

Impact of animal reproductive biotechnologies

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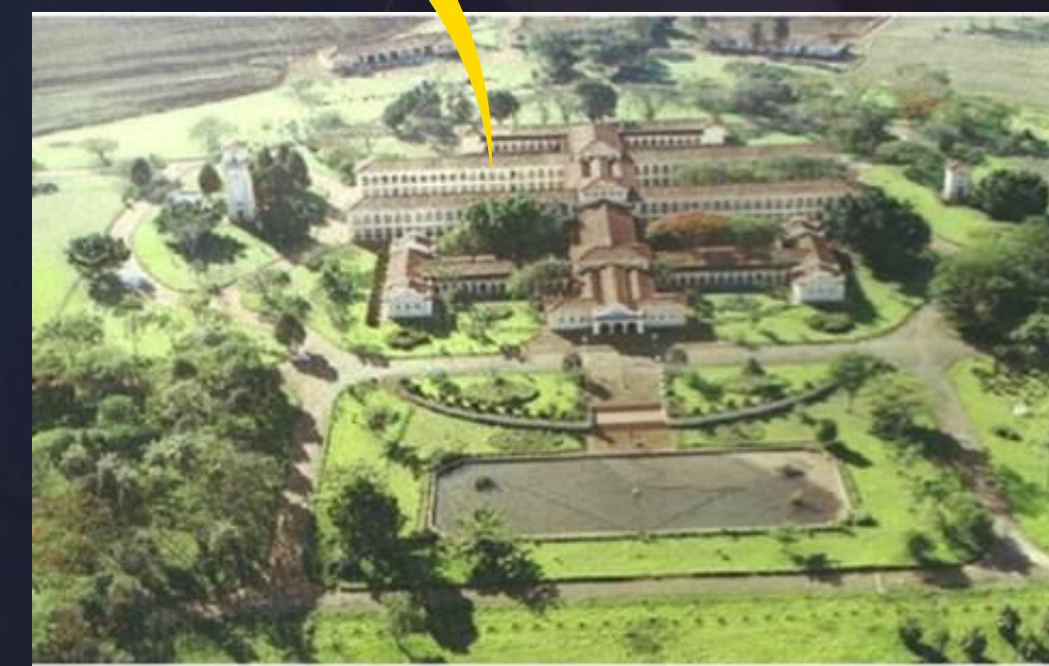
Beef farms



Dairy farms



University of Sao Paulo - USP



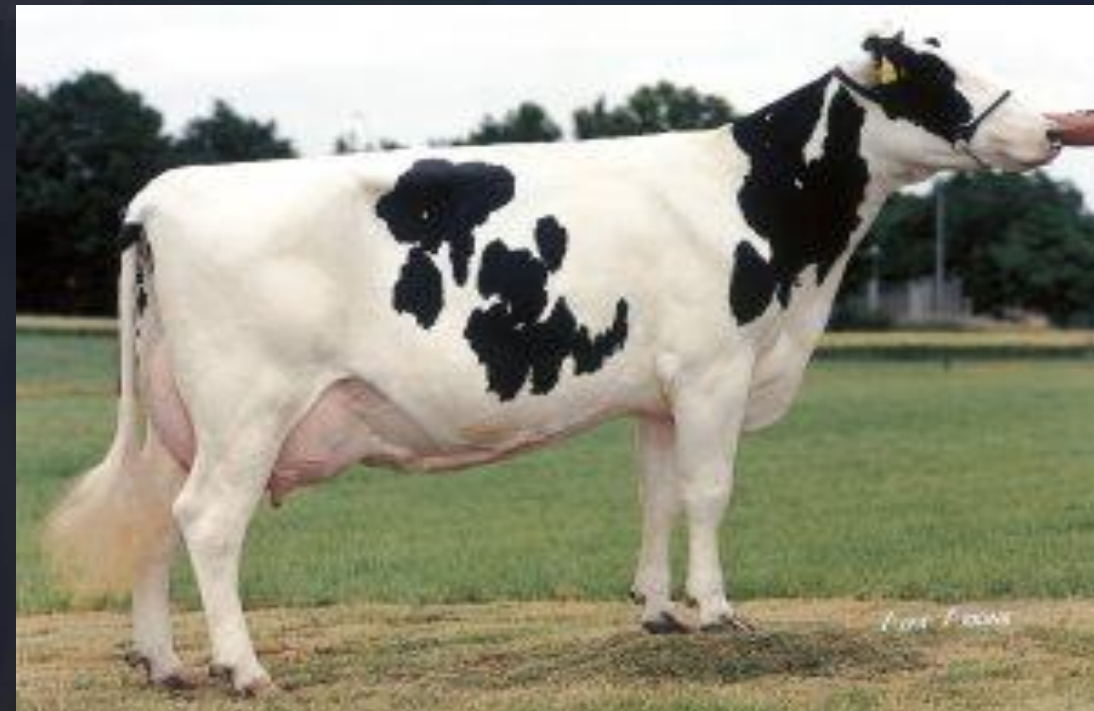
USP: CAMPUS IN PIRASSUNUNGA (Experimental farm)

Animal Reproduction Department - São Paulo University

Beef cattle



Dairy cattle



Buffalo



BIOTECHNOLOGIES OF REPRODUCTION

Artificial Insemination (AI) e Embryo Transfer (ET)

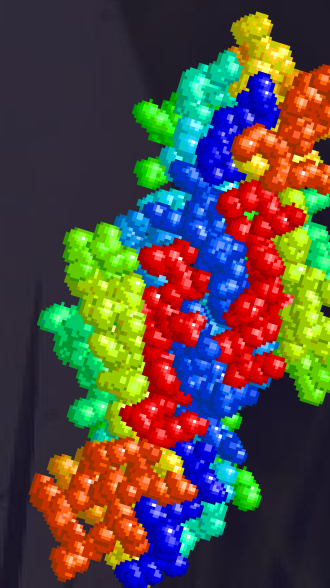
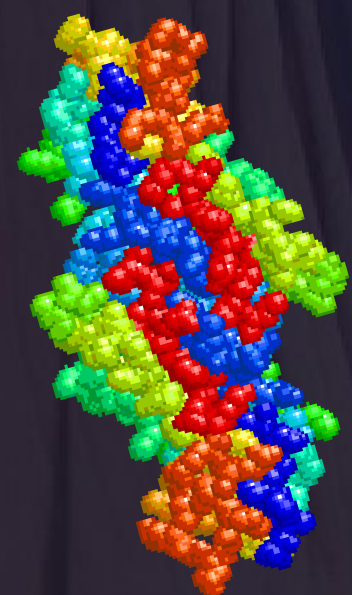
GENETIC IMPROVEMENT



- Identification of high production animals
 - Genetic and genomic tests
 - Diffusion of high genetic animals



INCREASE IN PRODUCTIVITY



BIOTECHNOLOGIES OF REPRODUCTION

- Powerful method of gene dispersal
- One of the most important assisted reproductive technology in the world

AI



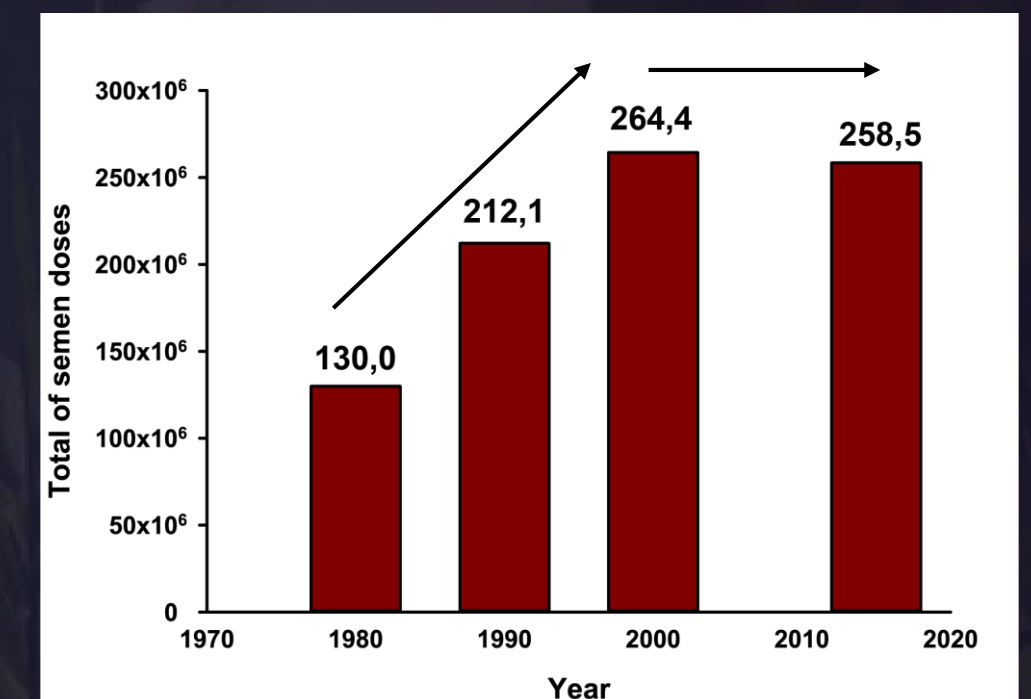
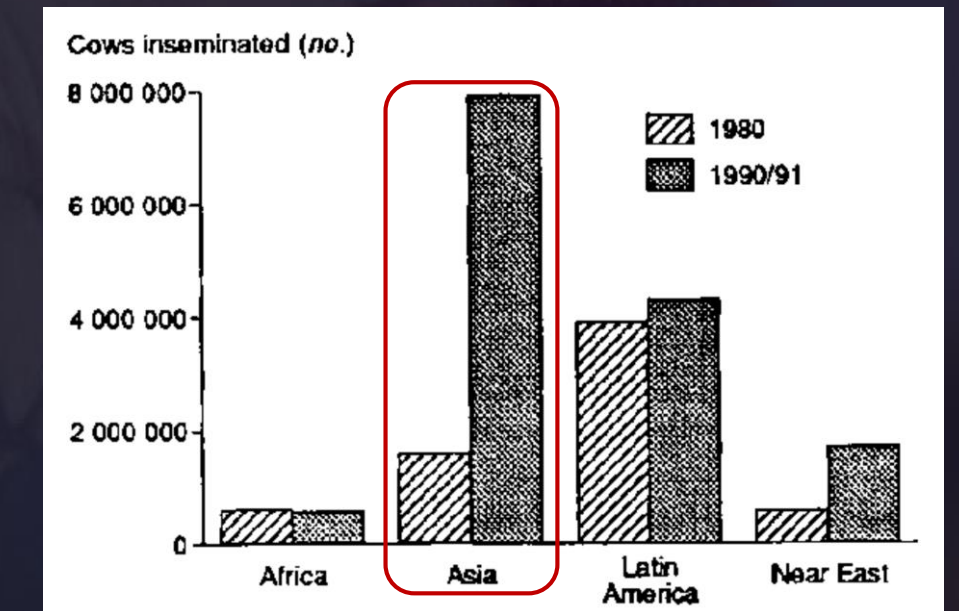
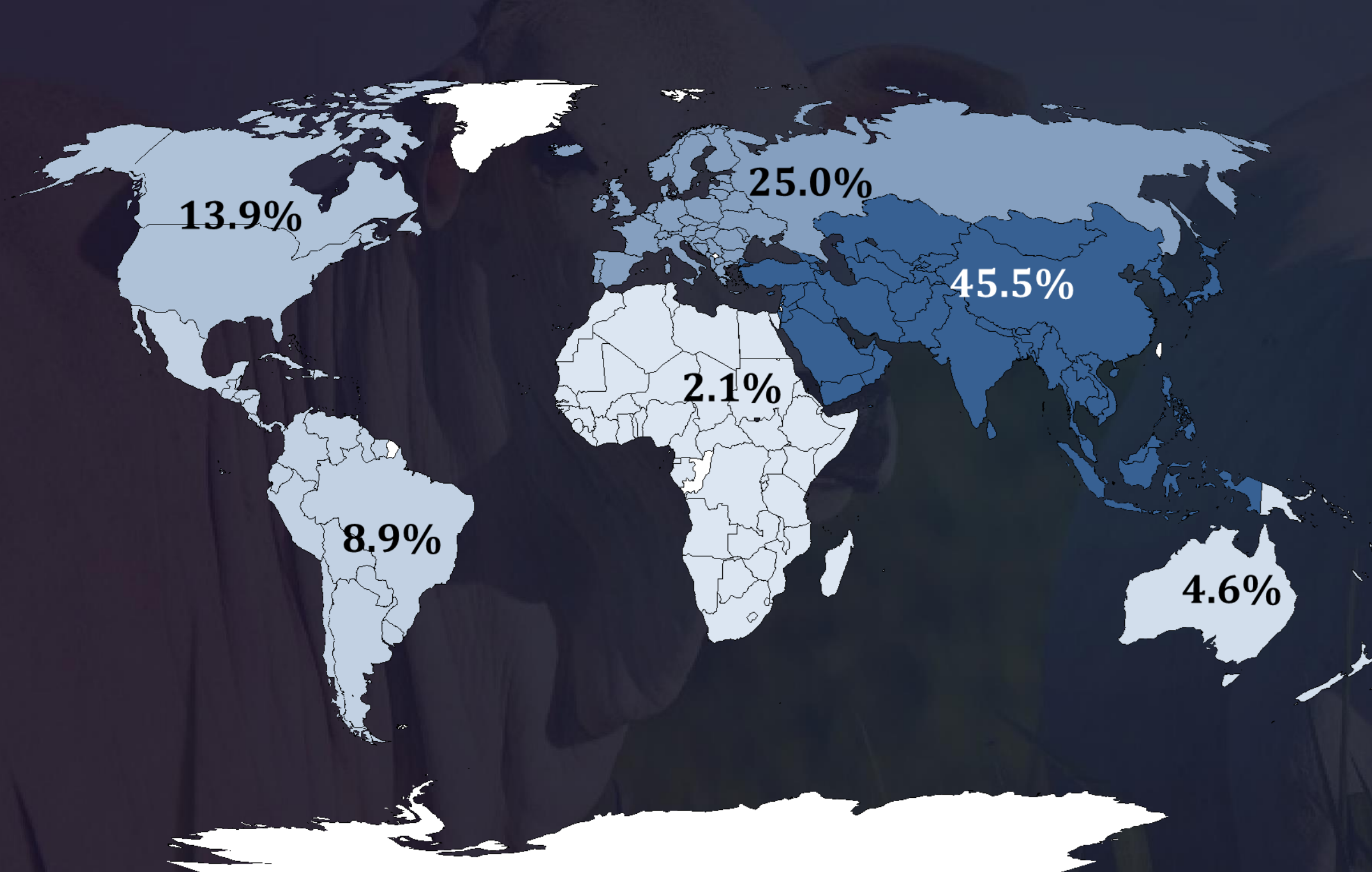
Multiply PATERNAL lineage

ET



Multiply PATERNAL + MATERNAL lineage

Semen doses produced in cattle (dairy and beef)



ESTRUS DETECTION: limited the use of AI



Low efficiency of estrus detection in dairy
(Pursley and Wiltbank et al., 1995)



Low efficiency of estrus detection in beef
(Bo et al., 2017)



Standing estrus is shorter in *Bos indicus*
(Baruselli et al., 2004)

Efficiency of reproductive programs (AI)

Reproductive efficiency

Genetic gain

1. Natural service



2. Artificial insemination with estrus detection



+



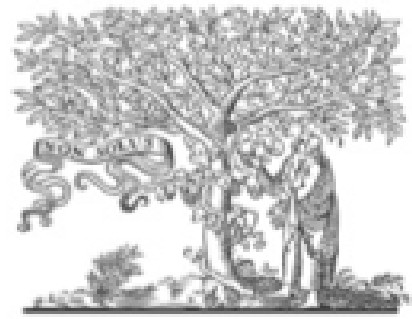
3. Fixed time artificial insemination (FTAI)



+



More calves in quantity and quality

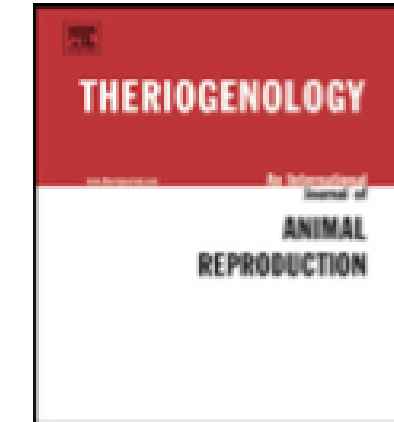


ELSEVIER

Contents lists available at SciVerse ScienceDirect

Theriogenology

journal homepage: www.theriojournal.com



Timed artificial insemination early in the breeding season improves the reproductive performance of suckled beef cows

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**Natural
service**

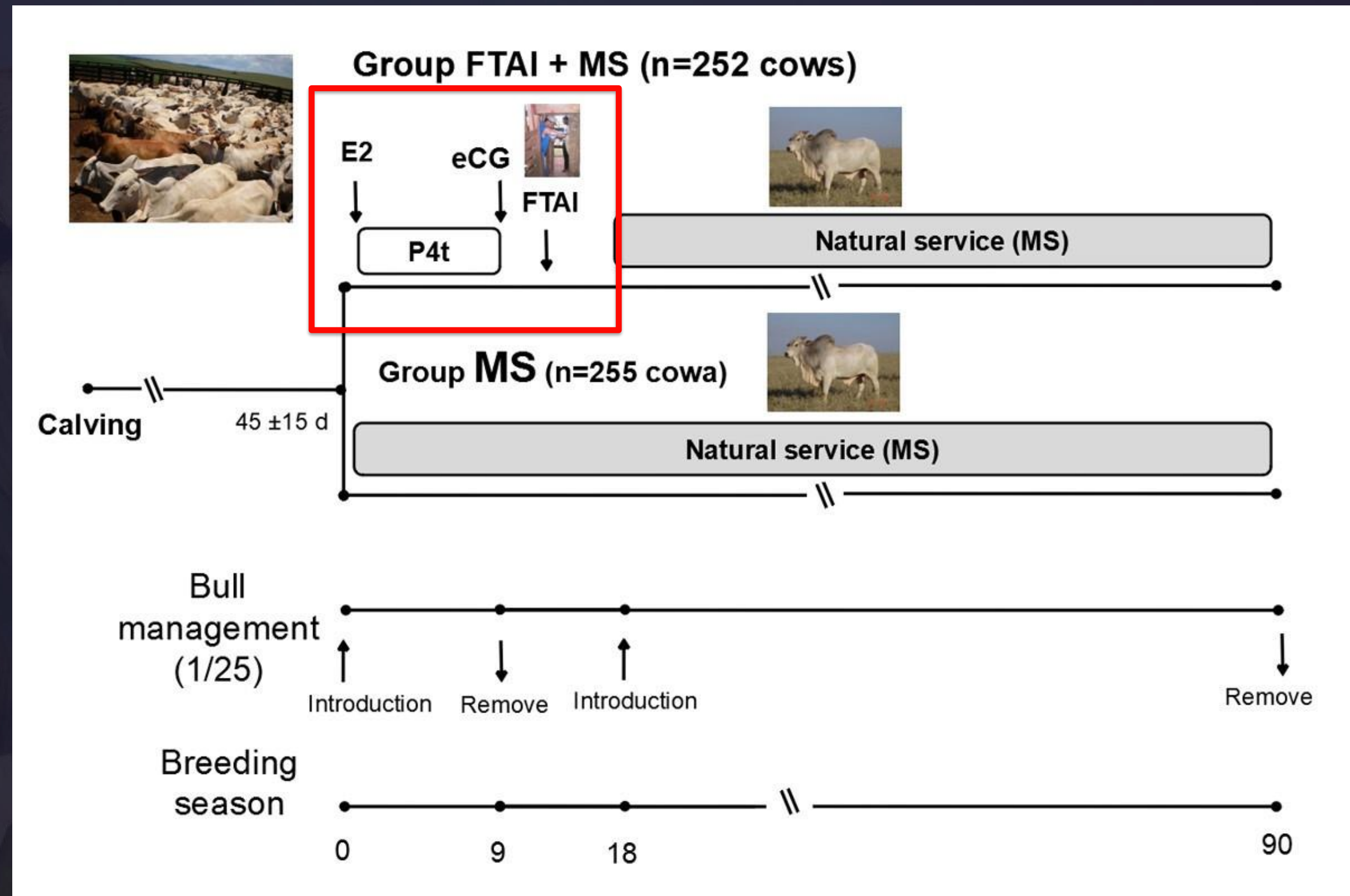
X

**FTAI +
Natural service**

Experimental desing

507 *Bos indicus* COWS

(same group)
(same bulls)



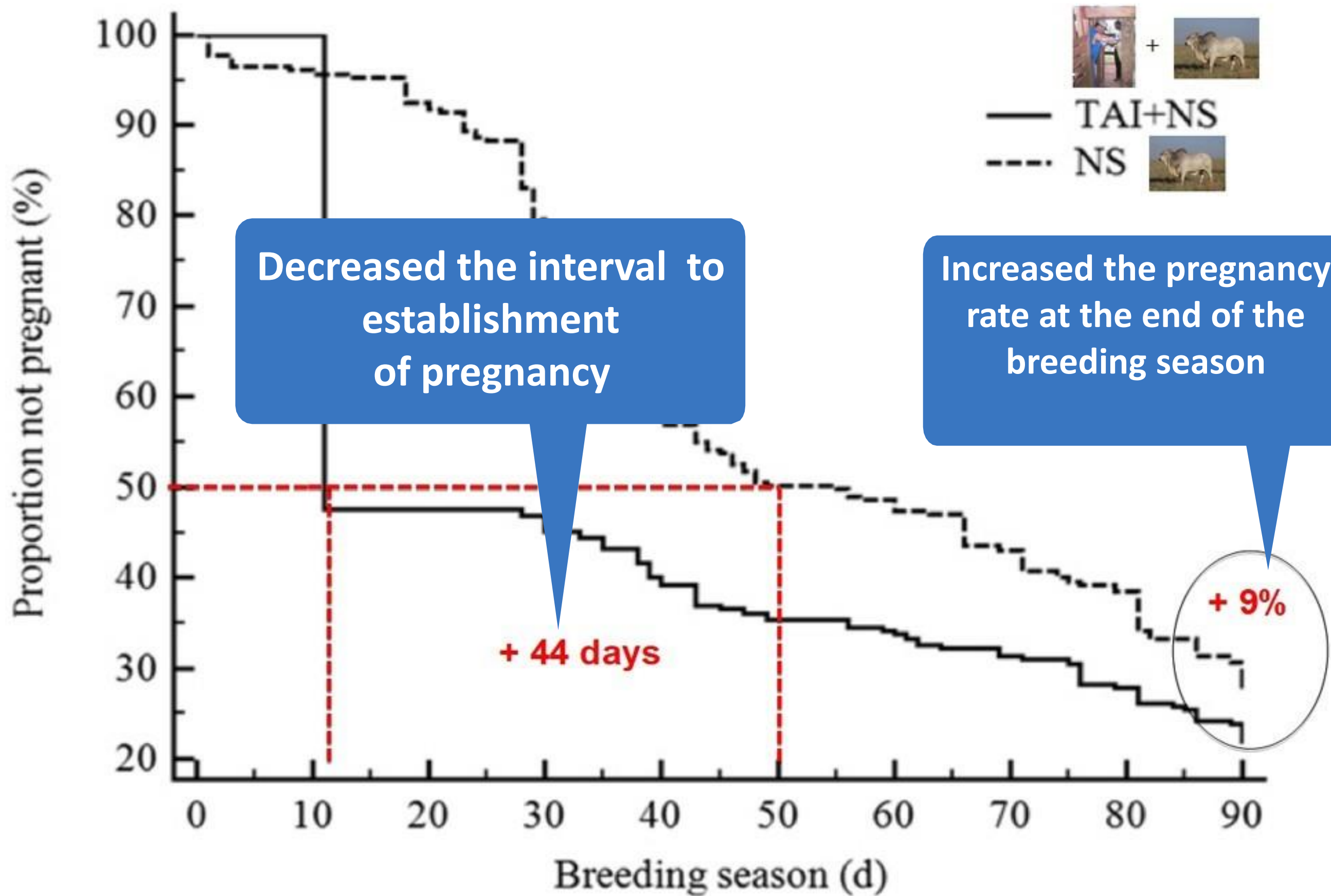
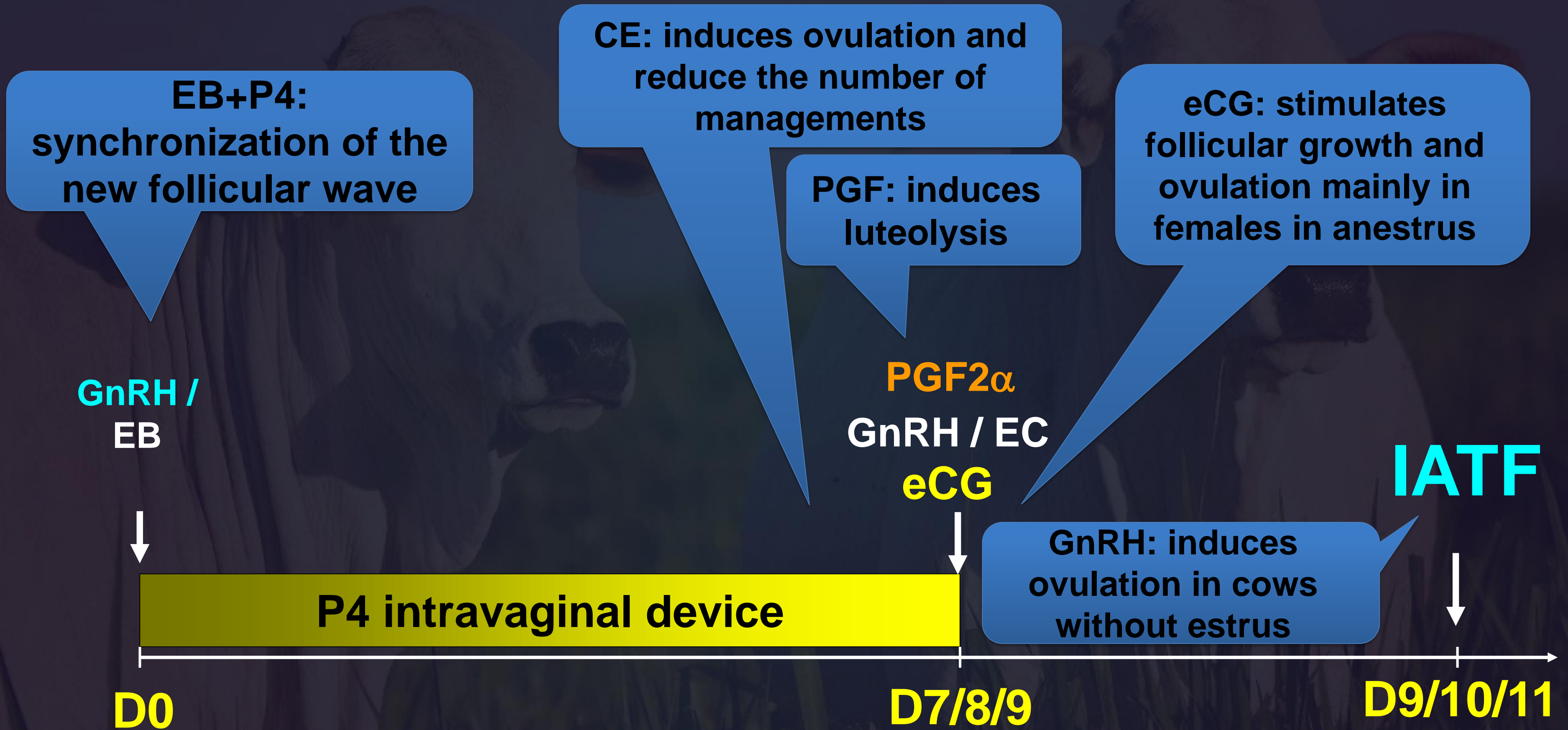


Fig. Survival curves for proportion of nonpregnant cows by Day 90 of the breeding season (BS) for suckled beef cows bred by natural service (NS; dashed line; N 1/4 255) or by timed AI (TAI) at beginning of the BS followed by NS; solid line; N 1/4 252) during 90-day BS. Median interval to pregnancy for NS and TAI groups was 55 days and 11 days (adjusted hazard ratio, 1.64; 95% confidence interval, 1.34–2.01), respectively.

Pharmacological basis of the FTAI protocol



Results of field trials evaluating a synthetic eCG-Like glycoprotein produced by Syntex in *Bos indicus* cattle



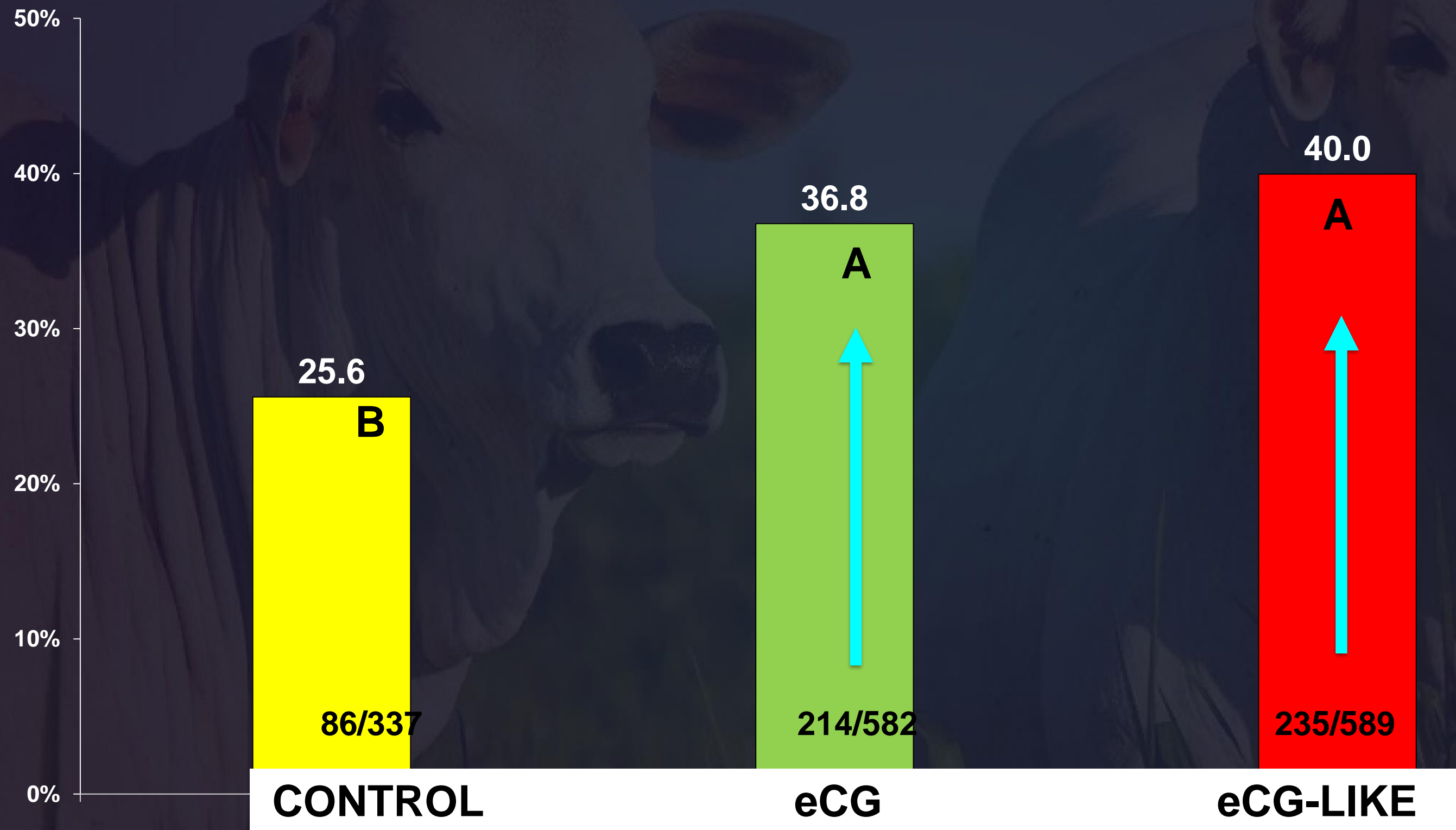
PhD Student Laís Ângelo de Abreu
Prof. Dr. Pietro Sampaio Baruselli
VRA - FMVZ/USP

Dr. Lucas Cutaia
Dr. Santiago Perez
Syntex S A/Argentina



Conception rate at FTAI (%)

(30 days)

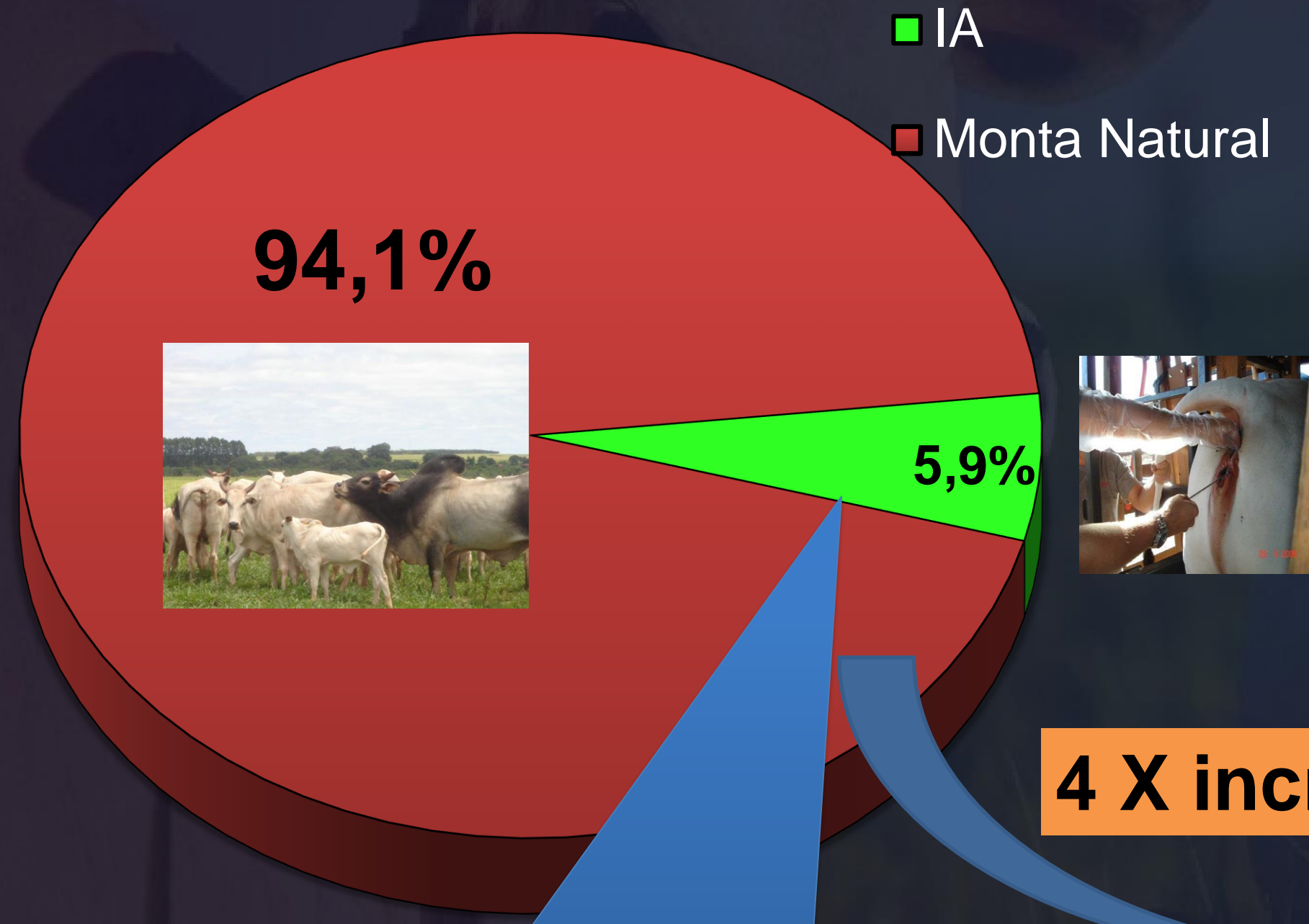


P <.0001
(n= 1,508)

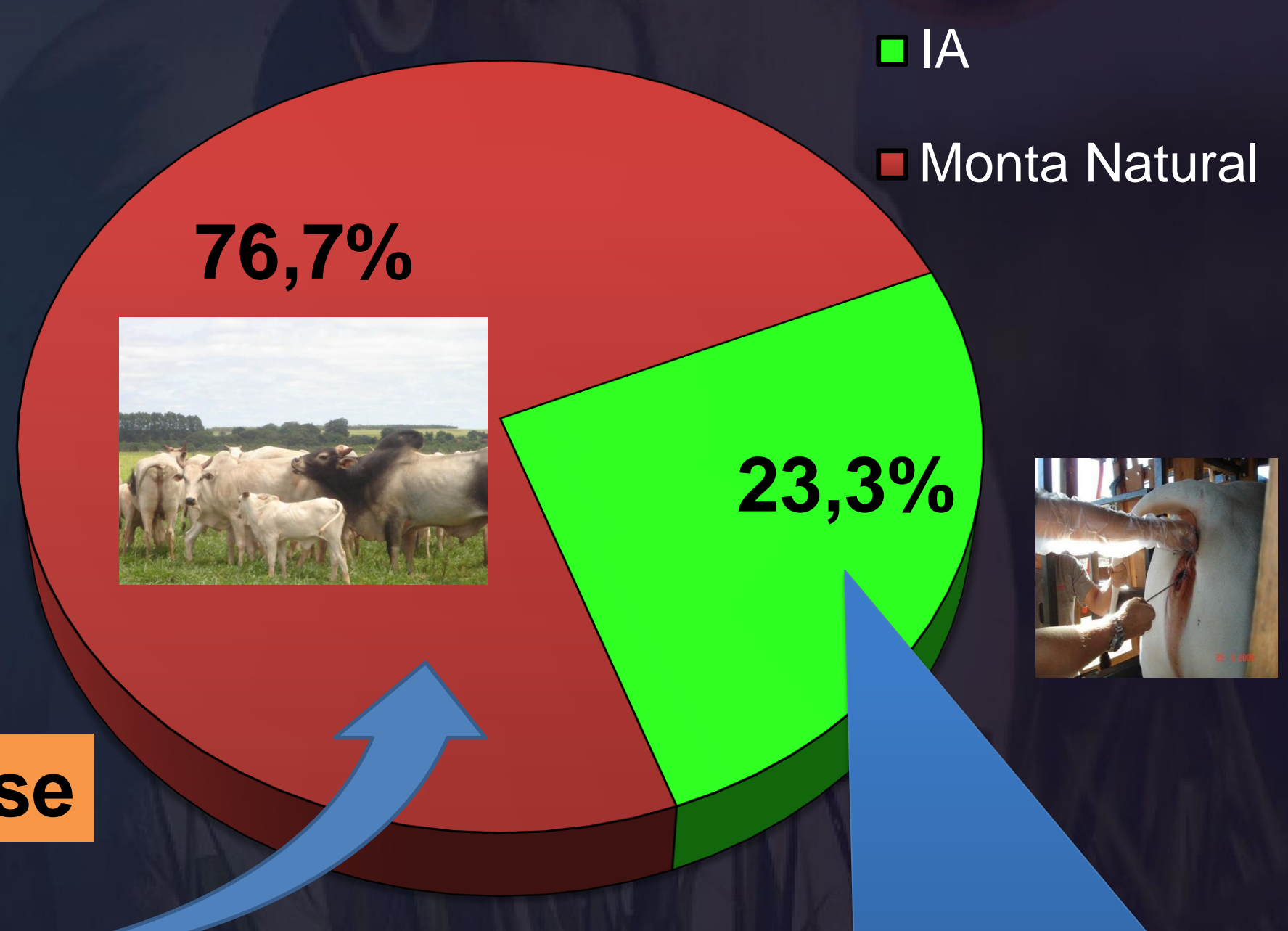


Evolution of the percentage of dairy and beef cattle inseminated in Brazil

2002



2021



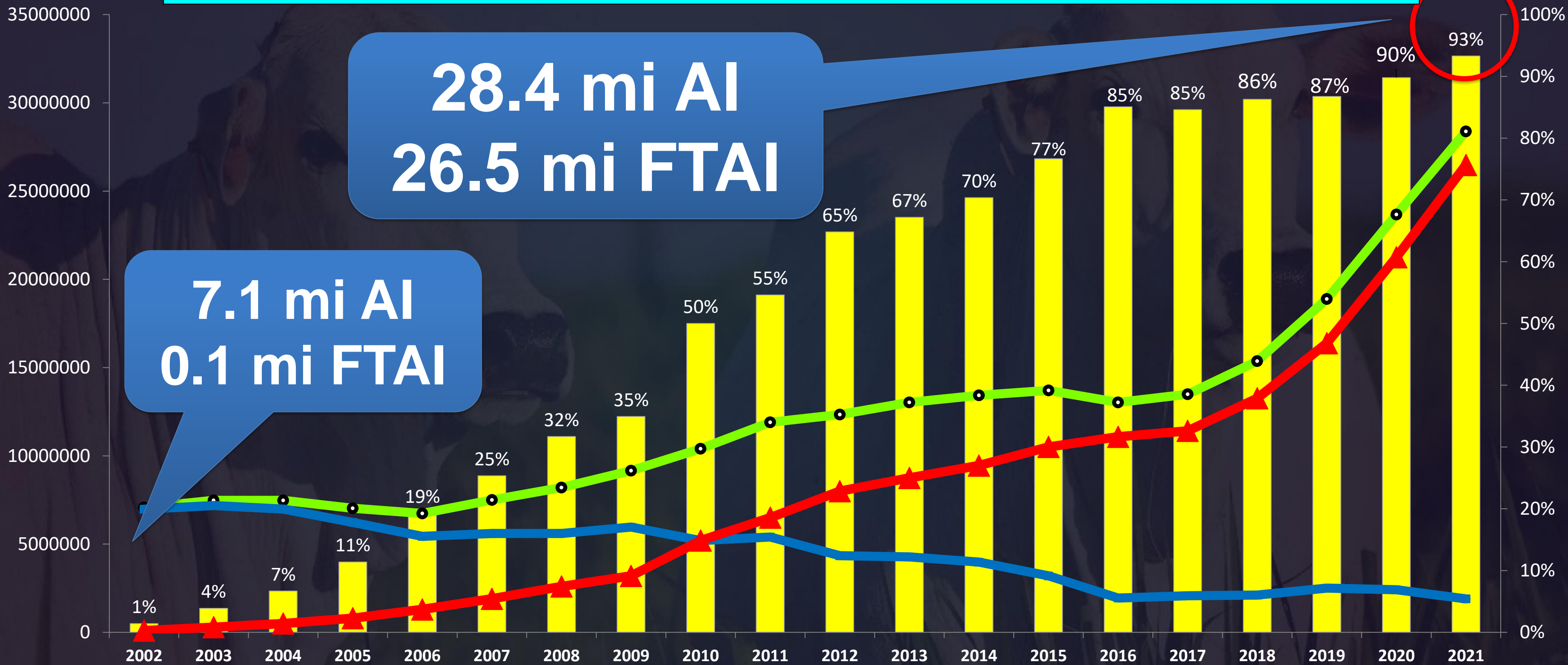
4 X increase

4,7 mi AI (ASBIA-2002)
3.4 mi heifers and cow inseminated
(1.6 doses / female in reproduction)

28.4 mi AI (ASBIA-2021)
17,7 mi heifers and cow inseminated
(1.6 doses / female in reproduction)

FTAI market in Brazil

(% of heifers and cow artificial inseminated)



Dados analisados com informações do Boletim ASBIA



*Estimativa levando em consideração a venda de produtos para sincronização

Elaboração: Pietro S Baruselli (FMVZ/USP)

Fonte: Boletim Eletrônico do Departamento de Reprodução Animal/FMVZ/USP

BIOTECHNOLOGIES OF REPRODUCTION

AI



Multiply PATERNAL
lineage

ET



Multiply PATERNAL +
MATERNAL lineage

- ET for genetic improvement programmes at farm level.
- ET increases the selection intensity and decrease the generation interval.

World ET market (1995 to 2019)



INTERNATIONAL EMBRYO TECHNOLOGY SOCIETY

In vivo derived vs In vitro produced embryos

IVEP: more *in vitro* than *in vivo* embryos

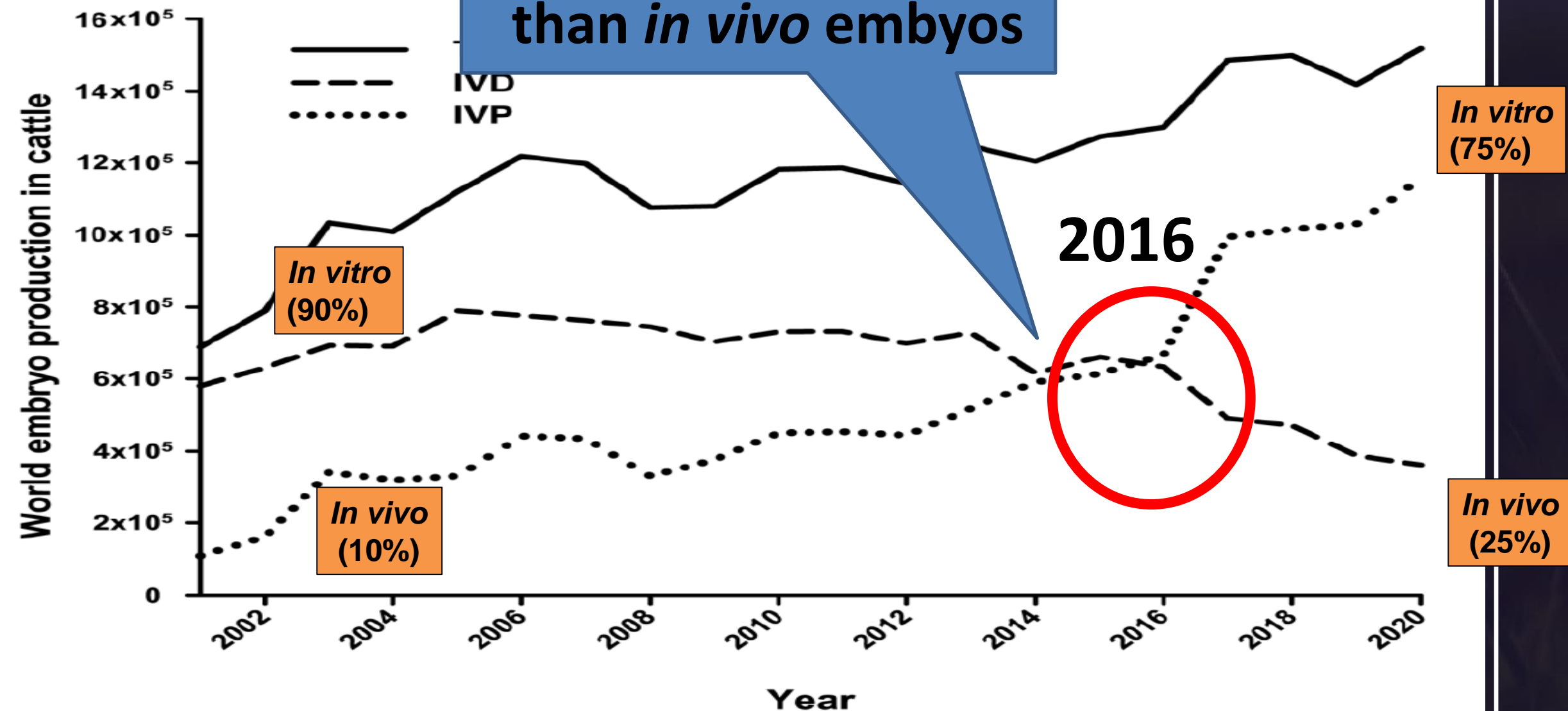
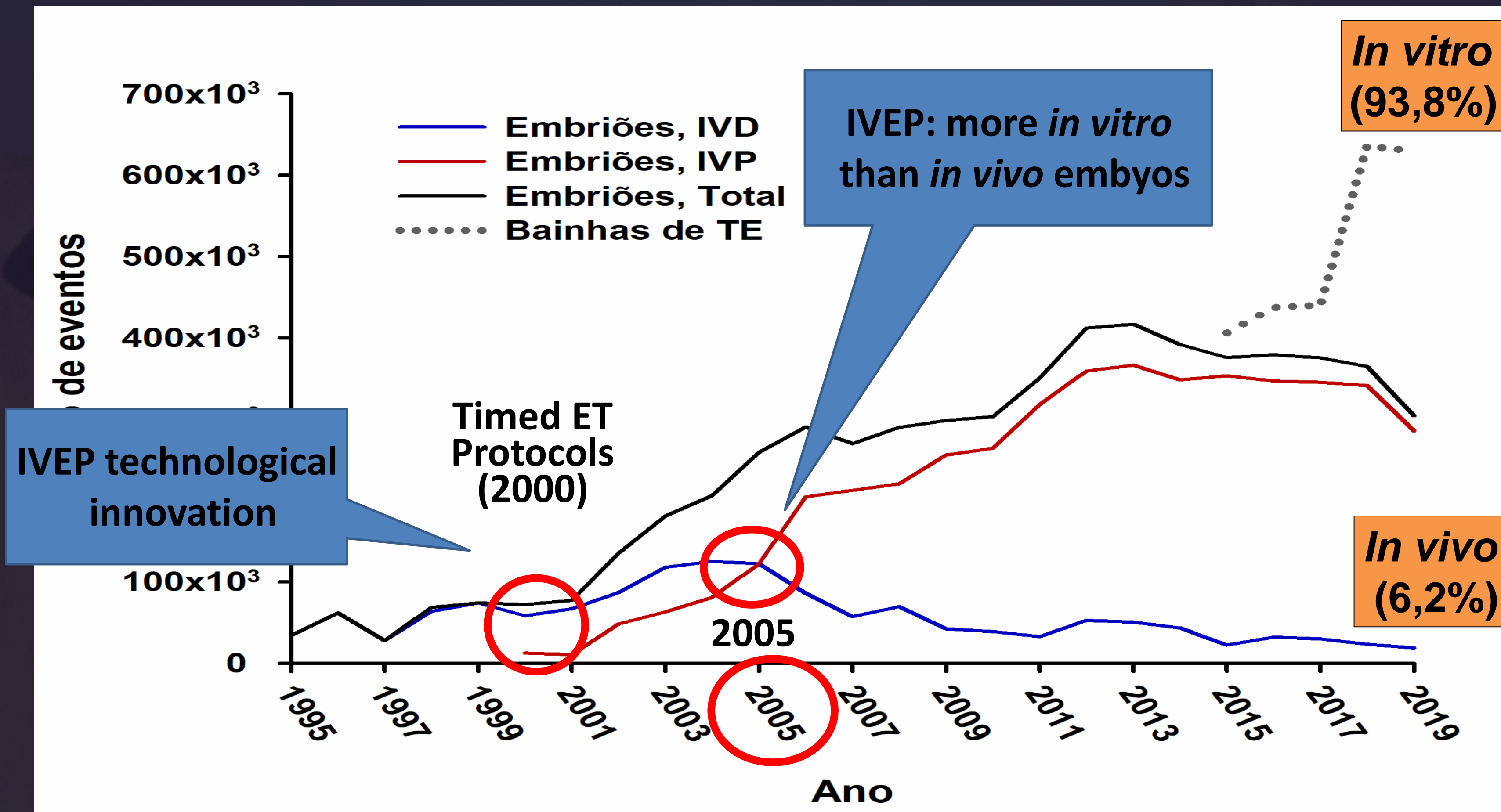


Figure 2. Number of bovine embryos (*in vivo* derived [IVD], *in vitro* produced total) recorded in the period 2001-2020

www.iets.org



ET market in Brazil (1995 to 2019)

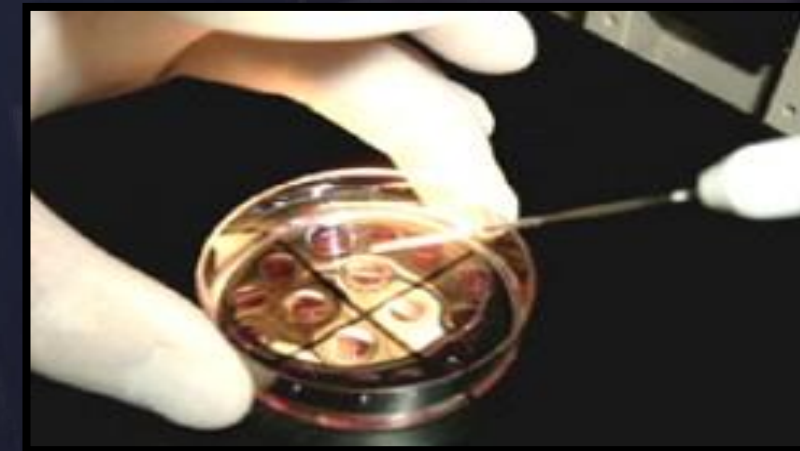
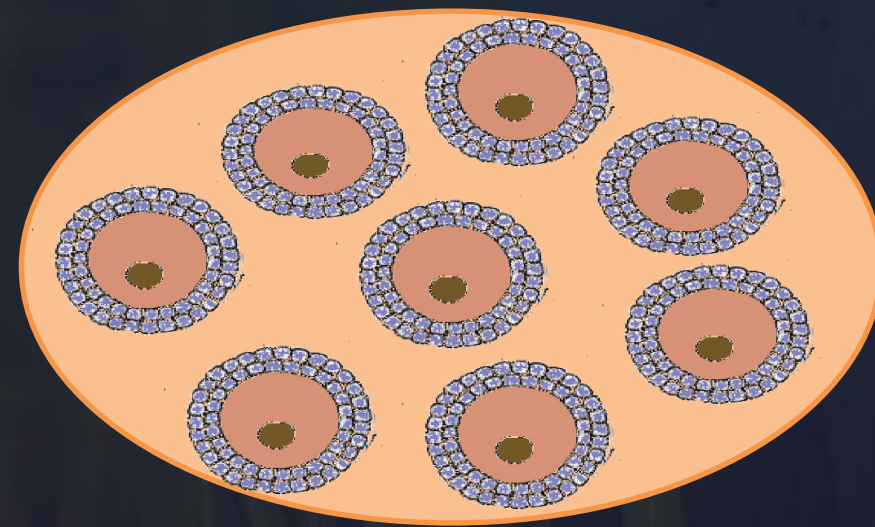


In vitro embryo production

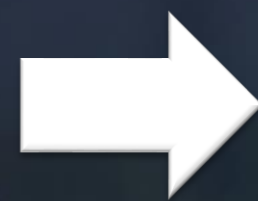
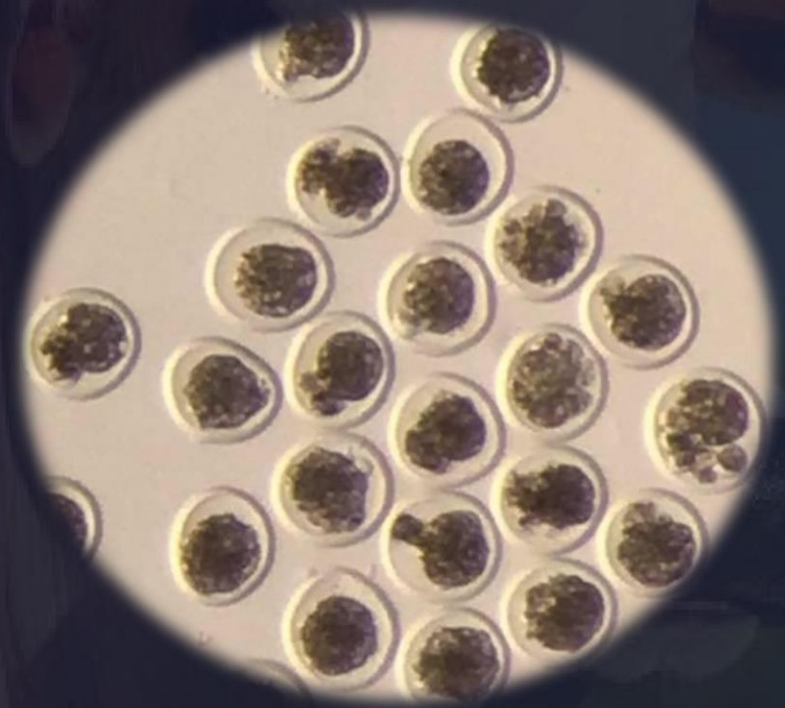
Effects of genetic group on follicular population and IVEP



VS



Why produce embryos from young donors?



Rapid multiplication of genetically superior animals

$$\uparrow \Delta G = \frac{\text{Accuracy} \times \text{Intensity} \times \text{Genetic Std Dev}}{\downarrow \text{Generation Interval}}$$

The ability to obtain oocytes with developmental competence from calves has been recognized for more than 60 years

Velogenesis

Viabile oocytes retrieved before birth

(Betteridge et al. 1989; Georges and Massey 1991; Kauffold et al. 2005)

Viabile oocytes retrieved before puberty

(Onuma et al. 1970)

Potential for IVEP



Ovary from a 3-month-old Brahman (*Bos indicus*) calf demonstrating the potential to stimulate a large follicular response to FSH and to obtain large numbers of oocytes in indicus (**Maclellan and D'Occhio unpublished**)

Laparoscopic OPU in calves



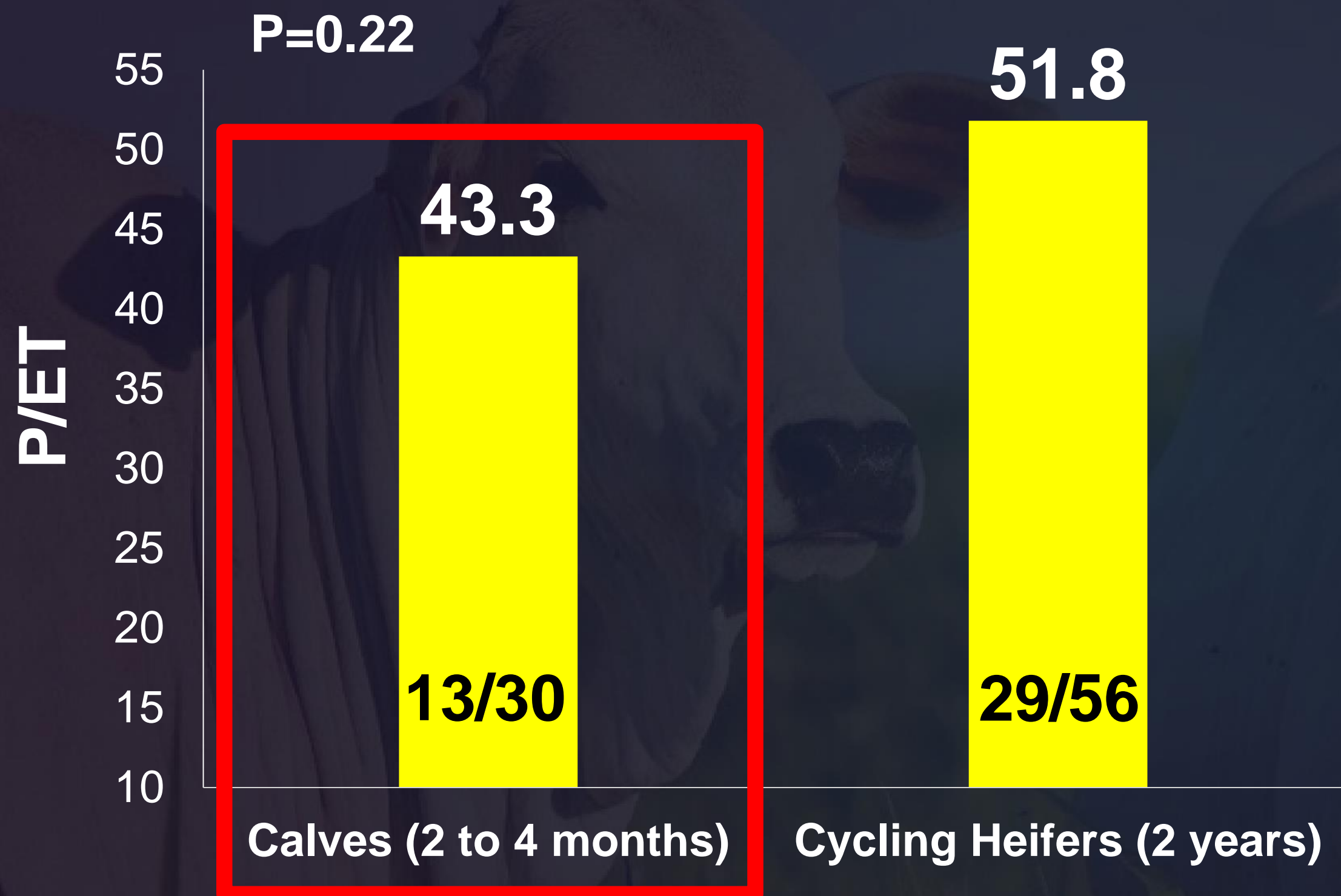
Laparoscopic OPU in calves



VS



Birth of calves from embryos produced from calf's donors (2 months) - 2015 -



Birth of calves from embryos produced from calves (2015)

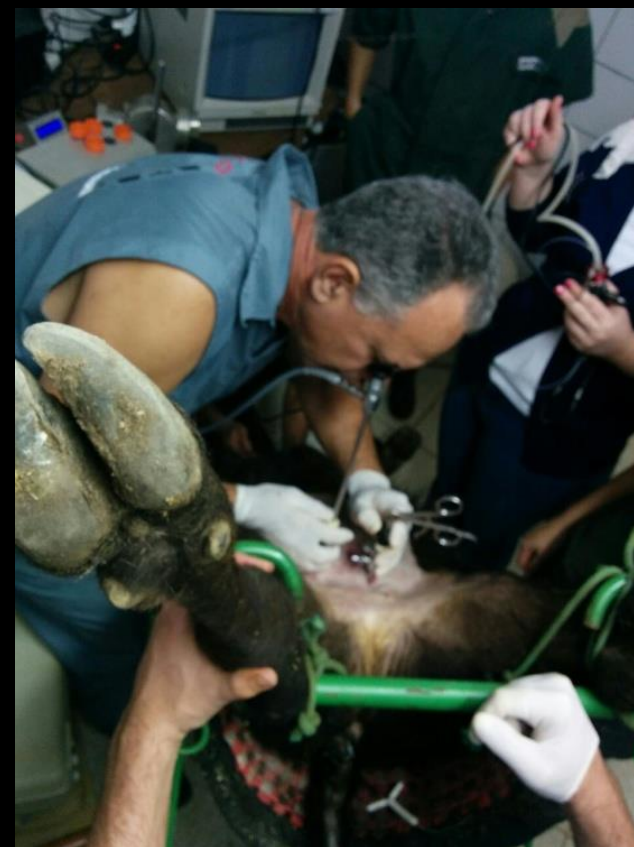


Donors
(2 to 4 months)

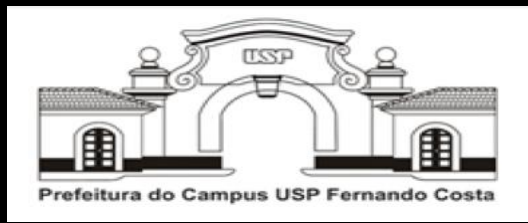
Buffalo

Murrah

Calves



Birth of calves from embryos produced from calves (2016)



Clinical trial to evaluate the effects of rFSH treatment for *in vitro* embryo production in Holstein cows and heifers





G3 16748 (Left ovary)



G3 16748 (Right ovary)



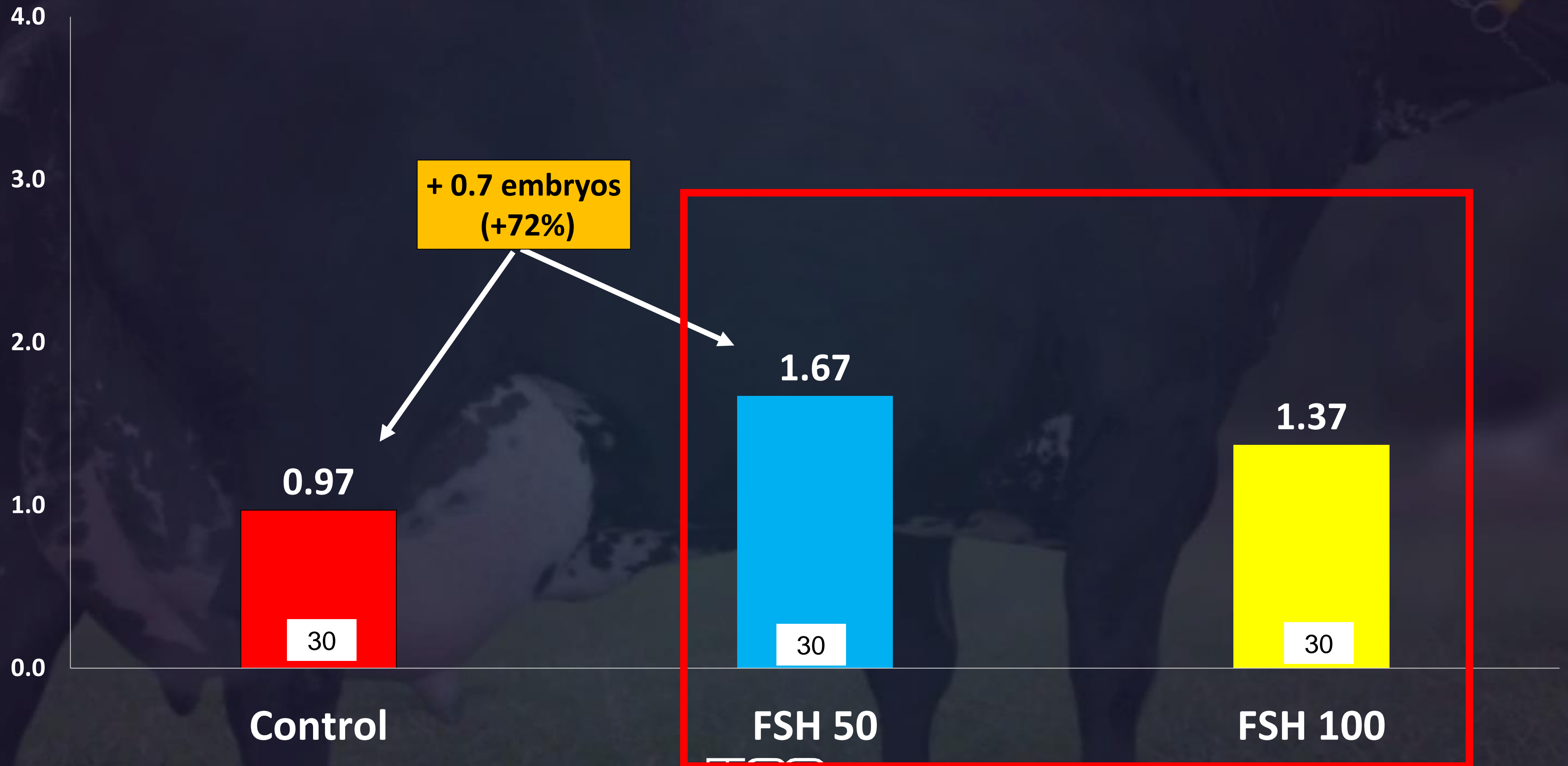
G3 16876 (Left ovary)



G3 16876 (Right ovary)

rFSH 100
mcg (G3)

Number of blastocyst per OPU (Heifer donors)



ET Pregnancy rate

Category	Control	rFSH 100	P value
Heifer	25.0% (7/28)	31.1% ^d (13/41)	↑
Dry cow	23.3% (14/60)	32.1% (26/81)	↑
Lactating cow	32.1% (18/56)	42.9% (21/49)	↑
Total	27.1% (39/144)	35.1% (60/171)	0.06

+ 8% P/ET (+29.5%)

Reproductive efficiency and ambiental impact

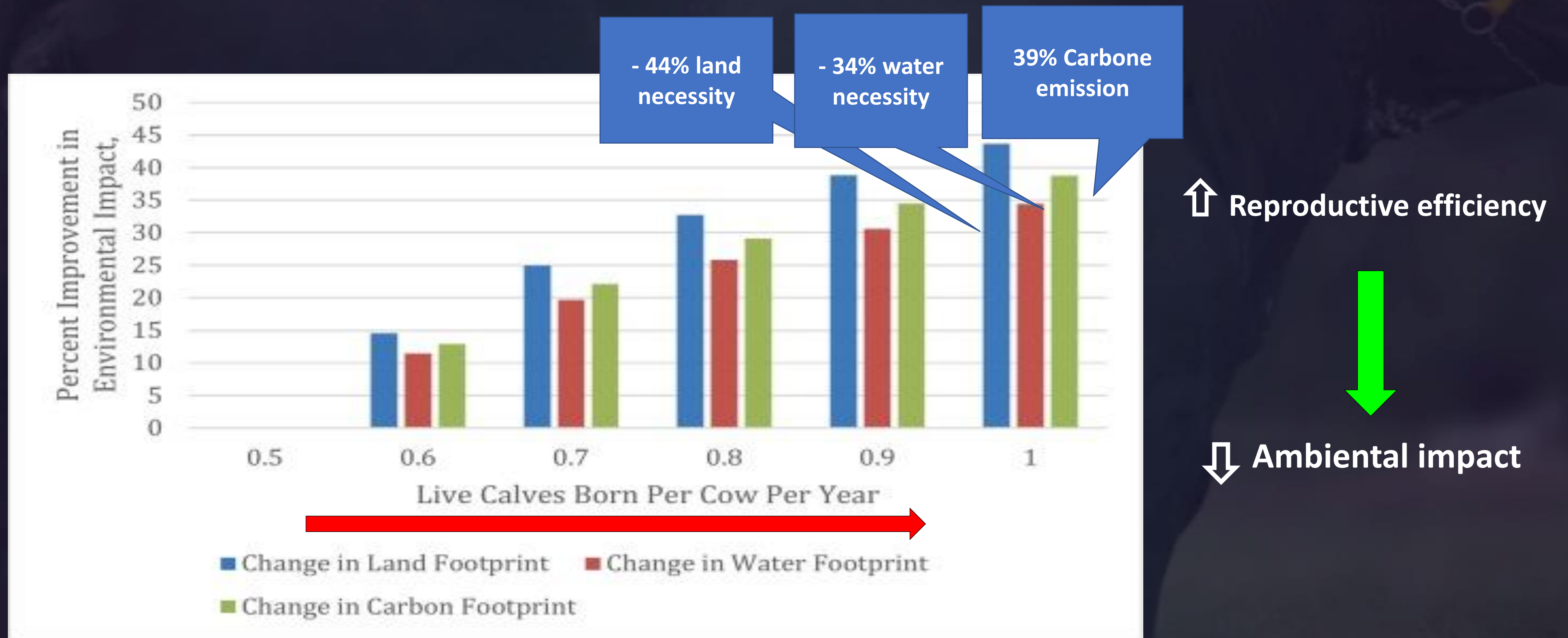


Figure. Relative changes in environmental impact of a simulated US beef production system. Percent improvements in environmental impact use a 0.5 calf per cow per year conception rate as a baseline for calculations.



Conclusion

Assisted Reproductive Technology (ART) have significant practical benefits for breed improvement programmes.

The widespread adoption of AI using frozen semen has allowed bulls of superior genetic merit to produce many more offspring than was possible using natural service.

ET allow for higher rates of genetic improvement to be achieved by increasing the reproduction of superior females.

Estrus synchronization technologies are used in the dairy and beef industry to increase the reproductive efficiency and rate of superior males and females.

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Partner companies

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Obrigado!
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Thank you!