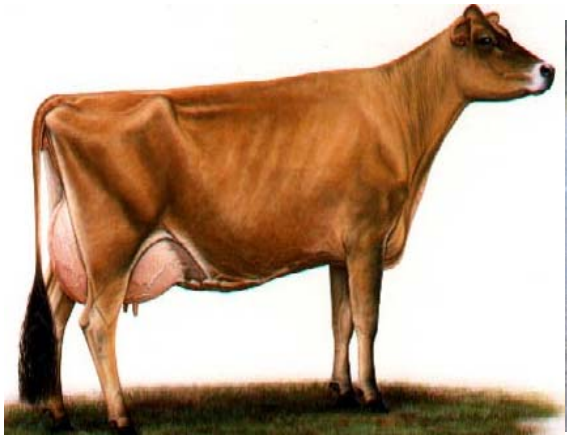
The need for environmental/genetic impact assessments of gene flows; possible positive and negative effects



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Animal Genetic Resources

- Animal genetic resources (AnGR) refer the genetic resources of those animal species that are used, or may be used, for the production of food and agriculture, and the populations within each of them.

- These populations within each species can be classified as wild and feral populations, landraces and primary populations, standardized breeds, selected lines, and any conserved genetic material (FAO, 2000).

Gene flow

- Gene flow gives us a clear picture of the nature and structure of genetic diversity, and helps us to determine how best to apply this knowledge to meet our goals.
- Gene flow allows us to study the inheritance of a trait, explore the relationship between genetic makeup and observed phenotype, look for genetic components associated with a trait, and identify ancestors that are the likely sources of a gene or trait, and much more, all from a single platform.

Components of gene flow

- **Pedigree module:**
  - This module uses a pedigree-based display and supports the overlay and analysis of genetic and phenotypic data within the context of known family relationship.
- **Genotype module:**
  - This module provides a detailed, chromosome-level view of the genetic content and organization of various individuals.

Components of gene flow.....

- **Population module:**
  - Analysis of structured population, ranking the progeny and producing a detailed report can be effectively done from this module.
  - It is also helpful to quickly decide which progeny to select and markers to track that makes the selection process much more efficient.
- **Report module:**
  - This indispensible component generates a large number of key reports and graphs. Many of the reports integrate genotype and phenotype data, shedding light on the structure of genetic diversity, and the relationship between genes and traits.

Components of gene flow.....

- **Workbench:**
  - It serves as a holding area for subsets of accessions, markers and traits, providing powerful filtering capabilities. Analysis can be run using the entire database or just a subset, allowing us to target queries and compare results between different segments of data.
- **Germplasm security module:**
  - This module protects the time and money invested in developing proprietary materials be detecting and displaying patterns of containment of one genotype within another.

Components of gene flow.....

- **Multiplex module:**
  - This module automates the complex and time consuming task of determining the most efficient way to multiplex a set of markers. The kits can be customized, edited and displayed graphically.

Pattern of gene flow

The gene flows in different hemispheres are seen as:

- **North to North flow**
  - There have been very extensive North to North flows, driven by advances in reproductive technology, which have largely taken place in a relatively free market managed by breeding companies, cooperatives and individual breeders. Such flows have driven the rapid expansion of highly improved livestock adapted to the intensively managed systems

Pattern of gene flow……..

- **South to South flow:**
  - Historically, South to South movements of livestock germplasm have been extensive and have had major positive impacts on productivity (Gibson & Pullin, 2005). One relevant example is the introduction of Indian cattle breeds (Kankrej, Gir etc.) into Latin America (Galal *et al*., 2006).

Pattern of gene flow……..

- **North to South flow:**
  - There are striking examples where such movements of germplasm, supported by business, interests and development agencies, proved insufficiently adapted to local conditions.
  - Some of these movements have been successful, especially where they were based on intensification of production systems. An example is the successful cross breeding of pigs in Vietnam.

Pattern of gene flow……..

- **South to North flow:**
  - Movements of livestock germplasm from South to North have been rare in the past century, and in most cases the economic benefits to both North and South have been relatively small.
  - The potential for profit in North is higher, but there is little or no demand in the North for the traits of indigenous livestock that make them so valuable in the South
  - An example of a South to North exchange is the Tuli cattle breed in Southern Africa, which was introduced to and commercialized in Australia and the USA

Major scenarios affecting the gene flow

- Four scenarios are identified that may affect the future management of AnGR:
- **Globalization**: Livestock production is shifting from being a multipurpose activity with mostly non-tradable outputs, to one focused on food production in the context of globally integrated markets.
- **Biotechnology**: Continued and rapid progress in reproductive and cryoconservation technologies, quantitative genetic tools, improved efficiency and safety of transgenic and cloning technologies and prevention and control of animal diseases are expected to accelerate ongoing changes in livestock sector.

Major scenarios affecting the gene flow……

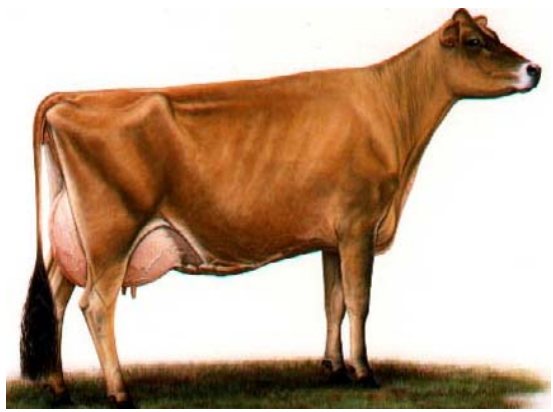
- **Climate change**: Changes to temperature, precipitation, rising sea levels, changing incidence of extreme weather events and increasing atmospheric carbon dioxide and other greenhouse gas content are the five main climate change-related drivers that may bring change in livestock production systems.

- **Diseases and disasters**: Increased international trade and travel, along with the effects of climate change, are expected to promote the spread of livestock diseases into new geographical areas in the coming years.

Gene flow in major livestock species

Cattle:

- Breeds of European descent account for eight of the world's top ten most widely distributed cattle breeds. The Holstein-Friesian is reported in at least 128 countries, and in all regions. Jersey is utilized in 82 countries, the Simmental (a dual-purpose breed) is utilized in 70 countries, Brown Swiss (a dual-purpose breed) is utilized in 68 countries and Charolais (beef breed) is utilized in 64 countries.



Gene flow in major livestock species

- South Asian cattle breeds have also spread over many parts of the world. These breeds are of all *Bos indicus* types. Sahiwal- a dairy breed originating from Pakistan and India has been introduced to 12 African countries. Ongole and Gir cattle are famous in Brazil. Gir cattle, indigenous to Gujrat, India, is the best breed in Brazil now.
- The Times of India, September 27, 2010 states as, "The Indian 'Holy Cow, Gir' has turned out to be a great money-spinner for Brazil".
- The N'dama, a trypanotolerant breed, developed in Guinea, is reported in 20 West and Central African countries.

Gene flow in major livestock species……

Buffaloes:

- Buffalo was originated in Indian sub-continent.
- Out of 170 millions buffalo in the world about 97% are found in Asia. Hence, buffalo is known as 'Asian Animal'.
- Most of the buffaloes are found in India, Pakistan, China, Nepal, the Philippines, Sri Lanka, Thailand, Brazil, Italy, Bulgaria, etc.
- Buffaloes were brought to Italy, Brazil and Bulgari from India and Pakistan. Most of them are Murrah buffalo types.

Gene flow in major livestock species……

Sheep:

- European sheep breeds are the most widespread in the world. They account for five out of the top ten most widely distributed breeds.
- The top three breeds are all European origin, the Suffolk (a meat/wool breed from England) is found in 40 countries, the Texel (a meat breed from the Netherland) is found in 29 countries and the Merino (a wool breed from Spain).
- The Awassi sheep of Israel is a good example of gene flow from South to North, North to South and South to South.

Gene flow in major livestock species……

Goats:

- Goat breeds are much less widely distributed than either cattle or sheep breeds. Purely European breeds are less dominant in this species, accounting only for 6 out of 25 reported trans-boundary breeds.
- Goats are major economic significance for smallholders in the South, particularly in economically marginal areas.
- The Sanen dairy goat is the world's most widely distributed breed, found in more than 81 countries and in all regions of the world.

Gene flow in major livestock species……

Pigs:

- The combination of European and Asian genetic material laid foundation for the creation of modern European pig breeds.
- Pure breeds, Hampshire, Duroc and Yorkshire, from the USA were exported to Latin America and Southeast Asia; Large white and Swedish Landrace from the UK to Australia, New Zealand, South Africa, Kenya and Zimbabwe.
- The worldwide distribution of pigs is dominated by breeds from Europe or the USA.

Gene flow in major livestock species……

Chicken:

- Commercial strains dominate the worldwide distribution of chickens, accounting for 19 of the 67 breeds reported in five or more countries. These strains are controlled by a small number of transnational companies based in Northwestern Europe and the USA.

Effects of indiscriminate crossbreeding: Possible positive and negative effects of gene flow

- Human migration-one of the most important factors for gene flow
- Domestication enhanced the breed diversity
- Exchange of stock was an important tool in breed formation and development
- Advanced mobility, reproduction biotechnology and modern breeding methods, A.I. and E.T. enhanced gene flow further in the 20th century

Possible positive and negative effects of gene flow

Positive effects	Negative effects
•Development of commercial breeds •Increase in the production and productivity •Farmers benefited economically •Development of cooperation , partnership and interrelationship between the countries, region and worldwide	•Indiscriminate breeding resulted the loss of biodiversity •Imbalance in gene pool •Disappearance of valuable traits developed over the thousands of years •Emergence of new diseases, pest and complications •Challenges to the ecosystems •Questions on the sustainability of the breeds •Shifts to the production systems

Some impact assessment (Case studies)

- Local cattle breed in southern Mali:

  - N'dama and East African Short horn cattle, have natural resistance to trypanosomosis.

Case studies.....

- Trypanosomosis kills an estimated three to seven millions cattle each year and costs farmers billions dollars each year in Africa.
- These breeds are being cross-bred with breeds from West Africa's Sahel zone, breeds from Europe and America.
- The local breeds of West and Central Africa that have evolved in those regions for thousands of years and therefore have evolved ways to survive many diseases, including trypanosomosis, which is spread by Tsetse flies, and also tick-borne disease.
- They have also the ability to withstand harsh climates

Case studies……

- According to **Abdou Fall**, leader of ILRI's livestock diversity project for West Africa, the short-horn hump-less breeds native to those regions are indiscriminately crossbred and are indiscriminately slaughtered has put them on a path to extinction.

- He urged to preserve these breeds either on the farm or in livestock gene banks because their genetic traits could be decisive in the fight against trypanosomosis, while their hardiness could be enormously valuable to farmers trying to adapt to climate change.

Indiscriminate cross breeding of Nine-palm height cattle with Haryana breed

- A native cow of Far-western region of Achham district, Nepal known as nine-palm height cow
- Has the characteristic features to survive in a harsh environment, efficient milker, bullock are good for plowing even on a steep slope terrains, resistance to disease and parasites
- Now in a verge of extinction
- Being cross-bred indiscriminately with other exotic breeds, e.g., Haryana breed of India

Conclusion

- The assessment of gene flows provides information on the nature and structure of genetic diversity that helps us to determine the knowledge to meet the goals
- Helps to study the inheritance of a trait and genotypic and environmental interactions
- Current pattern of gene flow is mainly from North to South and North to North
- Because of the globalization, biotechnological progress, climate change, and diseases and disasters, future trend of the gene flow may not continue as before

Conclusion.....

- Impact assessment of the gene flow seeks to understand the adaptability of the imported genes based on the positive and/or negative effects on profitability, acceptability and sustainability
- Current gene flows are useful to provide the milk and meat to the ever growing population of the world BUT due care has to be given on the possible negative impacts on bio-diversity, differences in market power and knowledge levels between the providers and the recipients

Thank You Very Much for Your Attention!!!