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**FEED INTAKE REGULATION STRATEGIES FOR THE GROWING RABBIT:
A 2005-2015 RETROSPECTIVE ON ECONOMIC AND ENVIRONMENTAL IMPACT
IN FRANCE**

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FEED INTAKE REGULATION STRATEGIES FOR THE GROWING RABBIT: A 2005-2015 RETROSPECTIVE ON ECONOMIC AND ENVIRONMENTAL IMPACT IN FRANCE

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ABSTRACT

INRAE has conducted from 2002 a research program to improve the feeding strategies for the growing rabbit, aiming to reduce the risk of digestive disorders (diarrhoea) without using drugs. Studies demonstrated that an adequate control of the post-weaning feed intake reduces the risk of digestive diseases while improving feed efficiency. INRAE performs thus an impact analysis of this innovation over the past ten years. Results showed that feed intake regulation strategies (FIRS) have led to both a reduction in the losses of growing rabbits (720000 rabbits saved/year, 30M€ over 2005-2015) a reduction in the use of drugs (-50% antibiotics used for digestive disorders) and a reduction in feed costs (+ 5% of feed efficiency, 40M€ saved). FIRS also impacted favourably the environment (-9% of global warming potential, -11% of eutrophication potentials). FIRS therefore combines economic (10M€/year), environmental and social benefits for French conventional rabbit farming systems.

Key words: feed intake regulation, growing rabbit, economy, environmental impact

INTRODUCTION

The search for alternatives to antibiotics is particularly important in the rabbit sector, since a strong societal demand has emerged to reduce the use of veterinary drugs. For instance, a French public inquiry (Chevance and Moulin 2009) revealed the high consumption of drugs in rabbit farming, knowing that about half of the antibiotics are used for digestive diseases. Since the 1990s INRAE has developed a "collaborative" research program with 7 partners (extension services and the main animal feed service companies) to improve nutritional recommendations for growing rabbits with the aim of reducing digestive disorders without impairing rabbit performances (Gidenne, 2015). We more recently studied the potential impact of feed intake regulation strategies "FIRS" after weaning. A first study showed how limiting intake after weaning improves rabbits' digestive health and feed efficiency (Gidenne *et al.*, 2003), then further trials confirmed the favourable effects of FIRS on health, feed efficiency, outputs and finally on the economy of rabbit farms (Gidenne *et al.*, 2012). Almost all French professional rabbit farmers now use FIRS, INRAE chose to carry out a retrospective impact study of FIRS on 10 years (2005-2015), which is presented below.

MATERIALS AND METHODS

Our impact study was based on a retrospective analysis methodology (Morton, 2012) and consisted in quantifying the impacts according to a generic scale (Colinet *et al.*, 2017) adapted to agronomic innovations and with a standardized procedure (Joly *et al.*, 2015). This approach has been used to analyse the impact of several innovations in livestock farming (<https://www6.inra.fr/asirpa>). More concretely, we quantified the FIRS impacts, based on existing literature and expert interviews (cited as acknowledgements) on : health, economy, environment.

RESULTS AND DISCUSSION

Economic impacts of FIRS

The economic impacts have three main sources: reduced mortality between weaning and sale of rabbits (usually a 5-week fattening period for French conventional systems); improved feed efficiency during the fattening and a reduced drug costs and feed purchase prices (less taxes if without antibiotics). Respect to mortality reduction, there is a decrease in the rate of fattening losses (Figure 1)

between 2005 and 2010, at a time when FIRS started its expansion in rabbit farming. According to experts (cf. acknowledgements), it is reasonable to attribute at least 50% of this decrease to FIRS, i.e. 1.8% less mortality. Since the annual controlled French rabbit production reached 40 million rabbits,

Mortality rate in fattening unit, %

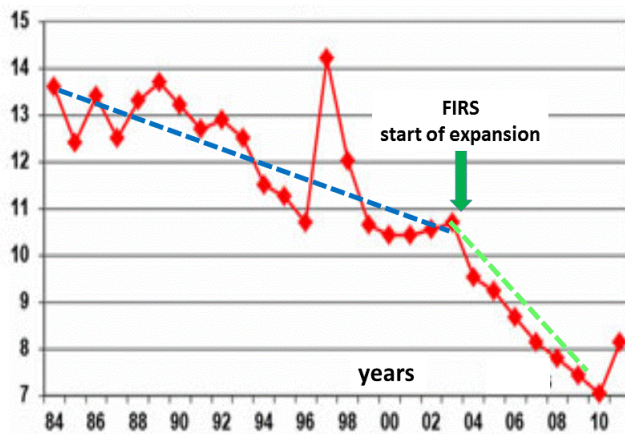


Figure 1 : Mortality rate in fattening unit of French rabbit farms (national database from 1984 to 2010, Braine and Coutelet 2012)

10 years.

Expenses for preventive antibiotic treatments has been estimated to 50€/tons of rabbit produced (ITAVI, 2016), half of this spent for digestive disorders in fattening (extra cost of a medicated feed is around 8-12€/t). Thus, the savings on antibiotic therapy for fattening would reach 1.5 to 3 M€ over 10 years, due to the favourable impact of FIRS on rabbit health.

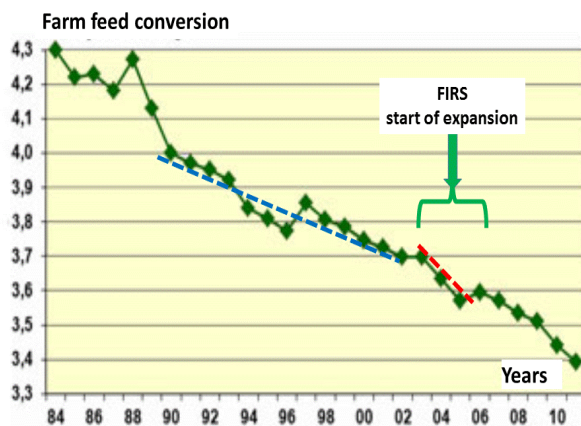


Figure 2 : Farm feed conversion for French rabbit farms (national database from 1984 to 2010, Braine and Coutelet 2012)

FIRS made possible to "produce" the equivalent of 720,000 rabbits, corresponding to a value of 2.9 million euros (M€) per year (1 rabbit with a live weight of 2.35 kg on sale at 1.7€/kg live). Over 10 years (2005-2015) the economic impact was 30 M€.

With regard to feed efficiency, there was a greater drop in the feed conversion rate between 2003 and 2006 (figure 2). More detailed studies conducted between 2003 and 2014, combined with a meta-analysis of the literature (Gidenne *et al.*, 2012) show an improvement in feed efficiency of 5% using FIRS. This corresponds to a higher feed cost margin of about 5€ per breeding doe. For a national livestock of 800,000 does, the economic impact reached 4 M€/year, or 40 million euros in

In total, out of the 3 economic impact classes, the benefit generated by FIRS over 10 years (2005-2015) amounted nearly 75 M€. This impact was probably underestimated, as our calculations were based on only 75% of national rabbit production corresponding to conventional "registered" rabbit farms. A similar impact is also expected in "independent" rabbit farms (medium or small size farms, often with a short circuit sales). Thus, the overall impact of FIRS for French rabbit farming would be around 100M€ over 10 years.

Due to the slightly negative impact of FIRS on carcass yield (-0.5 to -1%), a slight "negative" economic impact can be expected, but largely offset by gains in feed efficiency. Similarly, intake limitation can slow down the growth and thus extend the fattening period by 2 to 4%.

Nevertheless, FIRS have been optimized to increase positive impacts (health, feed efficiency) and minimize these 2 negative impacts.

Impacts on the health status of the fattening rabbit

Respect to rabbit health, FIRS allowed a reduces mortality and morbidity from digestive disorders during the fattening period (Figure 1), without inducing abnormal behaviour between congeners (aggressiveness or competition for feed access) due to a transitional daily hunger. As a result, animal welfare was globally improved. These health impacts were considered strong by the professional stakeholders who set up FIRS training programs for their technical and commercial teams. Quantification of the consumption of drugs (in particular antibiotics) was performed by animal drug

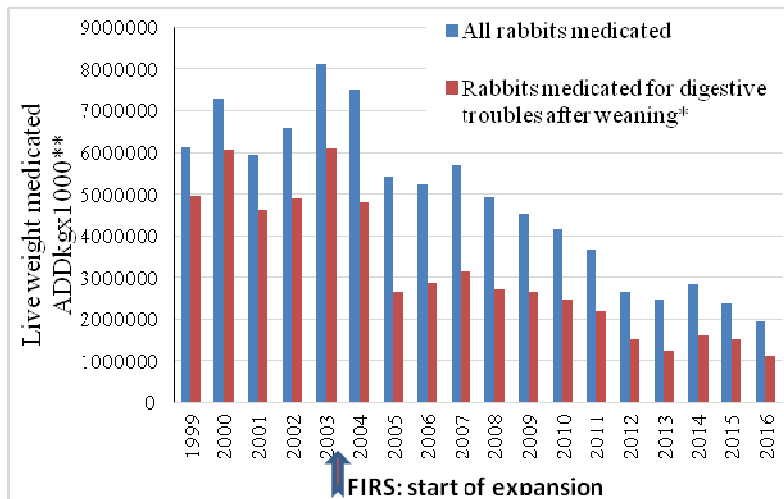


Figure 3: Exposure of rabbit to antibiotics in France.

*: weight medicated with the 3 main antibiotics used for digestive pathology (aminoglycosides, pleuromutilins, polypeptides); **ADDkg= weight medicated, kg/day, one rabbit of 2kg medicated for 5 days = 10 ADDkg

French agency (ANMV, figure 3, Méheust *et al.*, 2017). They reported from 2004 (start of FIRS expansion) a trend in reduction of the use of certain antibiotics such as bacitracin and tiamulin. The antibiotics most commonly used to treat digestive disorders after weaning (red bars in Figure 3) are polypeptides, pleuromutilins and aminosides. They represent about 50% of antibiotic purchases in rabbits. Thus, as early as 2004, there was a half decrease between 2003 and 2005 in the exposure of rabbits to antibiotics (ADDkg) for digestive disorders after weaning, just

after the implementation FIRS: 6000t ADDkg in 2003, then 2800t in 2005. This effect was then maintained, and from 2012 onwards, it was reinforced with the implementation of the drug reduction program for the rabbit sector (1000t ADDkg in 2013). In total, since 2003, we estimate that the mass of rabbits (ADDkg) untreated for digestive disorders thanks to the use of FIRS would be at least 30,000t live weight.

The use of FIRS probably contributed to raise the technical level of rabbit farmers. Digestive disorder detection techniques are more preventive than before. In concrete terms, the breeder can more precisely monitor the kinetics of animal feed intake, which allows earlier detection of digestive risks and therefore secure the production. This impact is particularly relevant for professionals who have invested in automatic feeding systems. In terms of health, public health, we can expect a favourable "one-health" effect, due to a better sanitary environment, less spread of antimicrobial resistance genes, less spread of pathogens in the farm and its immediate environment.

Environmental impact

Respect to environment, FIRS have a positive impact on at least three aspects. Reducing intake leads to lower consumption of feed resources, through a better feed efficiency, but also to a reduction in excreta, without significant changes in growth. Second, the reduction in the use of drugs (antibiotics) leads to a reduction in the release of antibiotics into the environment. Finally, the reduction of digestive diseases is equivalent to a greater number of healthy animals, and therefore to a lesser waste of feed by sick or dead animals, which are therefore not valuable for consumption. At the same time, there is a reduction in the number of dead rabbits to be incinerated, thus saving energy. The study by Zened *et al.* (2013) quantified the environmental impacts of the use of FIRS (Table 1) using a Life Cycle Assessment method. Based on these 3 main impacts mentioned below, the results show that the application of FIRS leads to: a decrease in global warming potential (-9%), eutrophication (-11%) and acidification (-12%) potentials and agricultural land use (-10%).

Table 1. Environnemental impacts of feed intake regulation strategies (FIRS) for one ton of rabbits carcass produced.

Impact items	Climatic change (kg CO ₂ -eq)	Eutrophication (kg PO ₄ -eq)	Acidification (kg SO ₂ -eq)	Terrestrial toxicity (kg 1,4-DB-eq)	Energy cumulated demand (MJ-eq)	Water use (m ³)	Agricultural land use (m ² /year)
Free feeding	4010	30.0	92.3	10.0	64245	91.2	3954
with FIRS	3666	26.7	81.7	9.2	60938	84.4	3541

Social impact and other impacts

The favourable economic and health impacts contributed to maintain the rabbit farmers (about 1000 in France) and their socio-professional network, through an improvement in their competitiveness. FIRS also contribute to secure the production, while reducing the working time if the farmer has invested in automatic feeding. On the other hand, such equipment raised the level of investment for a quite similar production level, and makes it a little more difficult to access this profession. Farmers who have invested in automatic feeding were able to allocate more time to health prevention techniques (hygiene, performance monitoring, etc.). It is very likely that without this innovation, the social image of the rabbit farming would have been degraded, in a context of limited use of veterinary drugs. In parallel with the dissemination of FIRS, various tools and equipment have been developed by several companies since 2006, such automatic feeding systems. Expansion of FIRS was very quick in France since the main feed producers were implicated in the studies on FIRS. Only 2 years after the first publication in French rabbit congress (2003), already 30% of the rabbit farmers used FIRS, and now about 95% of them use this innovation. Dissemination at the international level was relatively slow, probably due to the lack of economic calculations adapted to the rabbit farming systems of the countries considered (Italy, Spain, etc.), but above all to the absence of professional partners who have directly contributed to this innovation in feeding strategies.

CONCLUSIONS

The use of FIRS is original and contributes to the sustainability of the conventional rabbit farming systems. The application of FIRS has been carried out at the national level, and also at the international level in recent years. It mainly affects rabbit farmers competitiveness, but also surrounding professional staff (veterinarians, public or private technical advisers). A large favourable economic impact (about 10 million €/year saved) was obtained. This innovation is currently disseminated in several countries, but must be adapted to the technico-economical context of each national rabbit production.

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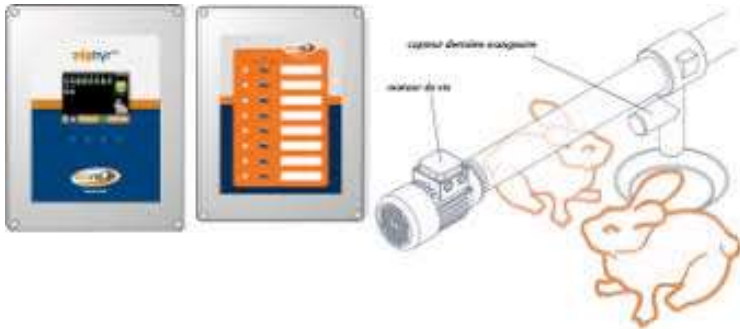
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Feed intake regulation strategies for the growing rabbit: a 10 years retrospective on economic and environmental impact in france

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Context

Feed Intake Regulation Strategies "FIRS" used since 2004, and for about 12 years by almost all **French** professional rabbit farmers, INRAE has chosen to carry out an impact study of this innovation. Here are the main results of this impact study (economic, social etc.).



Methodology

A retrospective analysis to quantify the impacts of FIRS innovation,

3 analytical tools: a chronology, an impact path, and an impact vector

Specifically for our study:

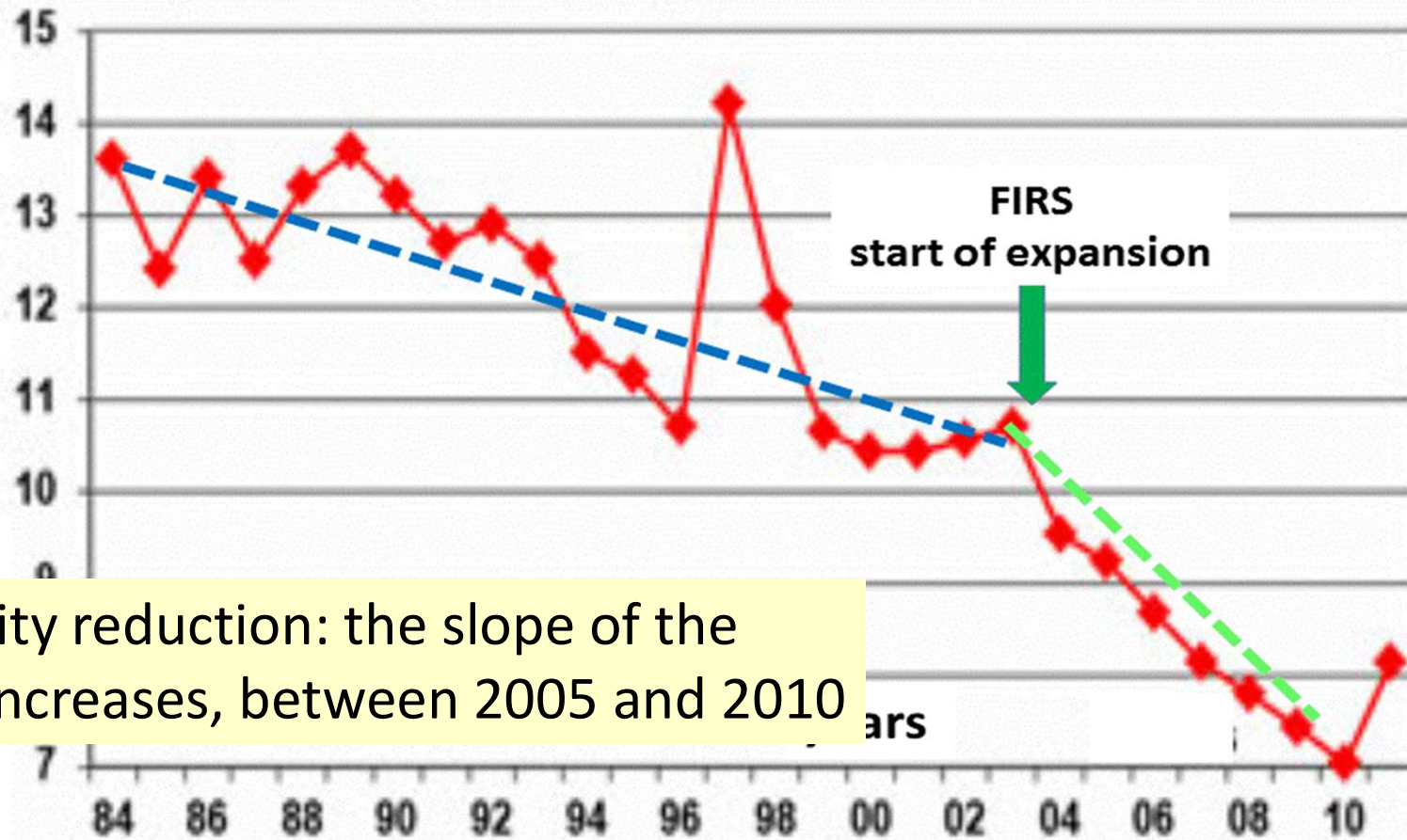
analysis of existing literature and expert hearings => health, economic, societal, environmental, social and political impacts.



Economic impact of FIRS



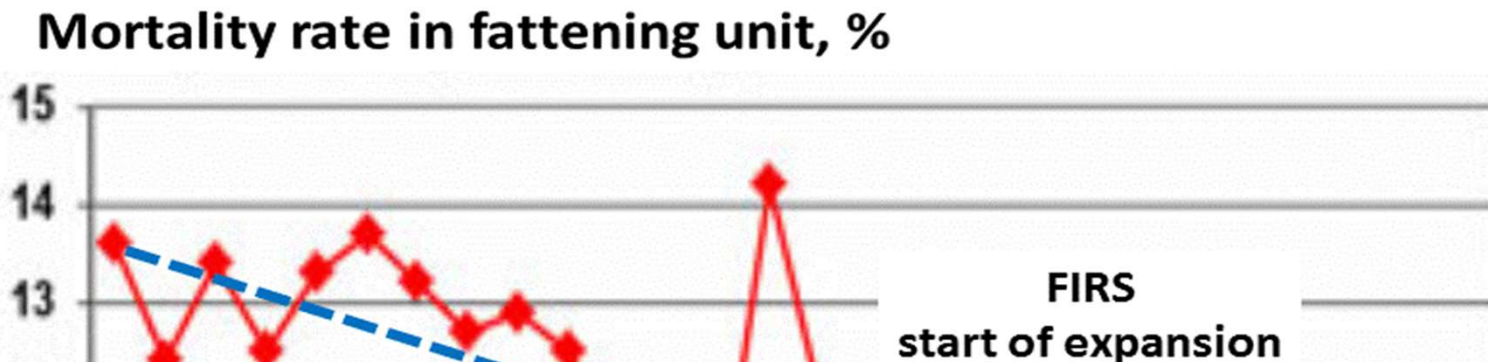
Mortality rate in fattening unit, %



Mortality reduction: the slope of the curve increases, between 2005 and 2010

FIRS dissemination

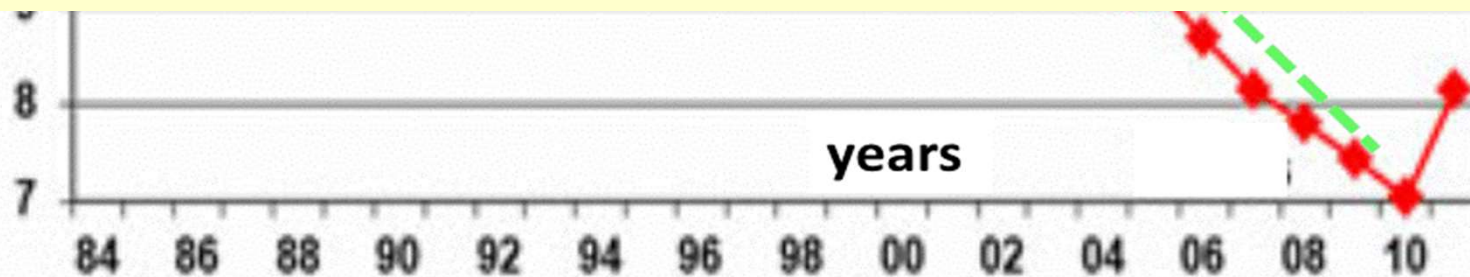
Economic impact of FIRS



If 50% of this decrease \Leftrightarrow FIRS \Rightarrow 1.8% less mortality.

For 40 million rabbits produced/year in France \Rightarrow FIRS = + 720 000 rabbits produced, meaning :

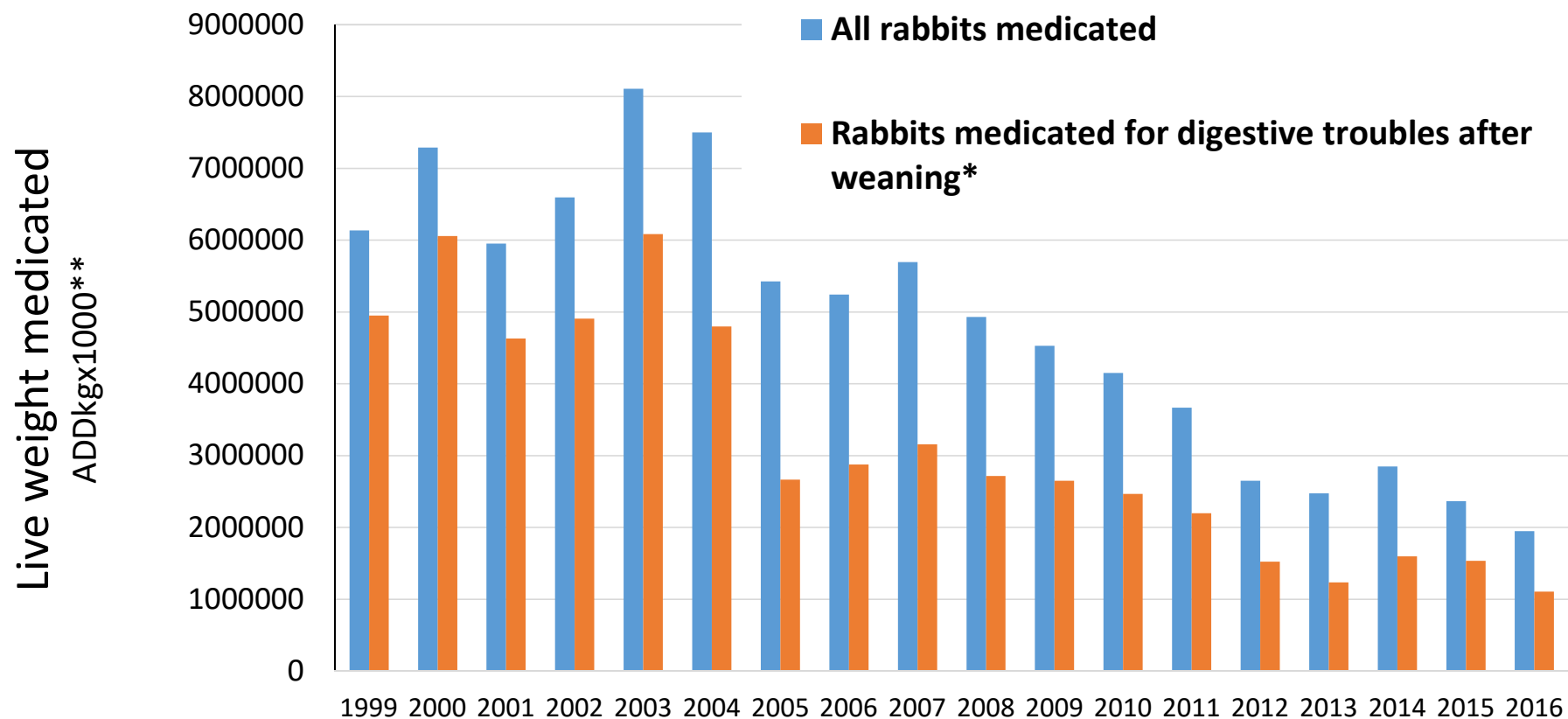
2,9 million € / year \Rightarrow **Over 10 years \Rightarrow 30 million €**



FIRS dissemination

Exposure of rabbit to antibiotics in France.

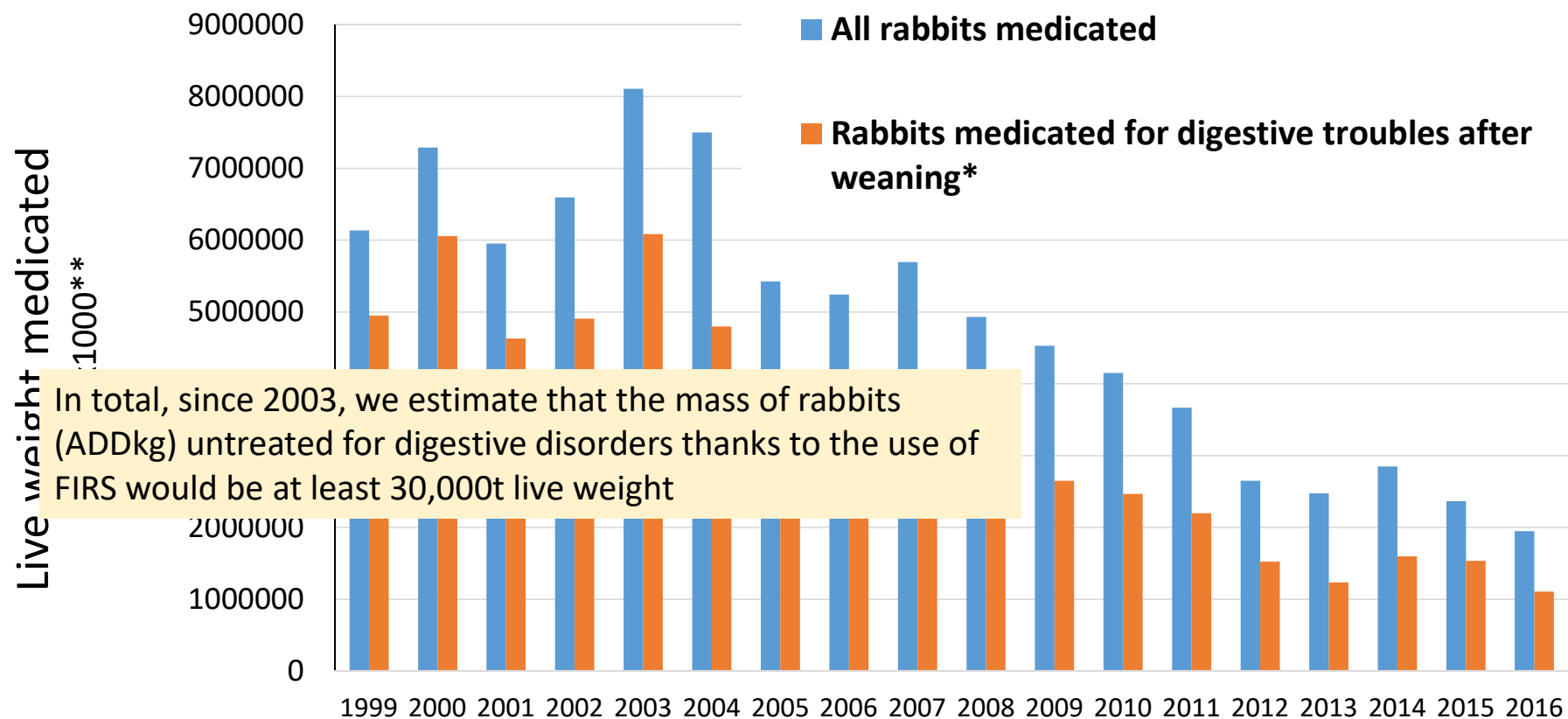
*: weight medicated with the 3 main antibiotics used for digestive pathology (aminoglycosides, pleuromutilines, polypeptides); **ADDkg= weight medicated, kg/day, one rabbit of 2kg medicated for 5 days = 10 ADDkg



FIRS: start of expansion

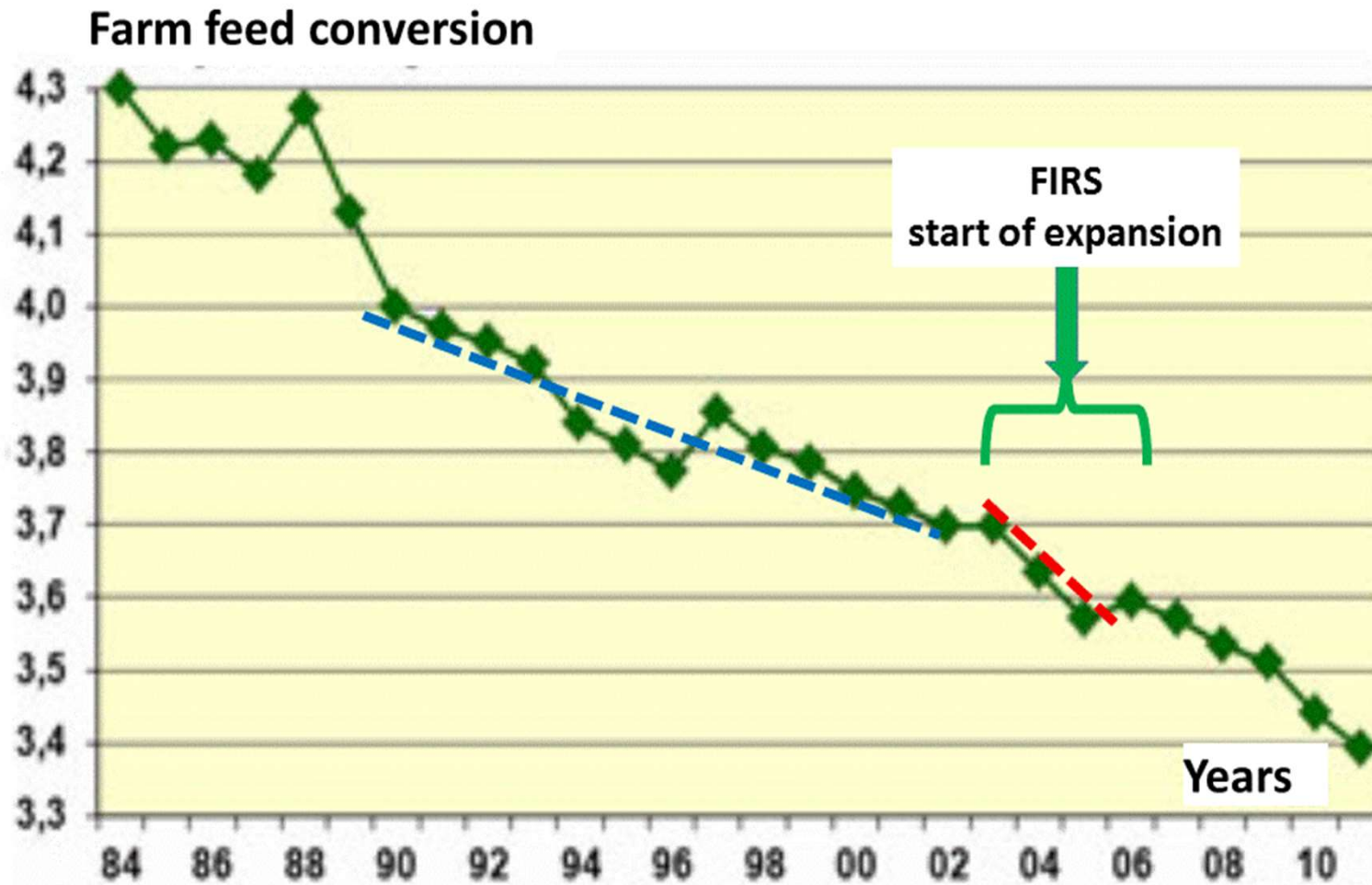
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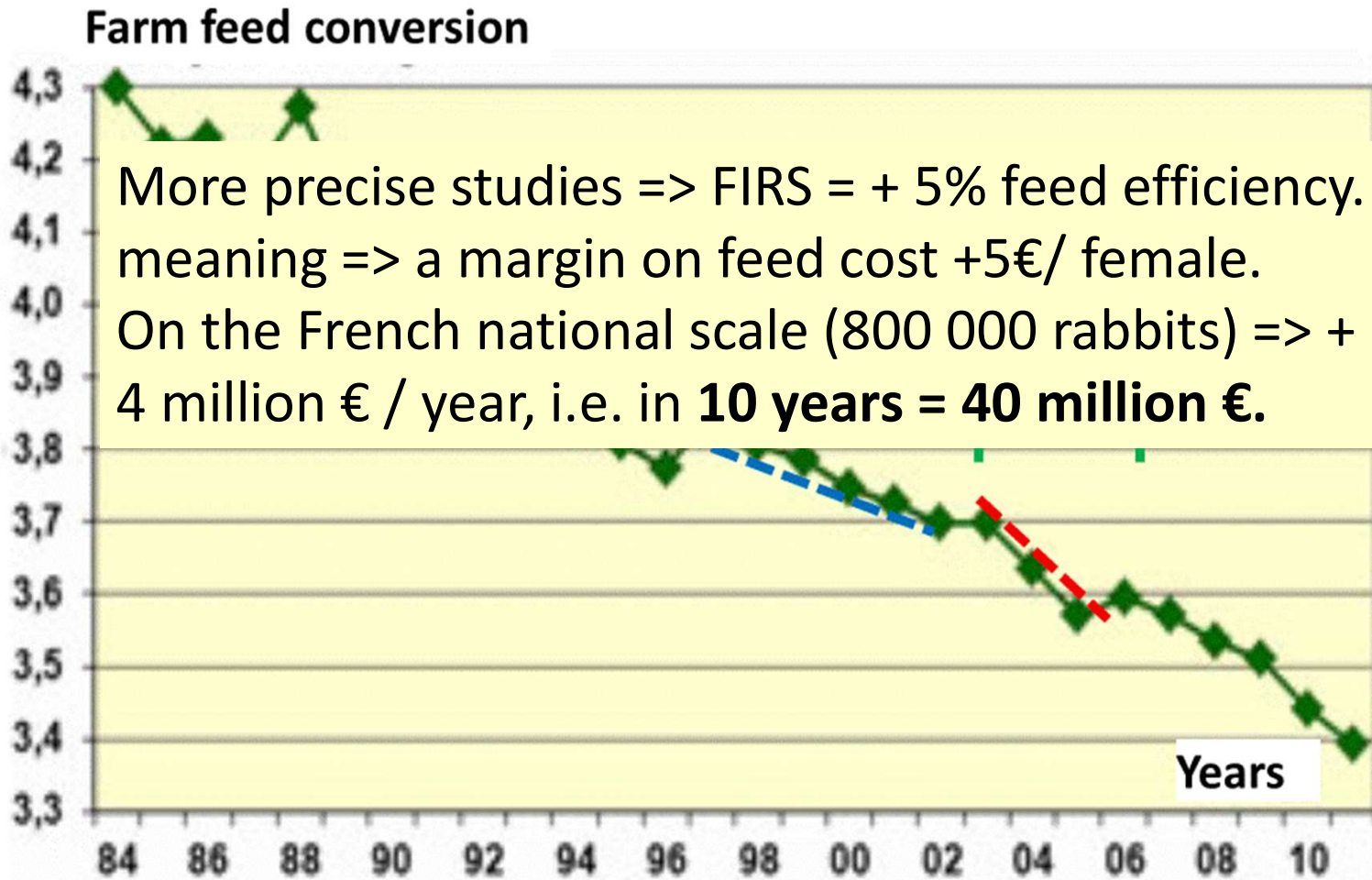


FIRS: start of expansion

Impact on feed efficiency



Impact on feed efficiency





Globally over the 3 impact classes , the **economic surplus of FIRS** over 10 years (2005-2015) in France = nearly **75 million euros**, for "conventional" rabbit farming.
In "independent" rabbit farming (1/4 nat. prod.) => similar impact....

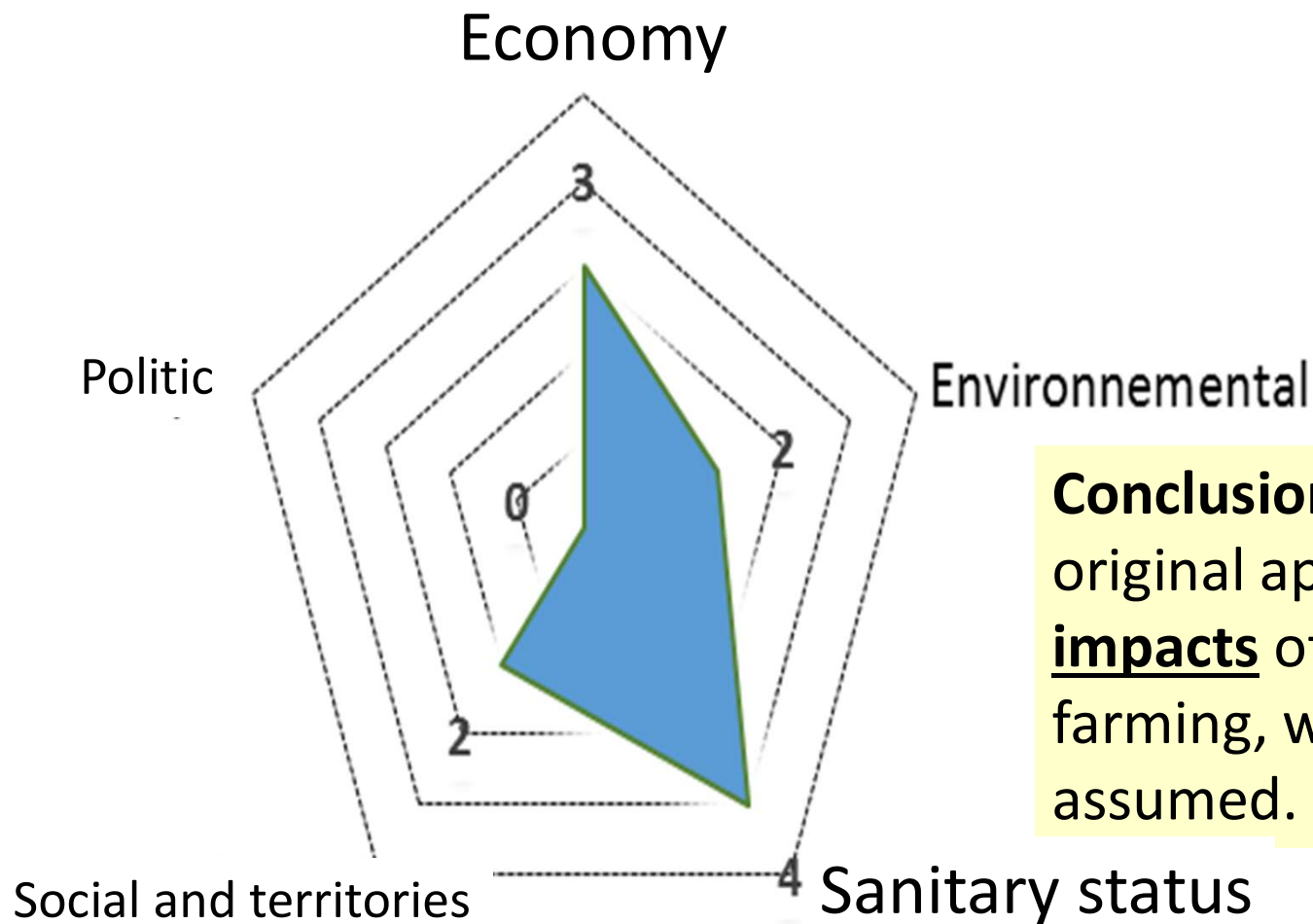
Global impact for the French rabbit farming \approx **100 M€** (over 10 years)

Environnemental impact



Production of 1 T of rabbit carcass	Ad libitum	FIRS
Climatic change (kg CO2-eq)	4010	-9% 3666
Eutrophisation (kg PO4-eq)	30,0	-11% 26,7
Water use (m3)	91,2	-7% 84,4
Use of lands for agriculture (m2/an)	3954	-10% 3541

FIRS => high économique impact \approx 10 millions € / an
from better health and feed efficiency



Conclusions:

original approach to **quantify the impacts** of an innovation in rabbit farming, which were previously only assumed.

THANKS for YOUR ATTENTION

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