



Food and Agriculture Organization
of the United Nations

Crossbreeding in developing countries: extent, constraints and opportunities

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IMPLEMENTING THE GLOBAL PLAN OF ACTION FOR ANIMAL GENETIC RESOURCES

Improving animal performance in developing countries

- Reduction of poverty need stimulation of agricultural sector
- Enhancement of livestock production contributes to the growth of the agricultural sector.
- Genetic selection makes a major contribution to performance improvement (Havenstein *et al.*, 2003).

Two major techniques:

- Within-breed selection (pure-breeding)
- Crossbreeding



Crossbreeding strategies and impacts

Different strategies: terminal crossing, rotational crossing, breed substitution, synthetic breed creation

Consequences on performance:

- In favorable environment, an improvement of performance of production traits
- Heterosis effect
- Fitness traits of usually deteriorated in comparison to local breeds
- Genetic by Environment (GxE) interaction

Indiscriminate crossbreeding also viewed as the main cause of genetic erosion (FAO 2015).



Issues behind crossbreeding

- What is the extent of crossbreeding in developing countries?
- What are the factors that influence the success or failure of a given crossbreeding program?
- When is crossbreeding beneficial at the smallholder scale?

Material & Methods:

- Country report provided by 128 countries for the second State of the World for Animal Genetic Resources (SoW2)
- National censuses and literature review



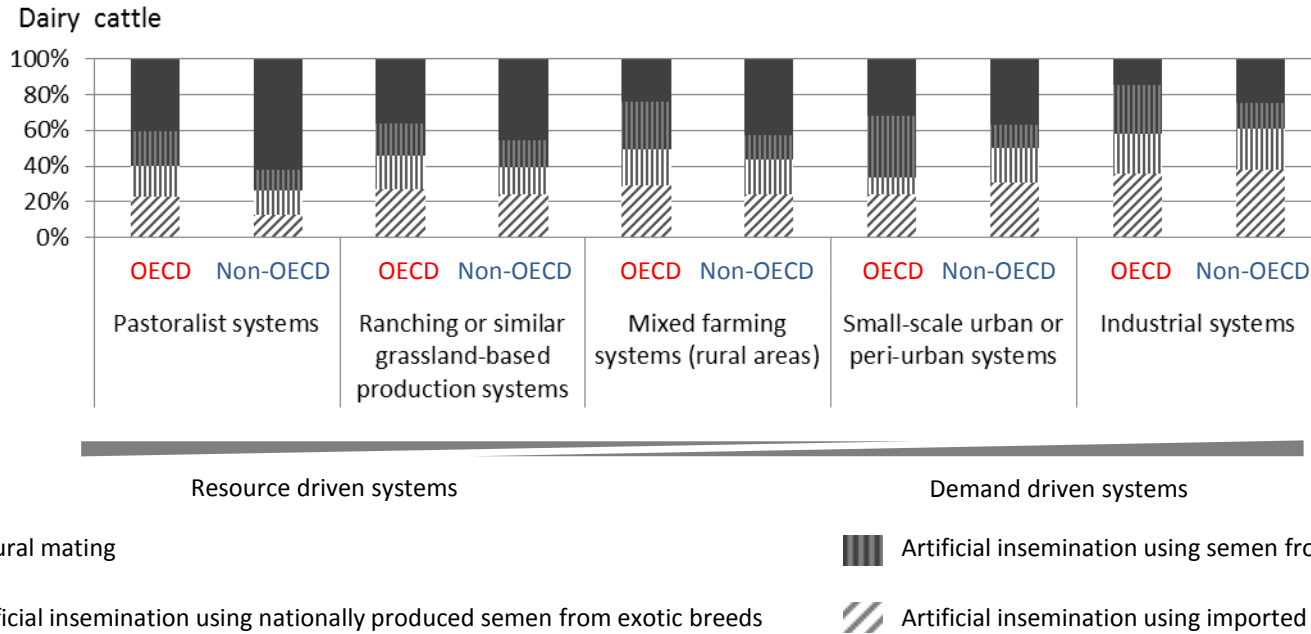
Extent of crossbreeding in developing countries *across species and countries*

Extent of crossbreeding in different species and countries based on national censuses

Species	Countries	Breed type (%)			References
		Improved		Locally adapted	
		Crossbred	Exotic		
Cattle	Ethiopia	0.7	0.1	99.2	CSA, 2010
	India	24		76	Gol/MoA, 2012
	Kenya	20		80	MSP, 2009
Dairy cattle	Brazil	74	6	20	Vilela, 2003
	Rwanda	20	8	72	Makoni <i>et al.</i> , 2013
Sheep	Burkina Faso	0.9		99.1	RGA, 2008
	India	6		94	Gol/MoA, 2012
	Peru	18.9		81.1	INEI, 2012
Pig	Burkina Faso	0.2		99.8	RGA, 2008
	India	21		79	Gol/MoA, 2012
	Peru	32.8		67.2	INEI, 2012
Chicken	Ethiopia	0.6	2.8	96.6	CSA, 2010
	Kenya	1.3		98.7	MSP, 2009
	Nepal	42.5		57.5	CBS, 2013

- Depending on countries and species, the extent of crossbreeding ranges from non-existent to widespread.
- Crossbreeding is however rarely applied in a programmed manner.

Extent of crossbreeding in developing countries *across production systems*



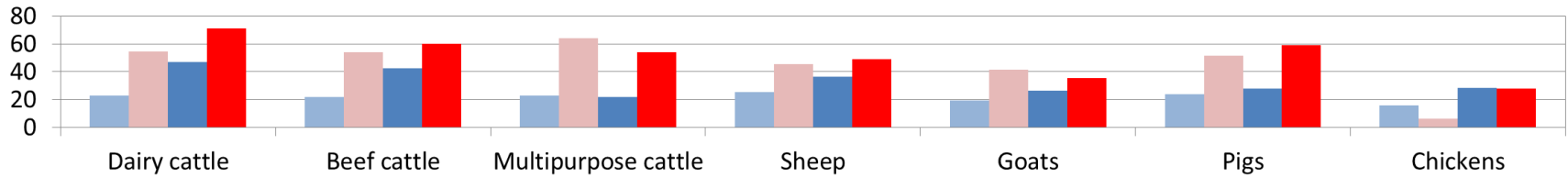
Extent of the use of artificial insemination and natural mating in dairy cattle according to production systems in OECD and non-OECD countries, based on extent scores provided in SoW2 country reports

- More intensive use of AI and semen from exotic breeds in demand driven systems relative to resources driven ones

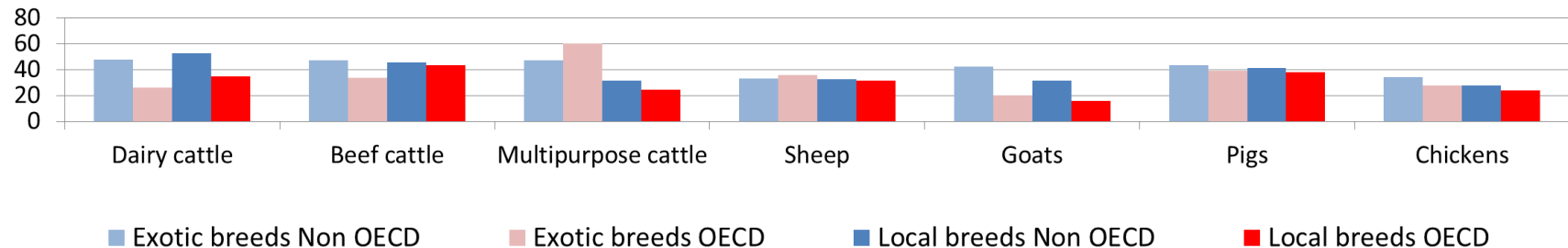


Crossbreeding vs pure breeding in developing countries

Proportion of breeds reported with genetic evaluation implemented



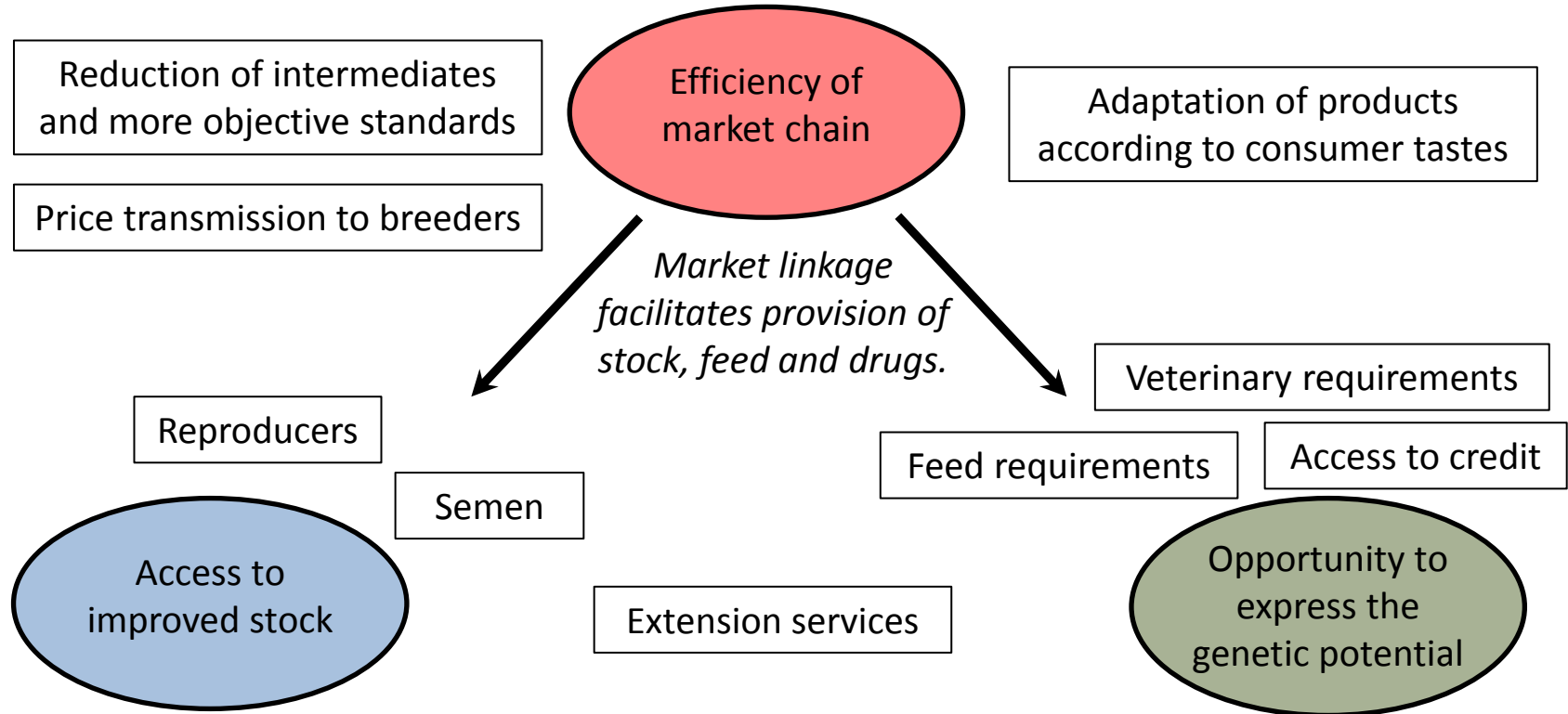
Proportion of breeds reported with breeding methods including cross-breeding



Proportion of breeds applying pure-breeding or crossbreeding according to SoW2 country reports

- Non OECD countries: no genetic evaluation programs implemented in most of breeds.
- Non OECD countries report greater proportion of breeds with active breeding programs including crossbreeding than OECD countries
- Genetic progress is therefore imported rather than generated domestically.

Three factors for successful implementation of crossbreeding

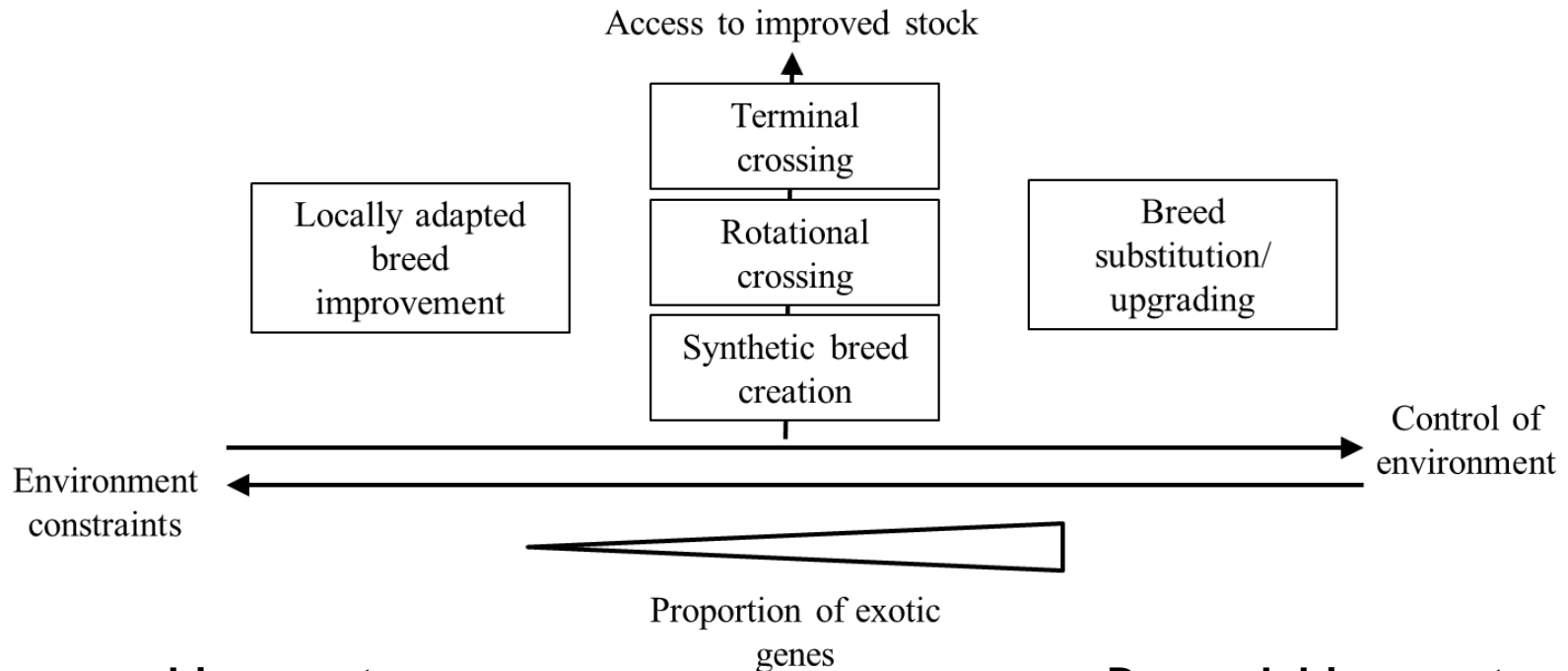


*Need to plan, from the beginning of a program, the **sustainability of genetic material delivery** and farmer support, including its cost recovery*

*Expression of genetic potential **facilitated in demand driven** systems versus **resources driven** systems*



When choosing a given crossbreeding strategy?



Resource driven systems

Demand driven systems

The choice of a given strategy is highly dependent of

- Access of improved stock
- Environment control/constraints, i.e. the opportunity for improved livestock to express its potential.
- Indirectly, the linkage to the market chain



Discussion

Crossbreeding at smallholders scale...

- Use of improved crossed genotype may increase smallholder revenue **but** demand resources that cannot always be sustained in resource driven systems.
- Strengthening of producer organizations may allow small-scale producers to deal with the challenges associated with market chains (access to credit, inputs and output markets).
- As it is associated with adoption of other technologies (AI, vaccination, improved feeding, and record keeping), crossbreeding can be a catalyst of innovation and development.
- Need to consider impact of crossbreeding on other livestock functions (draft, savings...)



Discussion

Crossbreeding at country scale...

- Developing countries rely on crossbreeding due to lack of straight-breeding programs in local breeds, usually due to poor infrastructure, organization and support...
- Yet, without regular provision of those same factors, outcome of crossbreeding projects are likely to be instances of unmanaged introgression, threatening local genetic resources.
- In relation to potential impact of crossbreeding on livestock, appropriate crossbreeding may combine resilience and fitness of local breeds and production efficiency of improved breeds
- Need to better characterize those traits and include them into breeding programs adapted to extensive conditions.





Thank you for your attention



More information: Leroy et al. 2015 Review: Sustainability of crossbreeding in developing countries; definitely not like crossing a meadow... *Animal*, *in press*

www.fao.org/ag/angr.html

