



# FMD VACCINES AND THEIR USE IN VACCINATION PROGRAMMES: THEORY AND PRACTICE

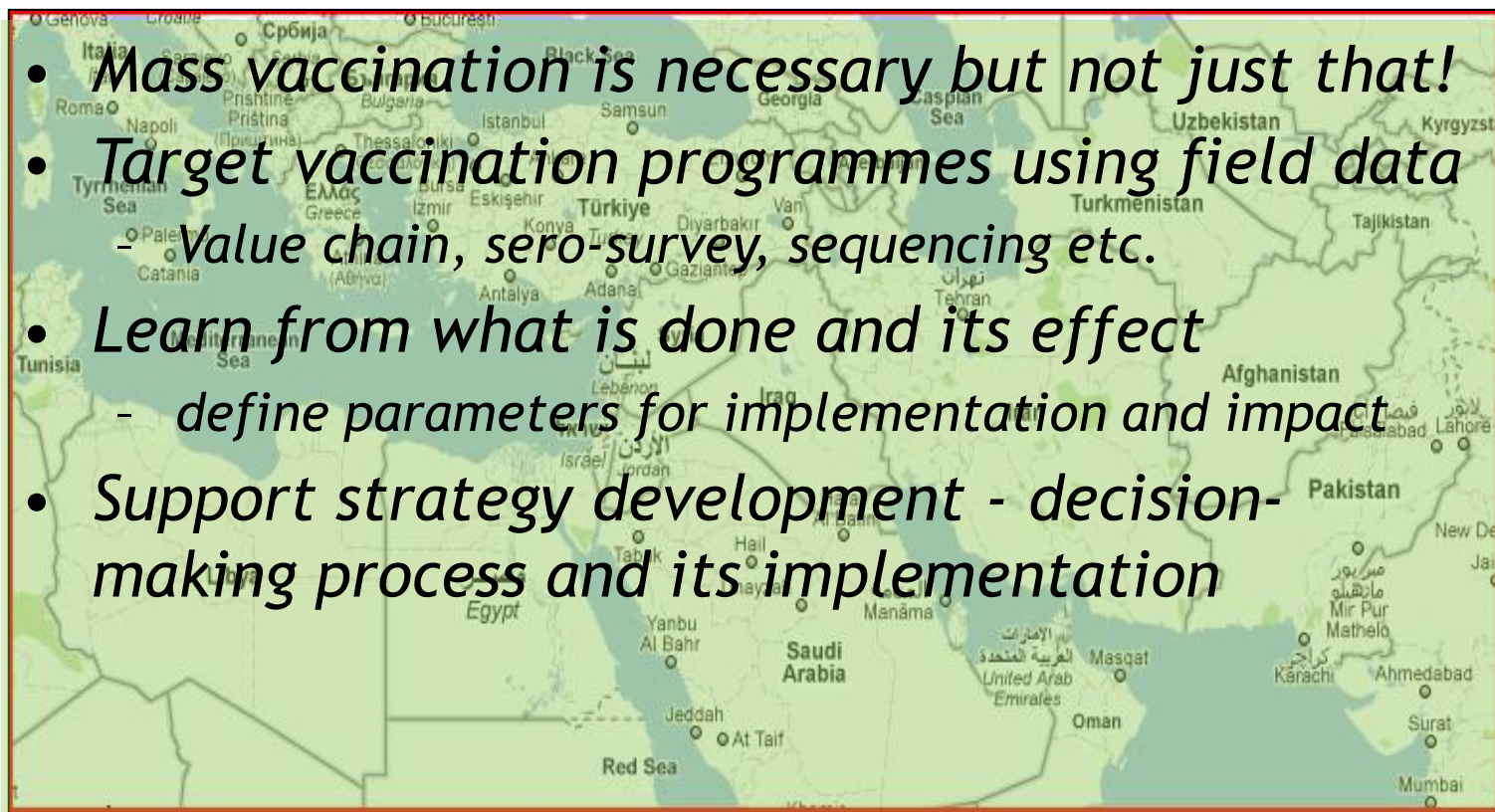
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Theodore Knight-Jones, Keith Sumption*





# Context

- Endemic FMD region
- EUFMD project activities in Egypt, Iran, Turkey
- PCP-FMD Stage 1 and 2

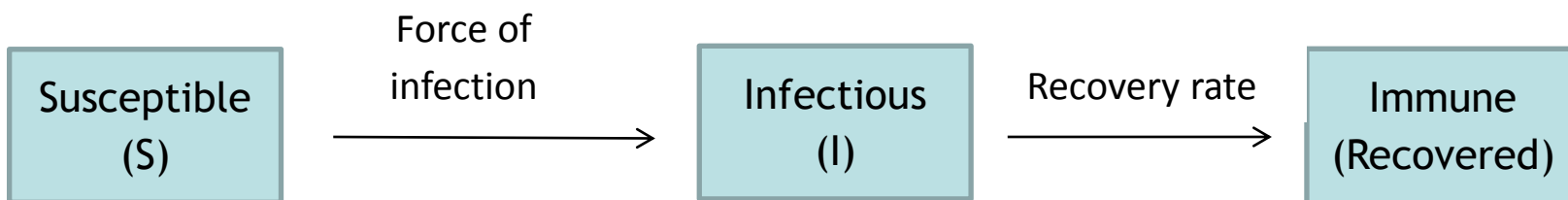




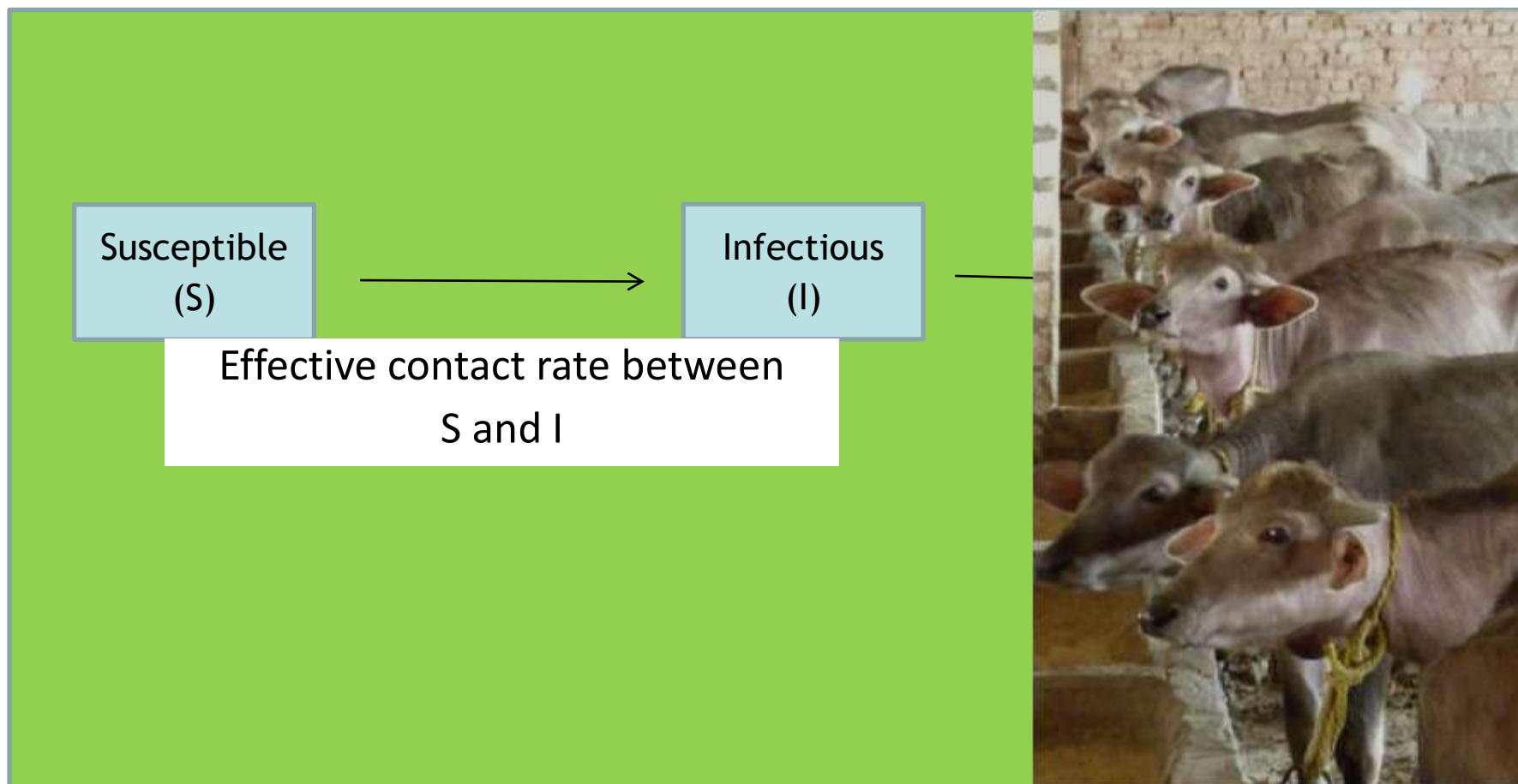
FAO-ICAR FMD conference



## S - I - R compartmental model

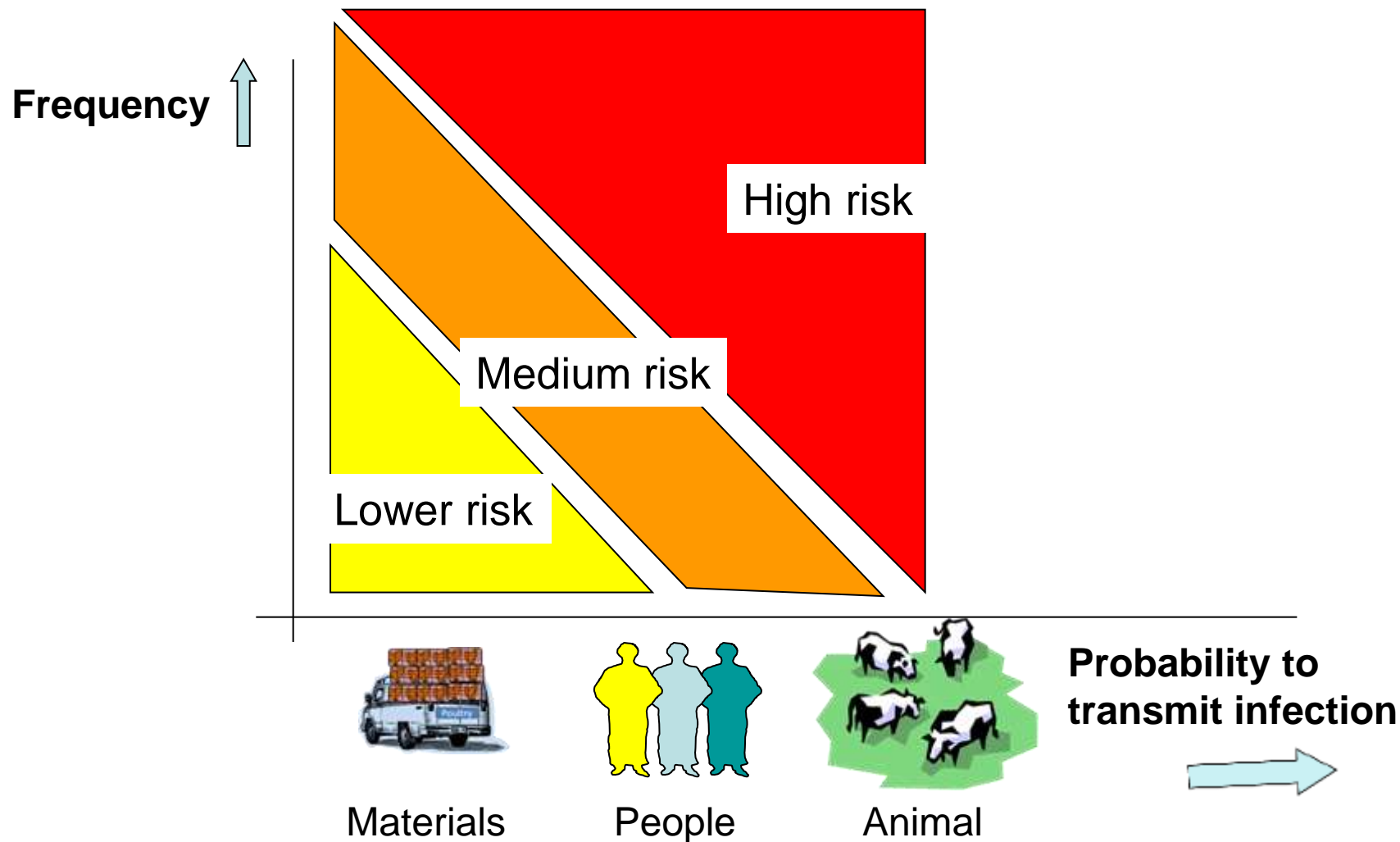


## Contact structure



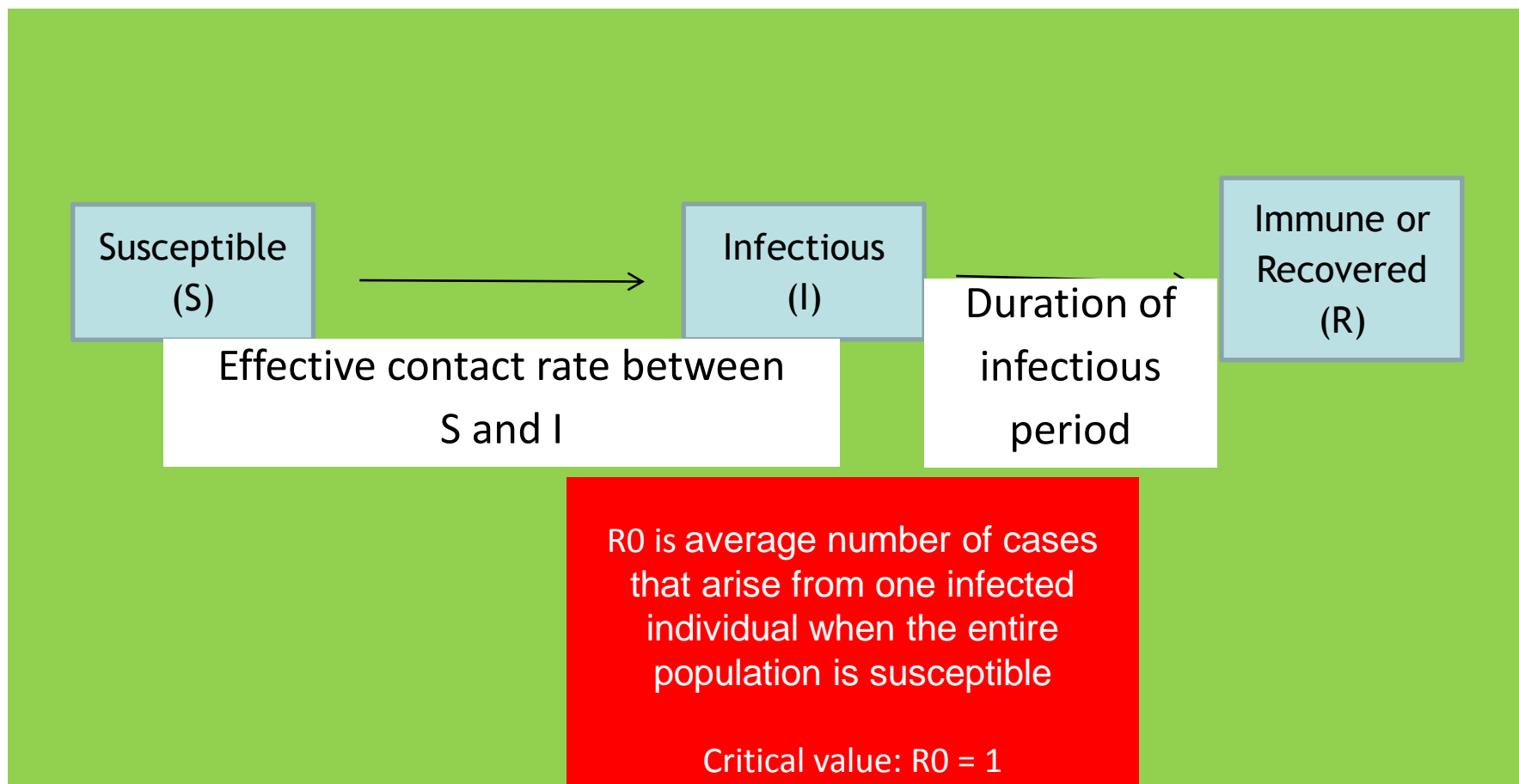


## Intensity times frequency

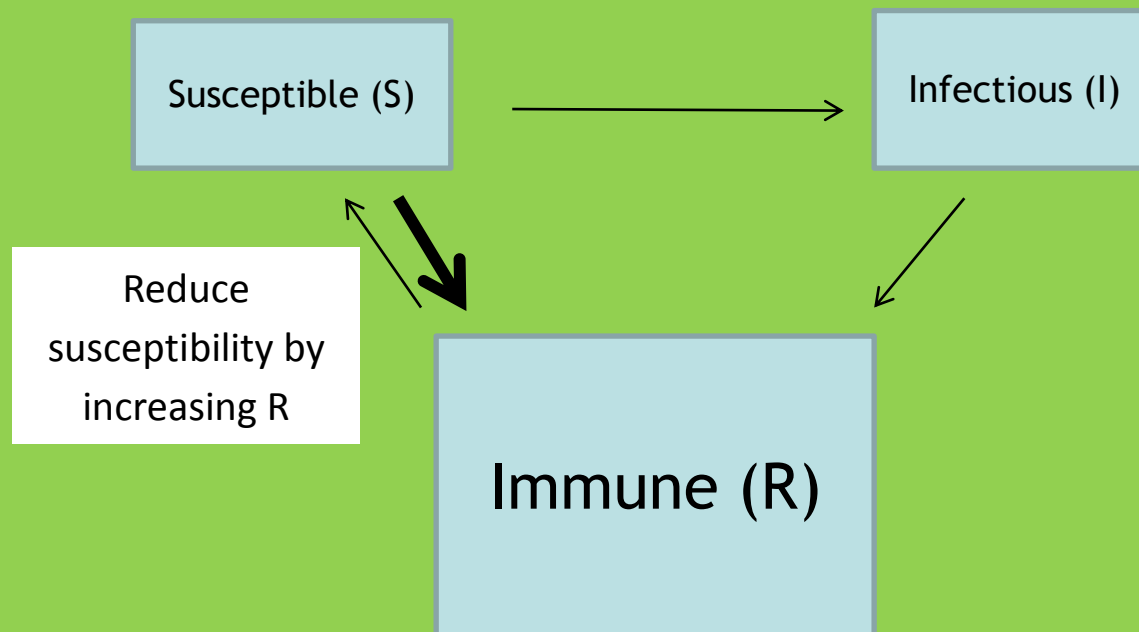




# $R_0$ : basic reproduction number



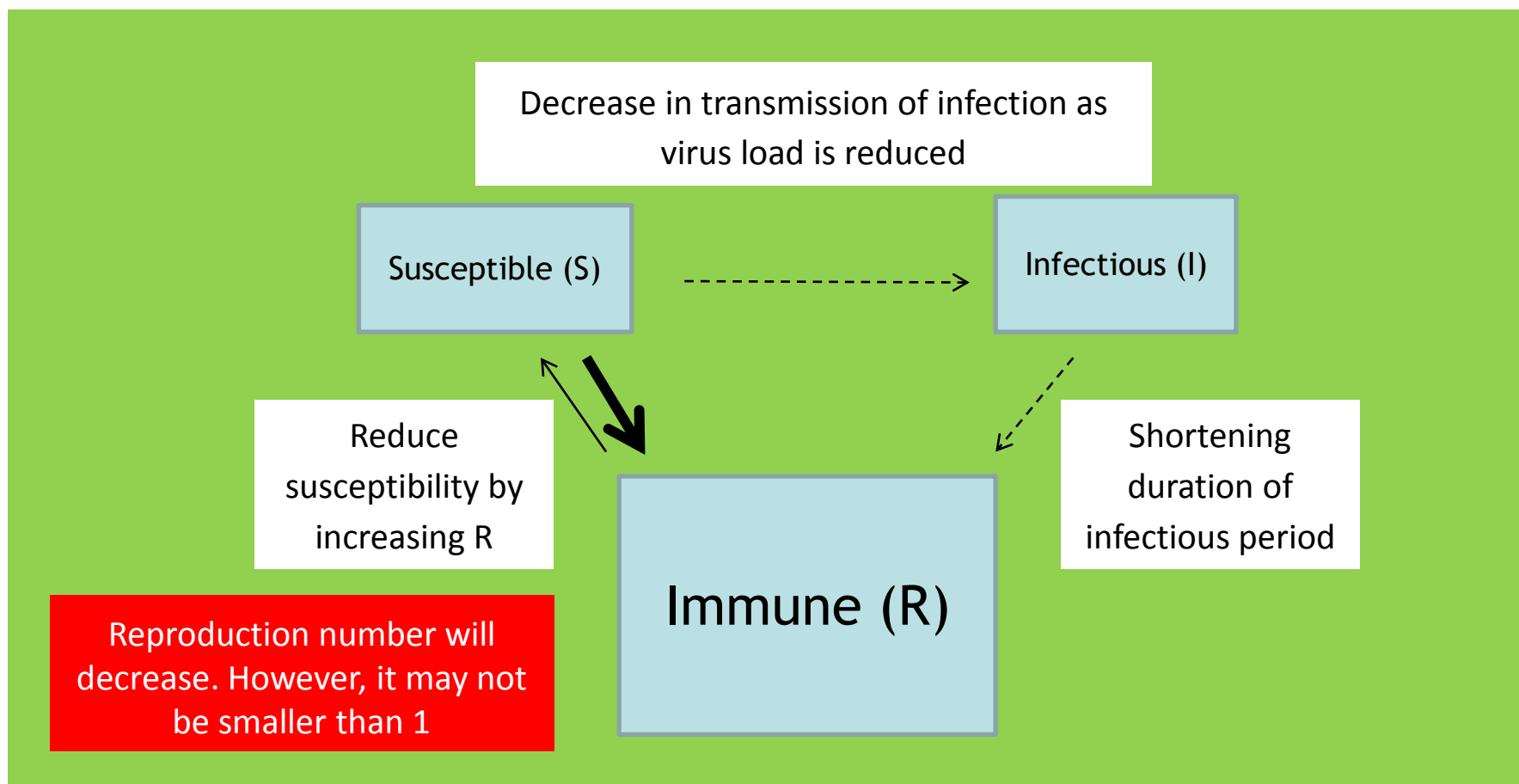
# Effect of vaccination



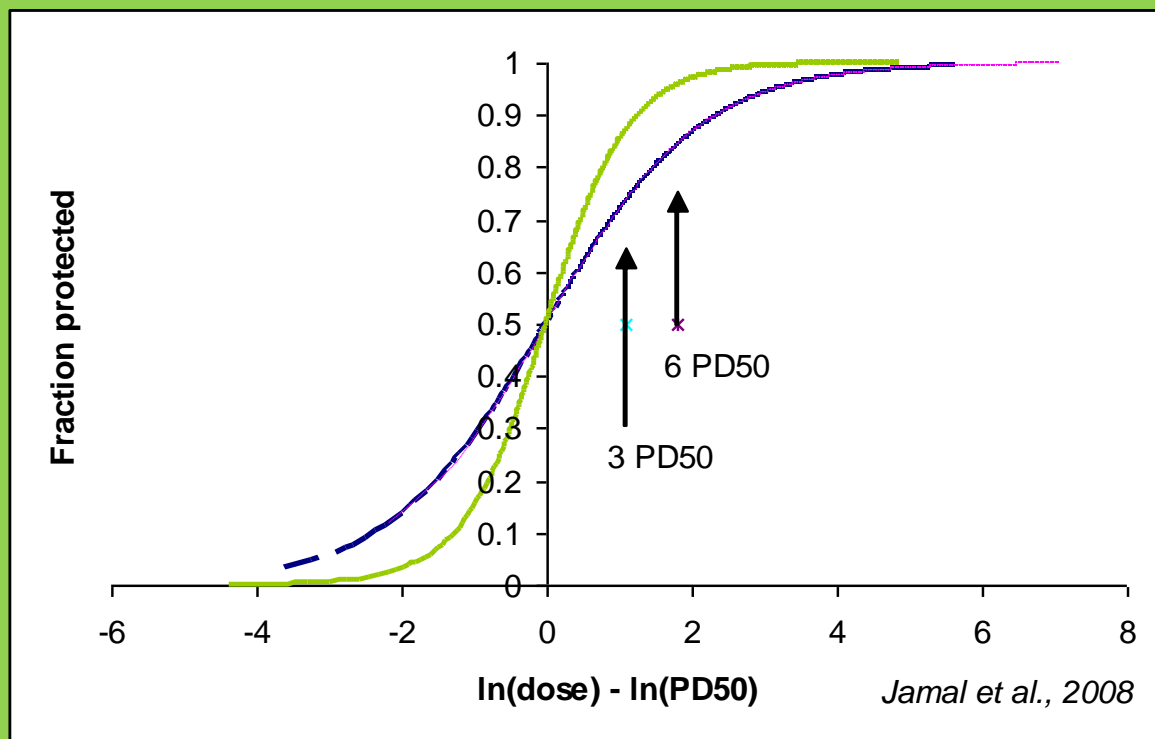




# Effect of vaccination



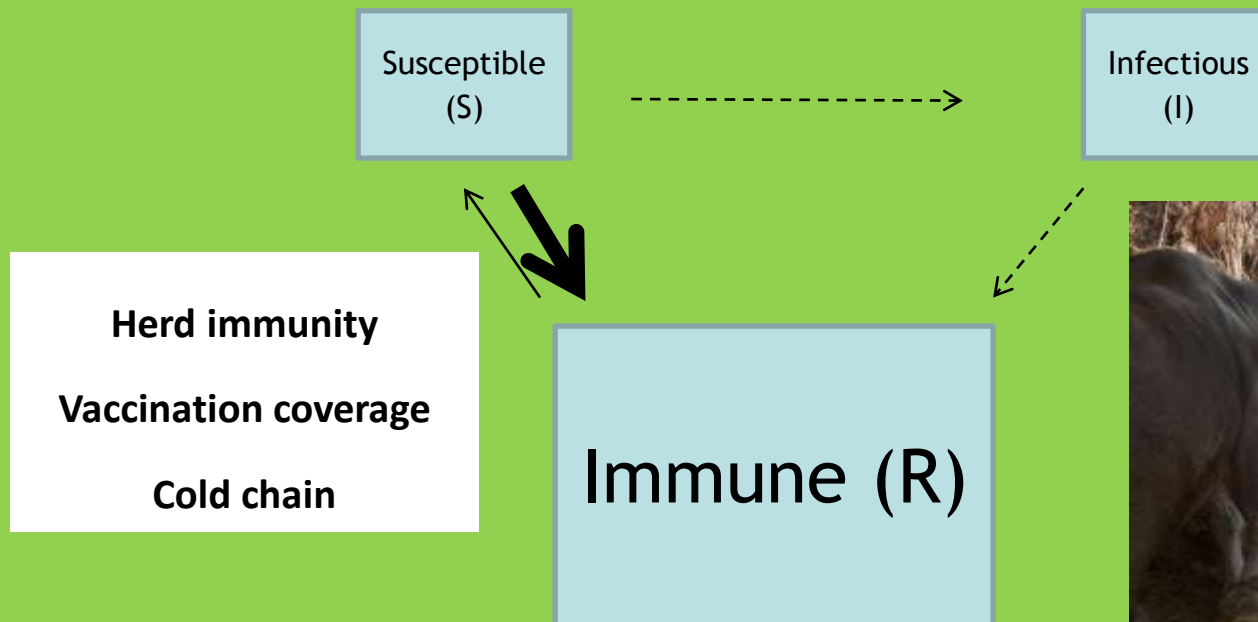
## Quality of vaccine



Infectious  
(I)



## Vaccination implementation





## Herd immunity

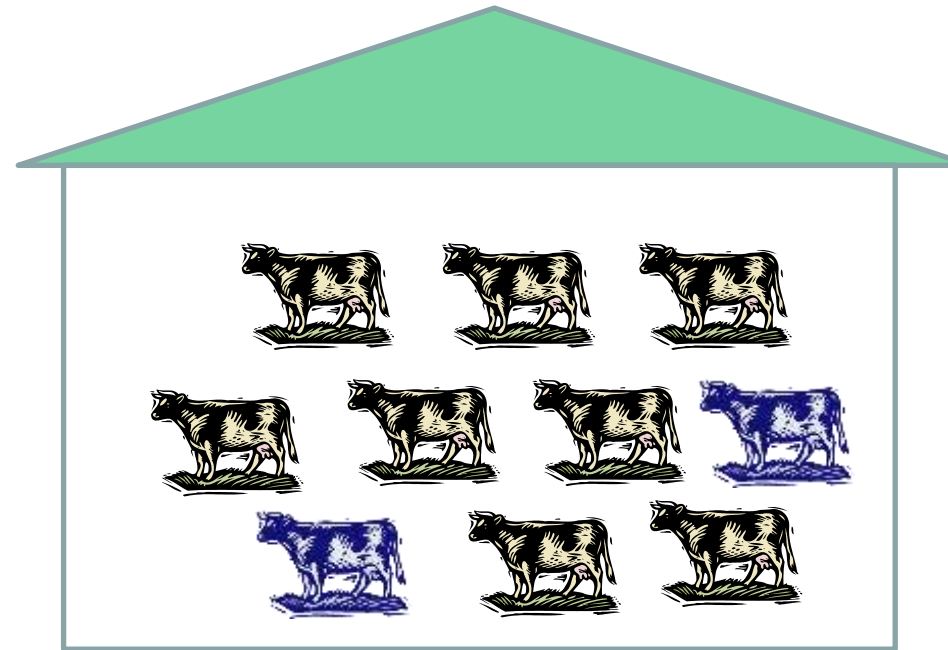
- To have a critical proportion protected such that infection will no longer lead to a major outbreak as the proportion of susceptibles becomes too small:  $R_0 < 1$ )

Critical proportion to be protected



Not vaccinated

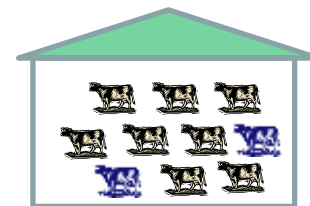
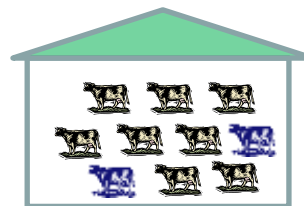
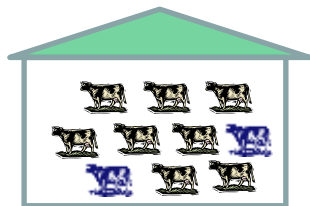
Vaccinated





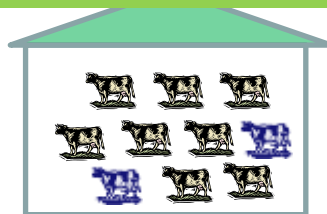
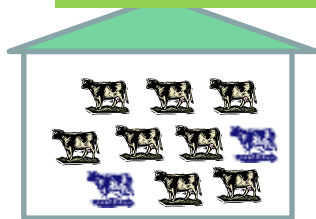


## Epi-unit immunity



However, there is large variability of R-epi unit between

- Species
- Production systems
- Regions/areas





# Setting a target for vaccination coverage?

Not at  
home

10%

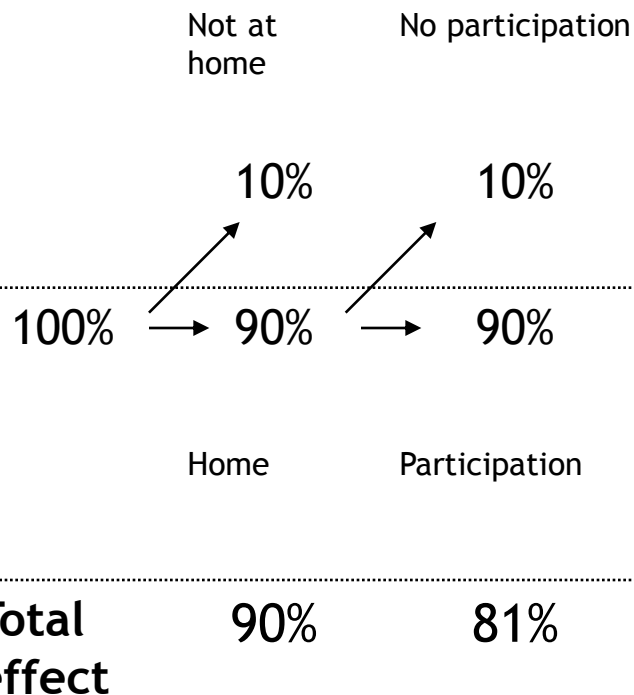
100% → 90%

Home

**Total  
effect**      90%

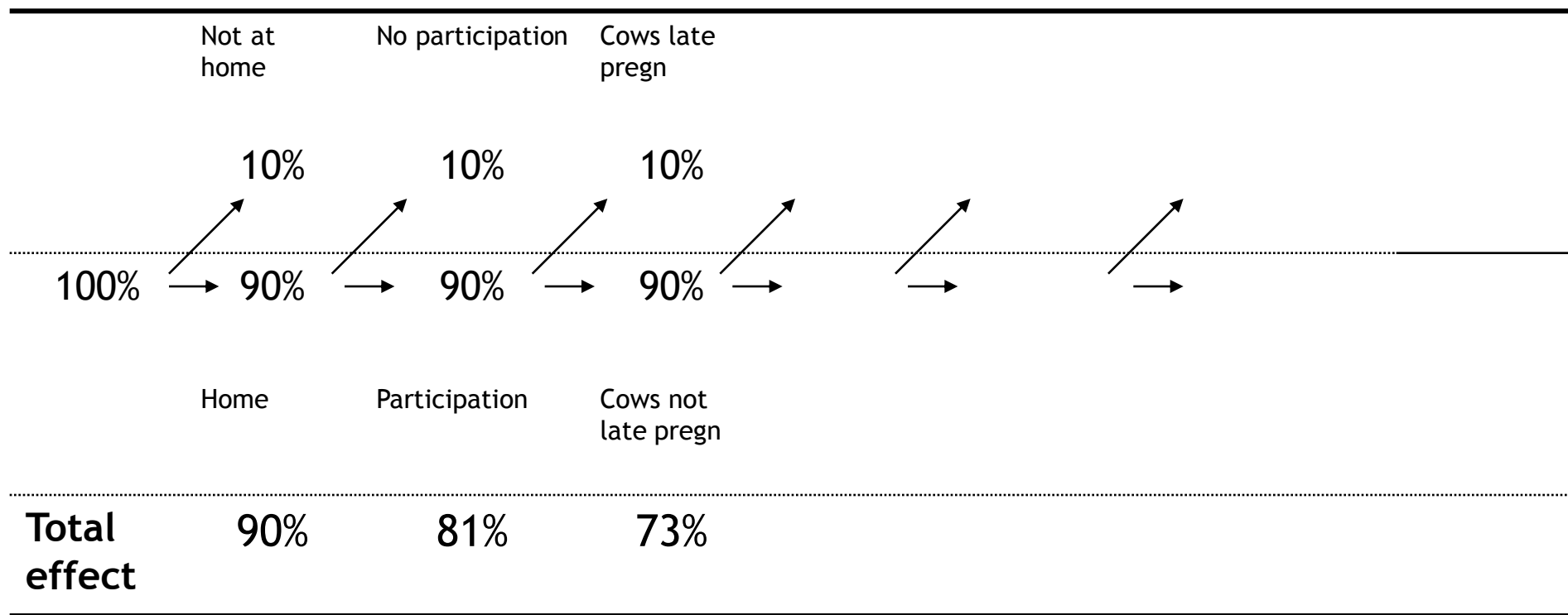


## Setting a target for vaccination coverage?





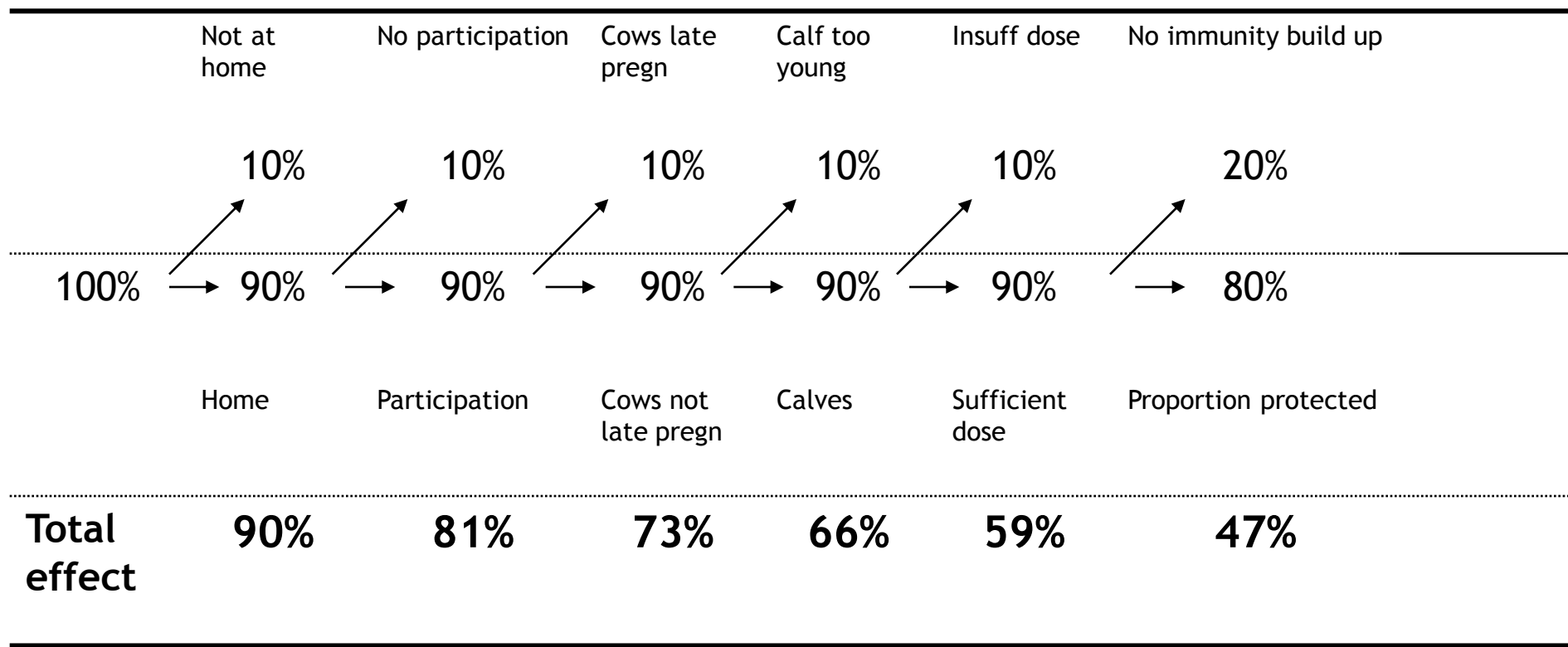
## Setting a target for vaccination coverage?



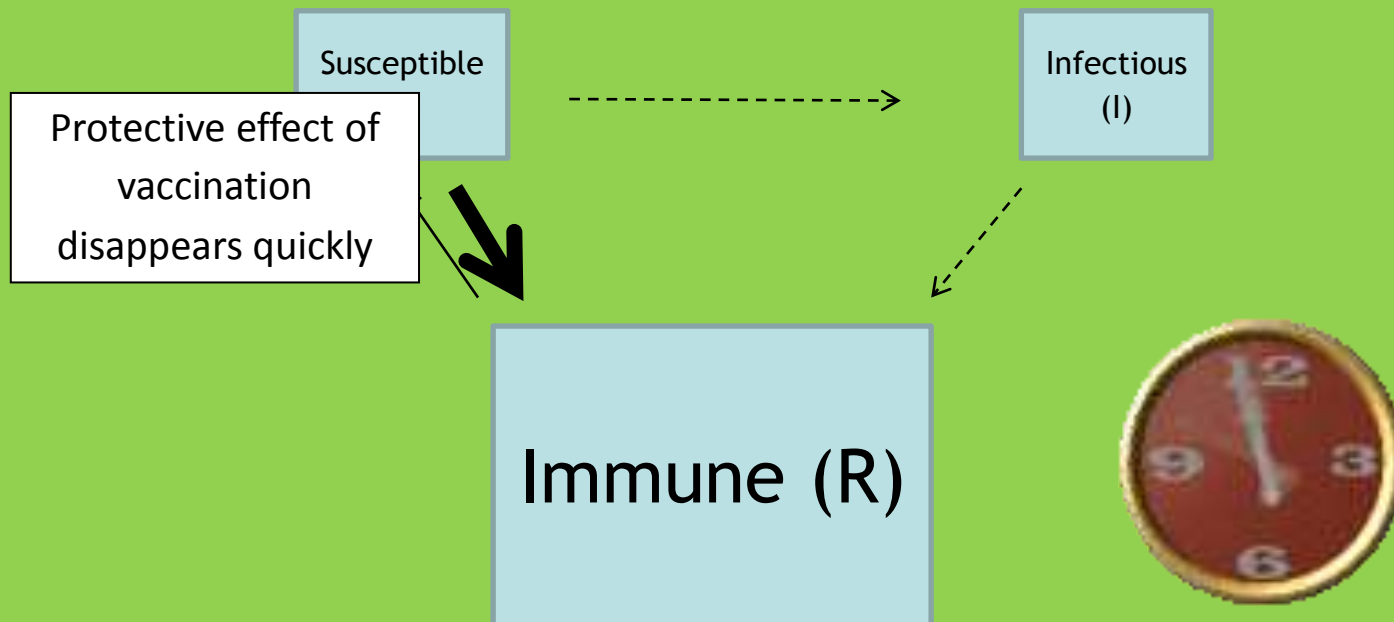




## Setting a target for vaccination coverage?

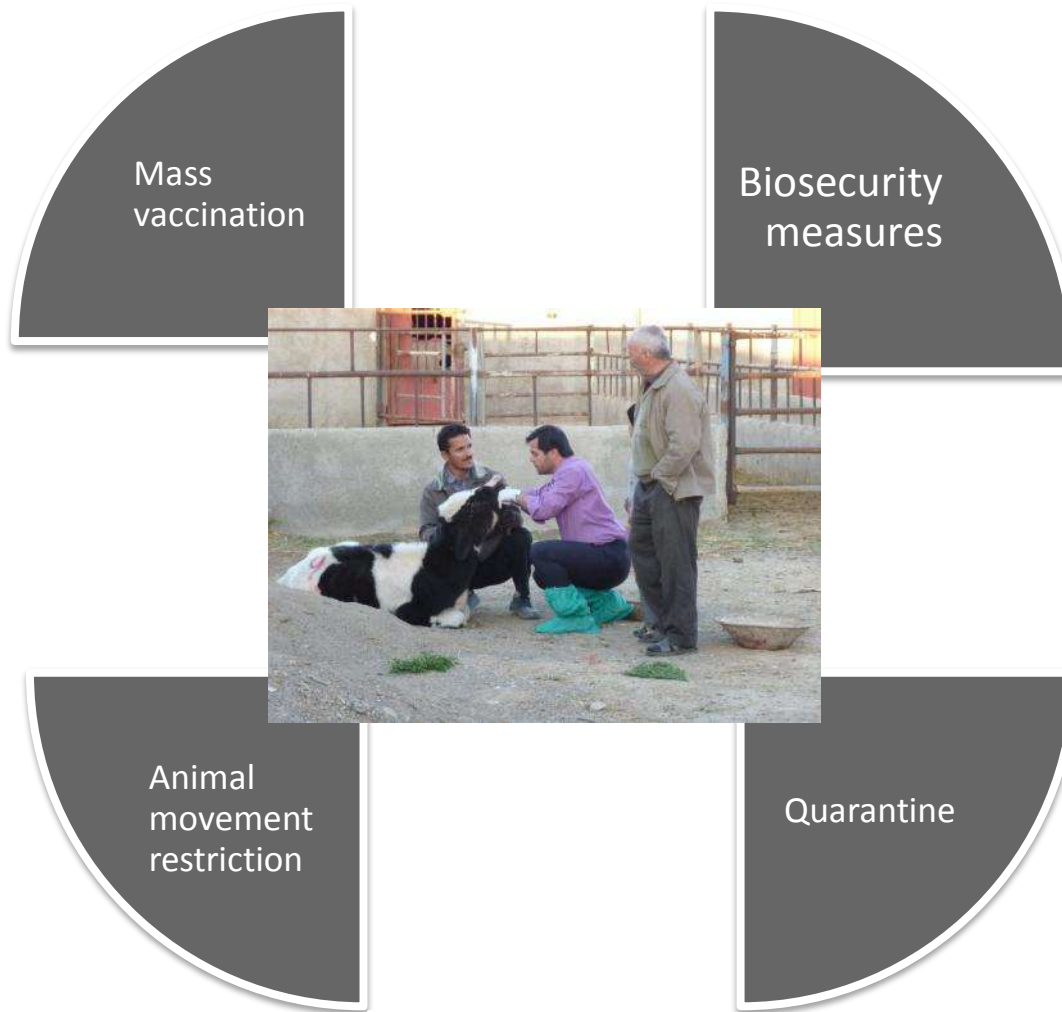


## Time component: Animal turn-over and relative short protection after vaccination





# It requires more than just vaccination





*How best to target vaccination when vaccination is taken as one of the components of FMD control?*





# Input for revising a vaccination strategy

- Value chain analysis
  - important drivers for animal (and animal product) movements
    - people - stakeholders - are involved
- Level of FMD infection and putative risk factors
  - Sero survey in different husbandry systems, regions, species
- Defining risk hotspots of FMD transmission
  - Need for prioritization of routes of spread
- Cost-benefit analysis of control strategies





# Differences between production systems

High  
impact  
of FMD



Low  
impact  
of FMD



Low risk of  
getting FMD  
infection

High risk of  
getting FMD  
infection



High  
impact  
of FMD

Dairy farms (15%)

Beef farms (15%)

Low  
impact  
of FMD

Common  
Villages (60%)

Trading  
Villages (10%)

Low risk of  
getting FMD  
infection

High risk of  
getting FMD  
infection



**Primarily young bull calves are transported**  
Dairy farms (15%) → Beef farms (15%)

Common Villages (60%)

Trading Villages (10%)

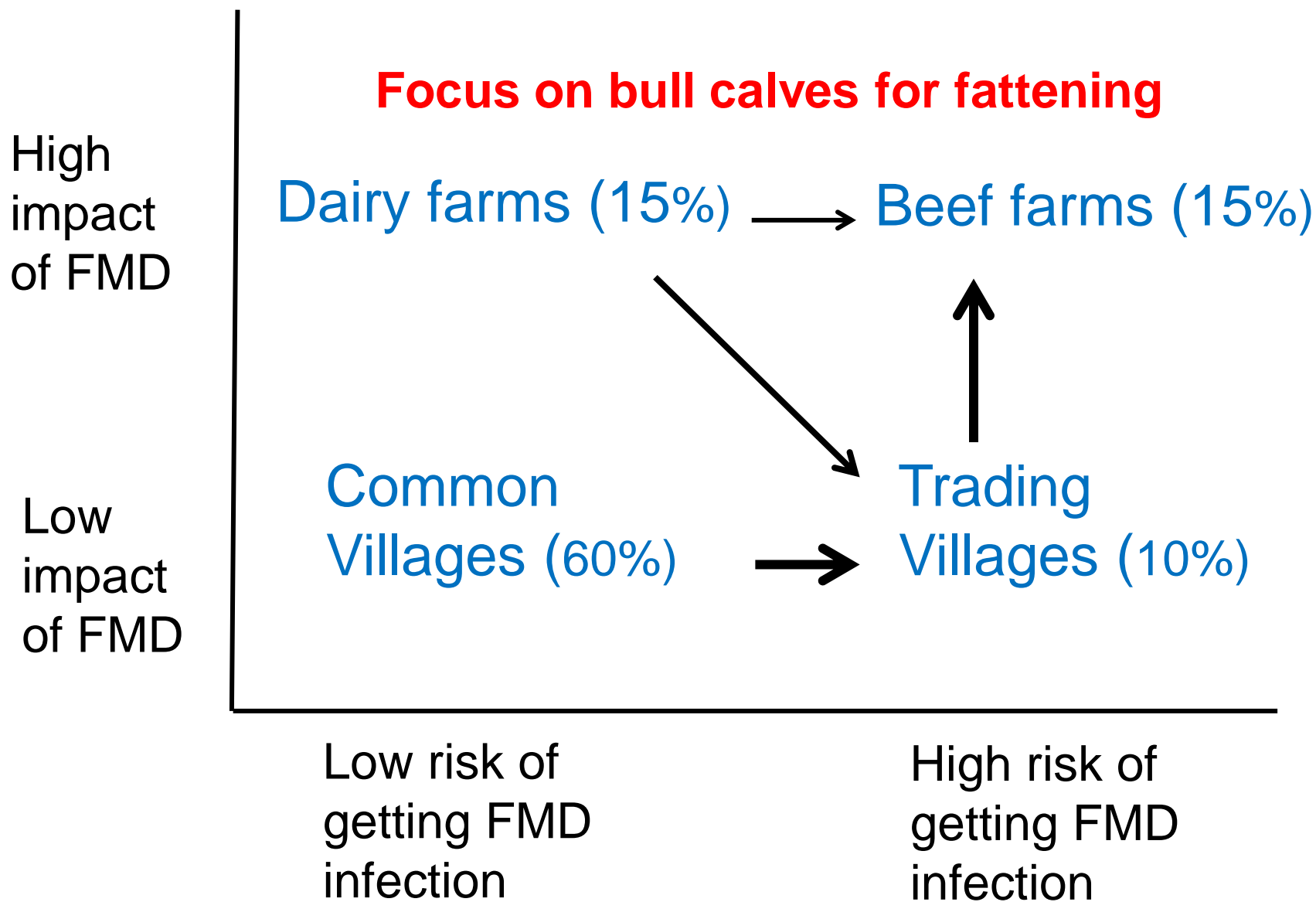
High impact of FMD

Low impact of FMD

Low risk of getting FMD infection

High risk of getting FMD infection







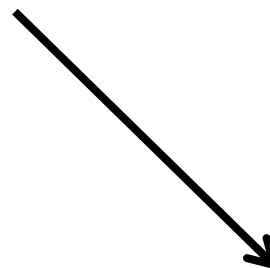
High  
impact  
of FMD

Vaccination of calves before trading  
+ mass vaccination 3x/year

Dairy farms (15%)

Mass vaccination 3+x/year,

Beef farms (15%)



Common  
Villages (60%)

Vaccination of calves  
(before trading)

Trading  
Villages (10%)

Mass vaccination 3x / year

Low  
impact  
of FMD

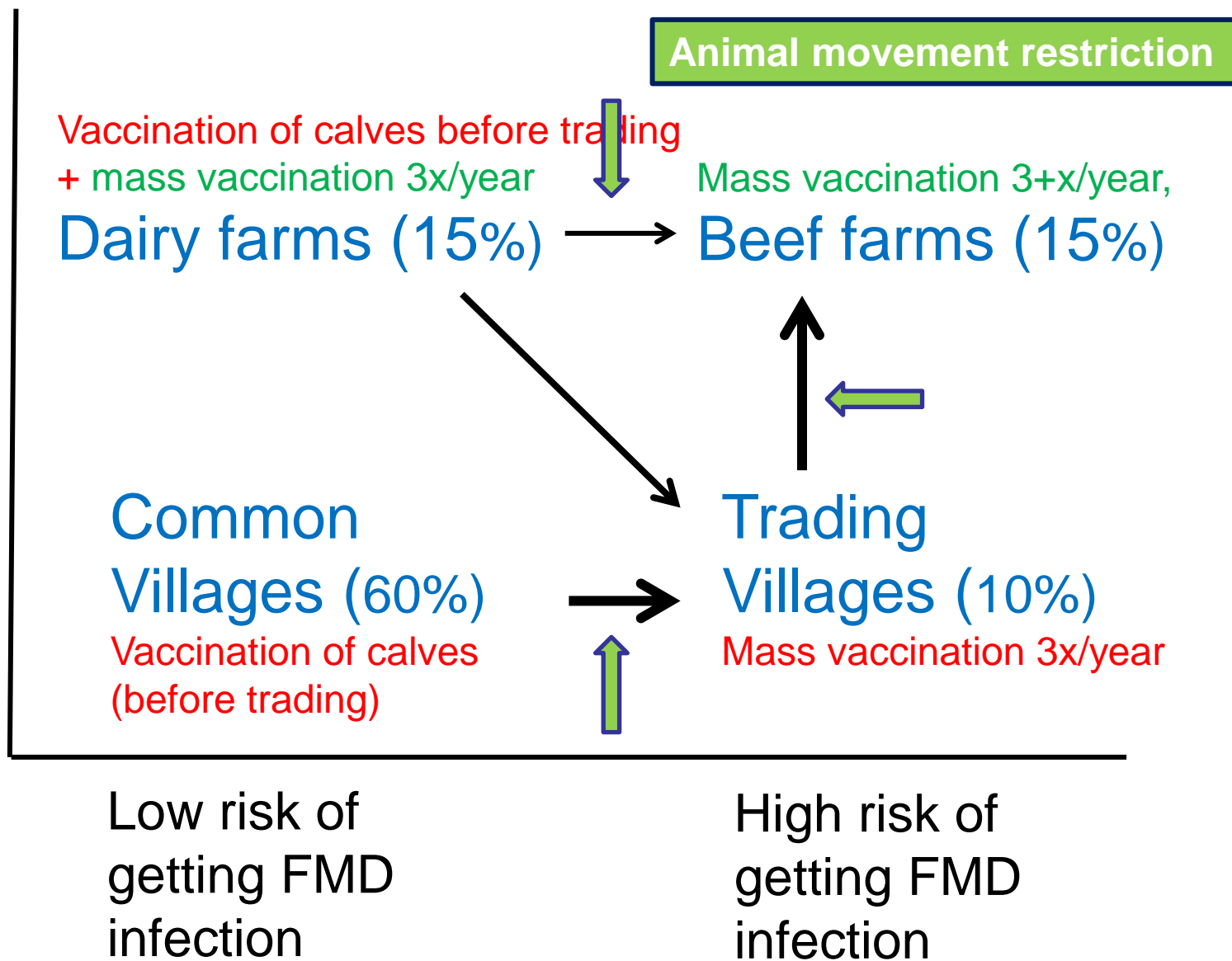
Low risk of  
getting FMD  
infection

High risk of  
getting FMD  
infection



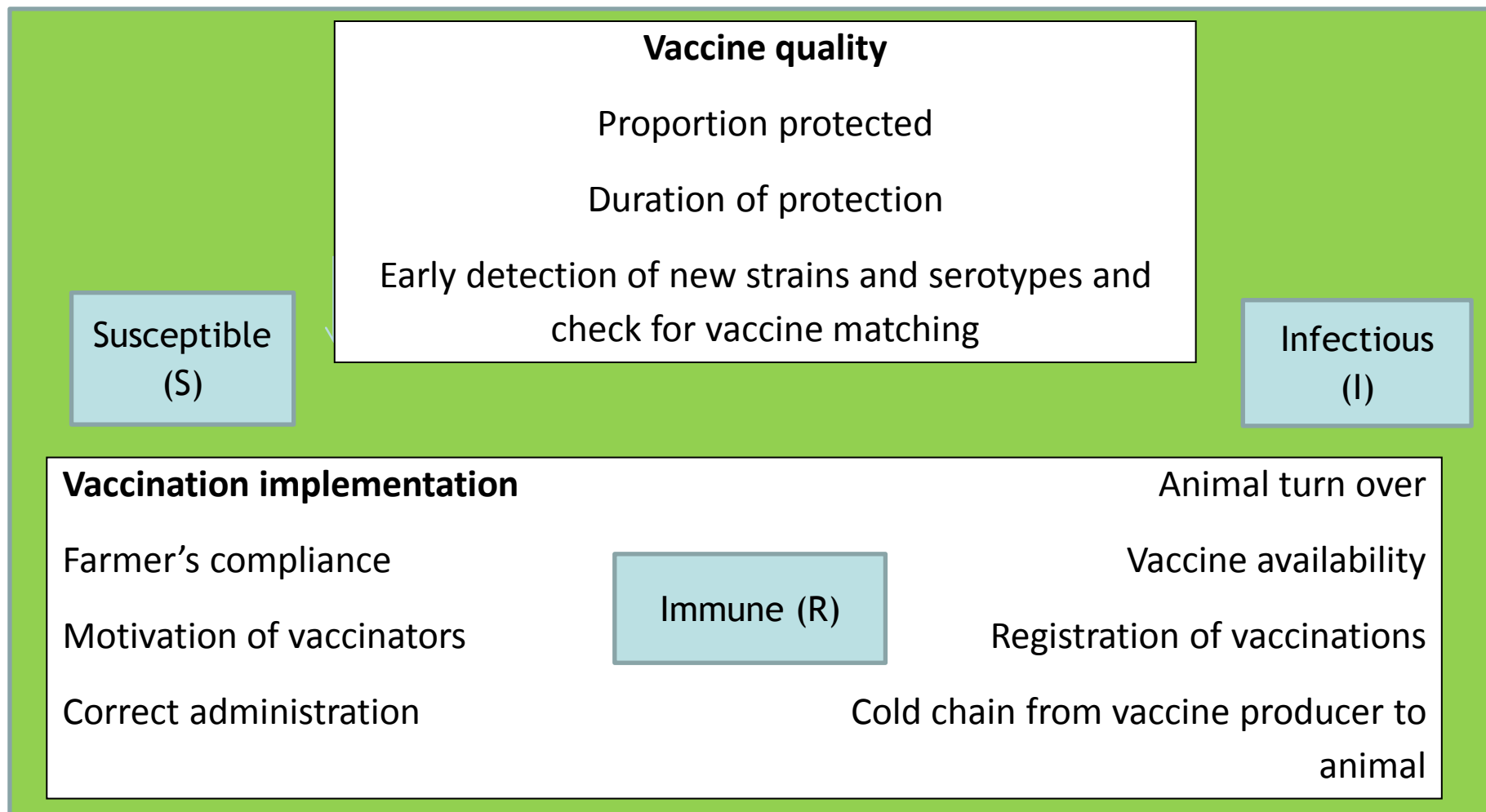
High  
impact  
of FMD

Low  
impact  
of FMD





## *Why and how to monitor vaccination programs?*





# Key performance indicators<sup>s</sup>

- Implementation

- KAP for farmers - how do farmers perceive FMD and control against FMD?
  - Knowledge, attitude and practice
- Cold chain check: use of temperature tags
- Vaccination coverage: within and between epi-units over one year period

- Impact

- Vaccine quality assessment
- Vaccine effectiveness
- Repeated sero-surveys
- Number of FMD outbreaks reported
- Cost benefit analysis



# Vaccine quality assessment

- SAARC Regional Roadmap meeting on FMD:
  - Whatever the origin of the vaccine used in a FMD control programme, the veterinary authority is responsible for vaccine quality (primary vaccine failure).





## Vaccine effectiveness - VE

- Reduction in risk of disease experienced by vaccinated compared with unvaccinated individuals in the field

(Halloran et al., 1977)

$$VE = (1 - \text{Risk}_{\text{vac}} / \text{Risk}_{\text{non-vac}}) * 100$$

- ‘Easy’ to study - provides field information
  - Combination of vaccine efficacy and effectiveness
    - Effect of refrigeration, storage, transport, administration in animals → observational results
- Requires good documentation on vaccination and FMD disease history

## Preliminary results from Turkish studies

- Investigation of new Asia-1 *Group I* vaccine
  - Turkish 2011 field strain vaccine
  - Village FMD Asia-1 outbreak investigation in Turkey
    - Vaccinated: Oct, 2011    Outbreak: Dec, 2011    Investigated: Jan, 2012
    - Cattle from affected barns only*

		Total	FMD cases	Relative risk [95%CI]	Vaccine effectiveness [95%CI]
New Asia-1 vaccine	No	101	53 (52%)	-	-
	Yes	63	9 (14%)	RR=0.27 [0.16-0.46]	<b>73%</b> <b>[54%-84%]</b>



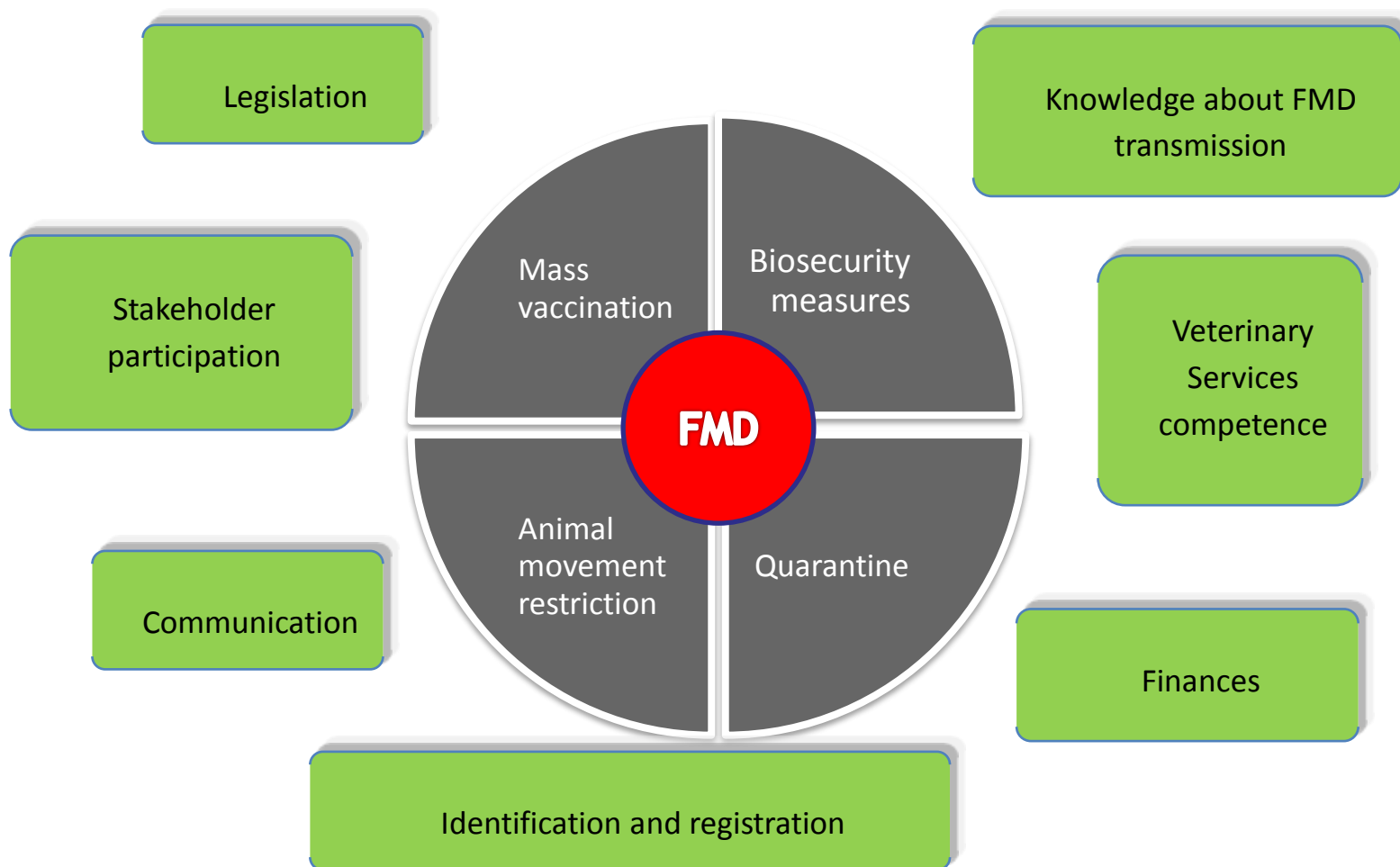
**Vaccine effect**

**But 44% village coverage**

*Vaccine effectiveness increased after adjusting for confounding (age and sex)*



# FMD control is risk management requiring tools and conditions

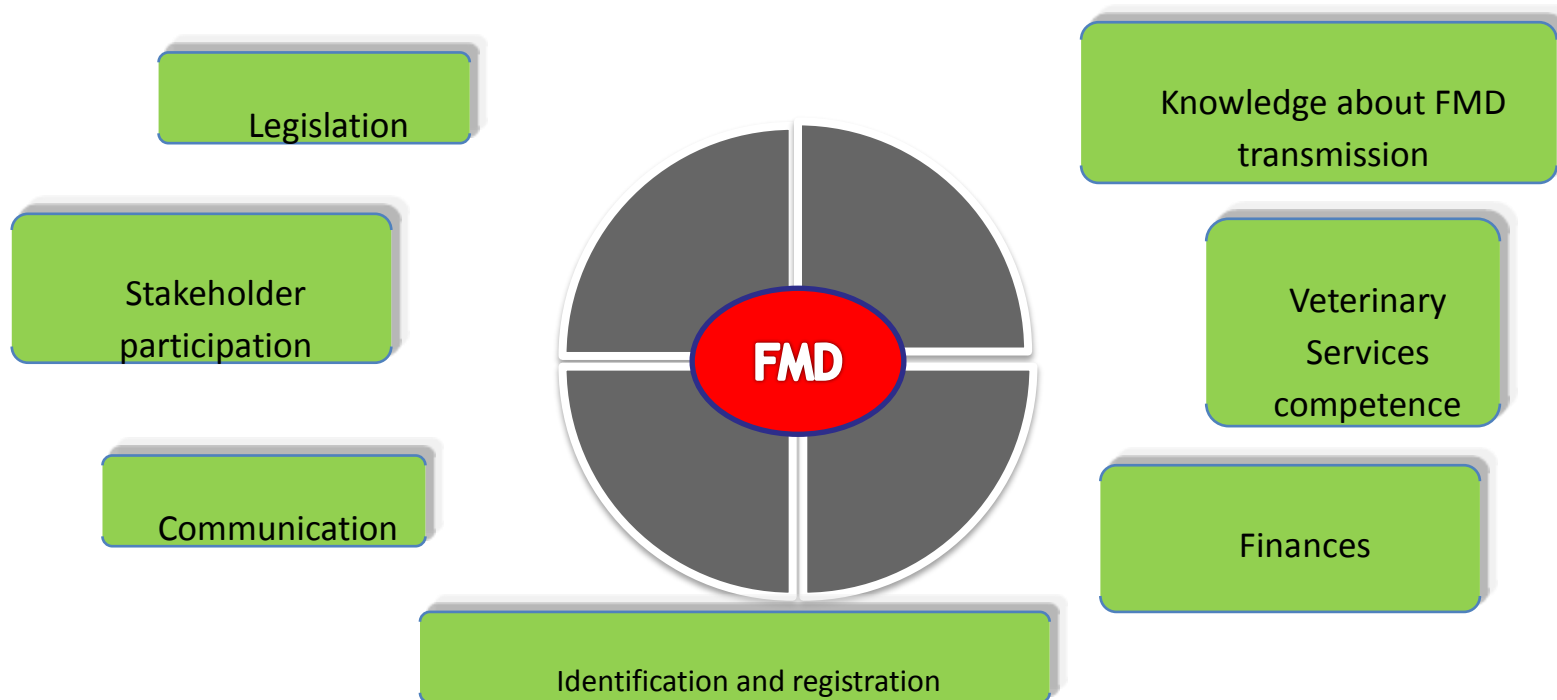




# FMD control is risk management

support to strategy development,  
decision-making, implementation and M&E

EU FMD/FAO has a role here







## Plenty of work ahead

