ROADMAP project

Rethinking of Antimicrobial Decision-systems in the Management of Animal Production

www.ROADMAP-h2020.eu/

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Dear reader,

It is with great pleasure, and a little pride, that I write these few words. It has already been four years since the ROADMAP team was established, at the crossroads of a dozen countries and almost as many scientific approaches, disciplinary cultures and toolboxes for research and innovation. We had this crazy idea of studying the problem of antibiotic resistance in an original and stimulating way, by varying the contexts and scales of analysis, by combining different forms of knowledge (those of researchers and those of stakeholders), in order to identify the best ways of promoting the prudent use of antibiotics in livestock farming.

Of course, this has not always been a smooth process. We had to invent a lot of things, starting with getting to know each other and finding the right ways to work together. But I think it all came together eventually and the enthusiasm has been there ever since, as we moved forward with the project and adapted to each new step to figure out how to reach our objectives. Sometimes I feel that we are only at the beginning of a process, as the matter we are working on and with changes and renews itself through each new step of the project.

Yet, if you look closely, there is no doubt that we have already achieved a great deal, probably even more than we imagined at the beginning. This booklet is intended to give an overview of what we have built and accomplished: our methods, our approaches, our results and the various processes of change we have initiated, which I am convinced will continue beyond the project and inspire others.

This booklet presents the main outputs of ROADMAP, from our socio-economic analyses of the "antibiotic system" and the different dynamics at work to gradually move out of it, to our Living Labs and our impact assessments aiming to drive the changes necessary for transitions that should be both local and global, context-sensitive yet transposable and always improvable thanks to cross-learning. These outputs also exist in other formats, from scientific reports and publications, to podcasts and policy briefs, all of which being available on our website.

I would like to thank not only all the partners of the ROADMAP project, as well as its funders, but also all the stakeholders, policy-makers and animal health professionals who have trusted us and whom we have worked with. We dedicate this booklet first and foremost to them, as well as to all the social actors who are calling for more responsible animal farming, respectful of the health, environmental and ethical concerns that are raised nowadays.

Nicolás Fortané

Project Coordinator

Content

MULTI-ACTOR APPROACH

ROADMAP is a **multi-actor approach (MAA) research project**, which means that project partners must have complementary types of knowledge from research and practice. This booklet presents the protocol created to **form a stakeholder's community**, how they were engaged and what kind of stakeholder's knowledge was needed to reach the goals set, where and when those stakeholders were involved.

Methodology

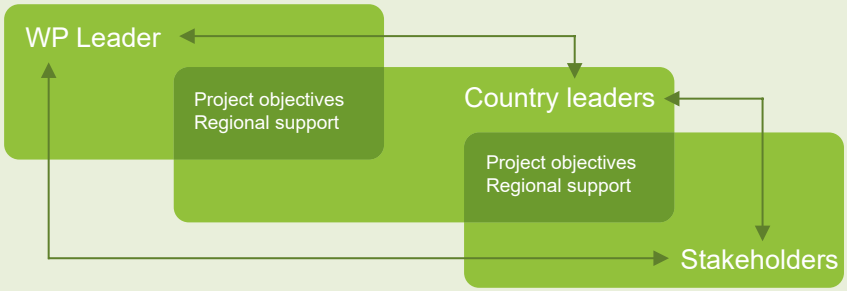
This methodology is conceived as a **matrix organizational structure** with two main dimensions:

Country leaders (CLs):

Identified and engaged with stakeholders with the support of WPs 1-6 leaders. They organized different workshops/roundtables (additional to those planned in WPs 1-6) with the intention of covering potential gaps (for instance in terms of stakeholders profiles not suffi-ciently covered, knowledge gaps, and mainly regions not covered). These activities included in WP7 and led by country leaders complement to the work planned in WPs 1-6, in which the tasks must be integrated. They provide the geographical contribution to the project.

Work Package leaders (WPLs):

They provided the technical contribution to the project, and participate in the events of their regions, helping Country leaders to select and supervise the activities carry out by Country Leaders.



→ MAA methodology work flow

" Stakeholder is any identifiable groups or individual who can affect or is affected by organisational performance in terms of its products, policies an work process"

↳ R. E. Freeman, 1984

↳ Involvement level

INFORM
One-way communication: project to stakeholder, there is no invitation to reply.

CONSULT
Two-way limited: project asks questions and stakeholders answers.

INVOLVE
Two-way or multiway engagement, learning on all sides, but acting independent way.

CO-CREATE
Two way joint learning, decision making and actions.

Activities

Different activities were created adressing stakeholders due to the different engagement levels needed on each work package.

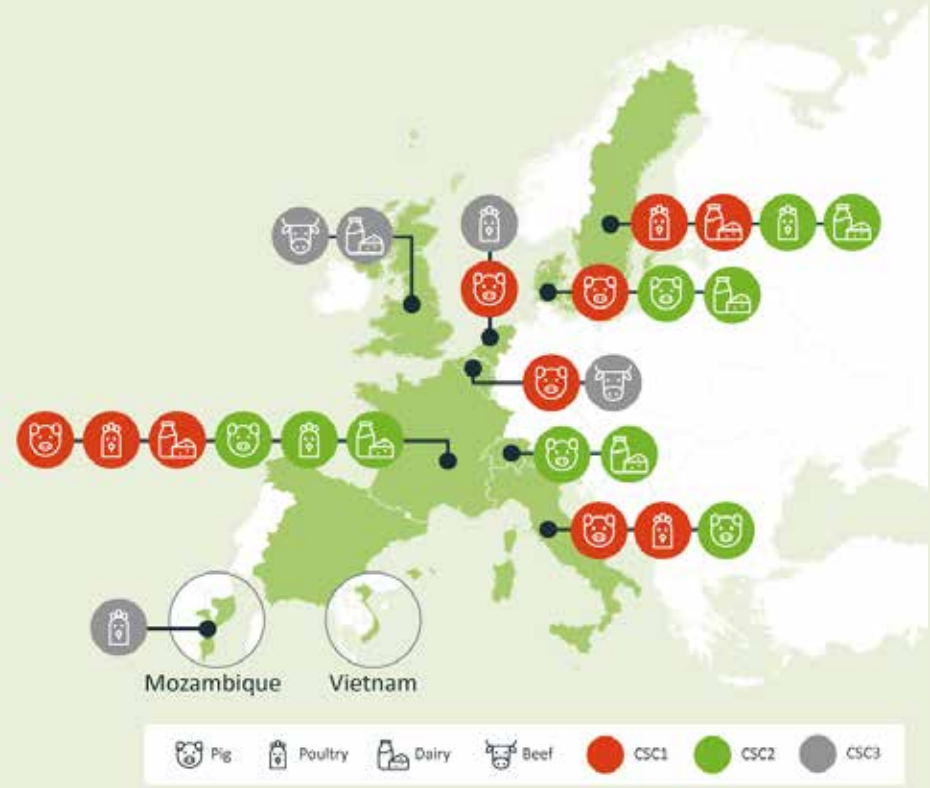
Here you can see a nice map where all activities at the different engagement levels were developed. Later on we will see regional impact of this activities.

INFORM	COMMUNICATION & DISSEMINATION	All stakeholders
CONSULT	SURVEYS	Local farmers (poultry, pigs, dairy) and vets
INVOLVE	WEBINARS	Researchers, advisors and policy makers
	INTERVIEWS	Local farmers and vets
	CO-LEARNING EXCHANGES	Partners from the Living labs
	TRAININGS	All stakeholders
	CASE STUDIES	Local farmers and vets
CO-CREATE	JOINT SESSION	Researchers and AMU experts
	12 LIVING LABS	Key actors: farmers (poultry, pig, dairy), vets, industry, distribution, researchers)

CASE STUDIES

ROADMAP is organized in case studies (CS) that are taking place in **10 different countries** (**Sweden, Denmark, Netherlands, Belgium, UK, France, Switzerland, Italy, Vietnam, Mozambique**) and **4 production sectors** **(pig, poultry, dairy and beef)**. The objective is to study a variety of contexts and production systems as we strongly believe that there is no "one-size-fits-all" solution or "one-way" transition to foster prudent AMU. On the contrary, we want to develop **tailored strategies** that are efficient and acceptable in given situations, and we want to learn and draw inspiration from each experience to encourage global change that is pushing everyone towards the same direction, i.e. better agriculture and food systems for a better planet! Our case studies are categorized in three clusters (CSC) that help us to develop critical reflections on the current strategies aimed at reducing AMU.

We want to promote global change that pushes everyone in the same direction, i.e. better agriculture and food systems for a better planet!



CASE STUDIES CLUSTER 1

Intensive livestock production systems

This first CSC aims at studying strategies to reduce AMU developed in intensive and conventional livestock production systems. It is hypothesised that in such systems AMU drivers and levers for change are quite specific, due to particular animal health management practices, contractual arrangements with downstream and upstream industries, and professional relationships with veterinary and technical advisors.

CASE STUDIES CLUSTER 2

Organic or label production systems

This second CSC aims at studying strategies to reduce AMU developed in alternative livestock production systems, either they are part of sustainable standards such as organic labels or still rely on intensive farming but that takes part and develops AM-free standards. Comparing fieldworks from CSC1 and CSC2 will help to better understand systems' differences and similarities, and how farmers and stakeholders deal with the coexistence of several systems and their respective opportunities (for example, when farmers distribute their production between different type of standards).

CASE STUDIES CLUSTER 3

Marginal Care

To reduce AMU developed in marginal livestock production systems. By marginal we mean several things. First, it could be farms in marginalized rural areas that don't have easy access to veterinary or technical advisory services. Second, could be marginalized animals (young animals, secondary production…) and workers (migrants, women…) which are not considered a priority in the farm management. Third, it could be countries where the AM regulatory framework is very peculiar and hardly enforced. It is hypothesised that features of marginal systems create unique AMU drivers and levers for change. It is important to recognize sociotechnical and socioeconomic specificities of such farming systems to be able to find strategies to reduce AMU in every kind of context.

LIVING LABS

A Living Lab (LL) is usually described as a **user-centered, open-innovation research approach, development tool.** LLs are responsive to their specific territorial context (e.g. city, country, region, or sector). They often involve a private-public partnership in order to integrate research and innovation processes in a systematic co-creative environment.

A LL is a 'lab' because it combines and integrates processes of co-creation, exploration, experimentation and evaluation of ideas, scenarios, concepts and technologies. It takes place in 'real life cases' or 'real life environments,' involving user communities as a source of creation of something which is useful for them in their context. This approach allows all involved stakeholders to consider both the global performance or usefulness of a product, service or strategy, and its potential adoption by a wider range of end-users. This can lead to considerations which may form the earlier stage of research and development.

In ROADMAP, twelve livings labs around seven countries worked on AMU issues focusing **on various species** (dairy cattle and calves, pig, poultry, turkey) and **levels** (1) farm and local actors, (2) sector and industry (agriculture or food chain), (3) governance and regulation and (4) societal level. The LL worked differently, determined by the specific context and aims but all with involving different stakeholders.

A Living Lab is a user-centered, open-innovation research approach, development tool or ecology of practices.

Main learnings achieved in ROADMAP living labs

The invited participants were identified thanks to a stakeholders' mapping within the different country livestock sectors. **Diversity of stakeholders, representativeness, willingness to participate and open mindedness** were part of the criteria. The very open LL frame contributed to gather people from different organizations, some of them had never had the opportunity to debate about the sectors' issues and reflect about actions together. **Wise and sound facilitation of the meetings** was a key point in the adherence of stakeholders.

Common vision & diagnosis: ROADMAP living labs used participative approaches to build a diagnosis, either online or in physical meetings. A small part of LLs adopted a very structured methodology, either generated by the FAO or research institutes. Whatever the used methodology, the LLs needed **time to build a common vision**. Negotiation on wording proved to be of paramount importance in the process.

Innovation and testing: The twelve LLs tested and implemented actions tailored to the context and participants. They dealt with (1) **technical innovation** (ear tags, monitoring of AMU and practices), (2) **social innovation** (empowerment of farmers, coaching processes in advice, education for vets, sectors' incentives or labelling), (3) **institutional and structural levels** (monitoring indicators' set, new R&D consortia, recommendations for policy makers). In some cases, small working groups - so called action labs - were developed to test the innovations.

"Bringing it further" - common learning: ROADMAP living lab facilitators and participants had the opportunity to reflect about the LL approach and their individual innovations through regular meetings and co-learning events. It contributed to common learning about the strengths and limitations of participatory and multi-stakeholders' approaches but also on **awareness of different perspectives** and modes of action.

Conclusions

ROADMAP Living Labs brought stakeholders together, to analyse, negotiate and find, test, evaluate and implement new social (primarily) and technical solutions to AMU. Living labs do produce innovation, part of them unexpected at the beginning. **Negotiation is paramount – far beyond 'innovation'.**

Living labs are **shaped by different contexts** and stakeholders involved. Underlying conflicts, competitions and dependencies among supply chains have to be considered while inviting stakeholders and managing the living lab. Hence establishing living labs in itself seems to have an impact, addressing and articulating the issues.

Scientists involved in living labs as facilitators acquired new skills in stakeholders' perspectives and multidisciplinary participative approaches. Most of them found it **highly relevant to solve complex issues**, although very time consuming.

ROADMAP living labs contributed to highlight paramount importance of **sector lock-ins to prudent AMU** within the value chain (impact of integrated sector, of value chain incentives, of subsidies, especially of animal mixing and transportation).

KEY RESULTS

This section presents the main results of our 6 research and innovation WPs. ROADMAP is an interdisciplinary and multi-actor project, guided by a vision of social sciences and economics. It is therefore definitely original and innovative, as such approaches have not been used before to study the problem of antibiotic use in livestock on such a large scale.

- **Work packages 1 and 2** identified the multiple economic and social factors that determine the "antibiotic system" in different contexts, as well as the levers that can be used to change it.
- **Work packages 3 and 4** were able to build on this body of knowledge, and to link it to the expertise of field actors through the iterative cross-learnings that our Living Labs have implemented.
- **Work packages 5 and 6** have then evaluated these dynamics and imagined the impact and transition pathways that could help transpose and generalise them to new contexts.

ROADMAP is an interdisciplinary and multi-actor project, guided by a vision of social sciences and economics.

The following pages highlight some of our key and cross-cutting results, while the next section presents local initiatives in each partner country.

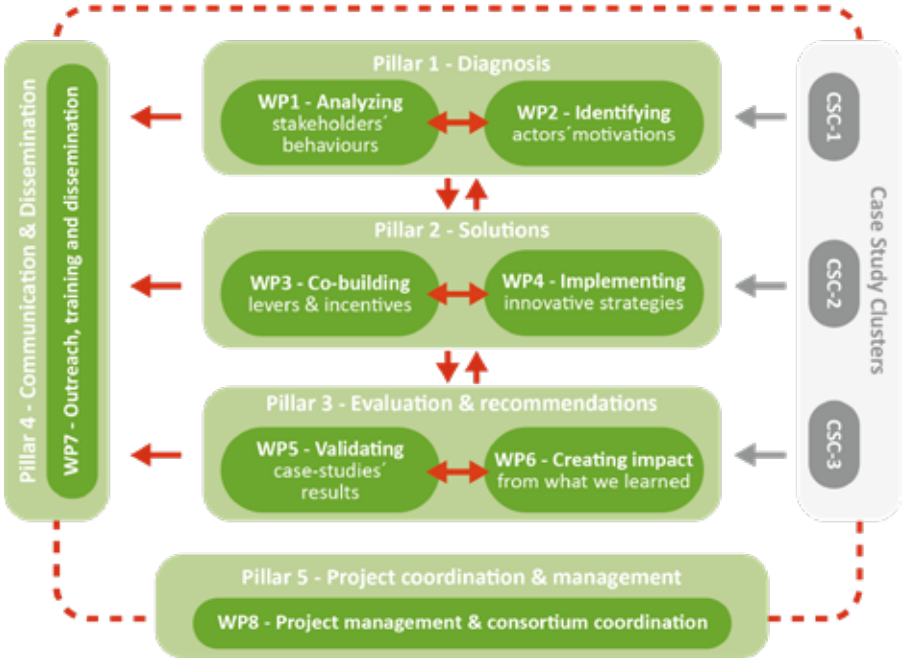
ROADMAP's two main innovative principles are as follows:

- **First**, a process of change is never driven at an individual or behavioural level, it is always structural dynamics that favour, or not, the evolution of practices;
- **Second**, a transition process is never purely technical, it is also the social, economic, ethical and even political dimensions of a farming system or a value chain that must be transformed for a real transition to take place.

PILLARS

ROADMAP is conceived as five interconnected pillars, which make possible the implementation of cutting edge research and methods, in a interdisciplinary and multi-actor perspective. Case-studies were developed alongside the work packages.

- The first pillar develops a global socio-economic analysis of the AMs decision-systems in different livestock production systems to identify the main AMU drivers and the technical, social, economic, and institutional lock-ins to be tackled in the transition towards prudent AMU.
- The second pillar develops integrative strategies to reduce AMU through improved health management, by relying on Pillar 1 results and on action-research programs developed in “Living Labs”.
- The third pillar validates and synthesizes the different strategies which have been studied or implemented to foster prudent AMU.
- The fourth pillar ensures effective outreach of the project towards a large community of stakeholders and end-users, and facilitates the exchange of information and knowledge.
- The fifth pillar ensures the scientific coordination of the project and maximizes interactions between partners and disciplines.



Evaluation of the National Action Plans in D1.3

Our analysis on policies and strategies found that the European legislation mostly focused on limiting the veterinary use of critically important antibiotics (CIAs) to situations where they are the last resort. In some EU countries, certain CIAs (e.g., 3rd, 4th, and 5th generation cephalosporins, fluoroquinolones, macrolides, colistin) have been limited to culture-proven infections or have been subject to special taxation. The new EU Regulations on veterinary medicines entered into force in 2022. In particular, the Regulation (EU) 2019/6 sets measures on marketing, manufacturing, import, export, supply, distribution, pharmacovigilance, control, and use of veterinary antimicrobials. Therefore, many EU member states should improve their monitoring capacity and, besides antibiotics, start to also check the farm use of antifungals, antiprotozoals, antivirals, and topical antimicrobials. Furthermore, in few years, AMU shall be monitored also for non-farmed animals (e.g., for companion animals).

Our qualitative comparison of the level of implementation of the National Action Plans (NAPs) of the EU member states based on the periodic Country Self- Assessment Survey of the Global Database for Tracking AMR (TrACSS 2020-2021) led to distinguish four groups of countries: the most advanced group was formed by Austria, Belgium, Denmark, Finland, France, the Netherland, Spain, and Sweden; the second group included the Czech Republic, Estonia, Germany, Greece, Hungary, Ireland, Lithuania, Malta, and Portugal; the third group Italy, Latvia, Luxemburg, Slovakia, and Slovenia; the last group Cyprus, Croatia, Romania, Bulgaria, Poland. According to the TrACSS self-assessment, the best performing countries of our evaluation identify the weak points of their NAPs implementation in the actions addressed to improve public and stakeholders' awareness (in particular, training and education on AMR for farmers and supply chain operators) and in the actions for governance to fully involve in the NAP implementation all the relevant sectors with defined monitoring and evaluation processes in place. Most of the countries declared that they do not use the data from AMU and AMR monitoring to amend the national strategy and inform decision makers. The countries that are not included in the first group suffer the weakness of measures related to public awareness, improvement of best practices for prudent AMU and governance of the diversified actions. In general, the measures for AMU monitoring resulted the policy area where European countries evaluated to have the best performances with respect to the global standards jointly set by the Quadripartite organizations (i.e., the WHO, the FAO, the WOAH, and the UNEP) for the NAPs.

To test the efficacy of the NAPs measures, we also analyzed the correlation between significant structural and policy variables and the sales of veterinary antimicrobials in the EU member states. Among the investigated variables, the ones that resulted more correlated to higher levels of antimicrobials' consumption are, on the one hand, historical trends of high consumption that seem to cause lags in the effects of policy stimulations to decrease AMU and, and the other hand, a high proportion of pigs in the total livestock production. On the contrary, the implementation of multisectoral One Health strategies, accurate information and AMU monitoring, and professional training are correlated to decreasing antimicrobial sales.

Such results suggest that there is no "one-size-fits-all" solution to improve AMU and strategies must be contextually developed. Successful solutions must be combined and tailored to the production systems and the social and economic context in which they operate. The relevant AMU decrease obtained by some

important livestock-producing countries indicate the possibility to overcome the trade-off between a reduced AMU and production performances. The achievements in reducing AMU are the outcomes of several main contributing factors: long experience of evidence-based guideline implementation, strong participatory local commitment, and integration between actions at local and national levels, in brief strengthened governance. Improved awareness and training for farmers, but especially for veterinarians, who are generally the principal advisors of farmers on these topics, can have rapid and highly positive impacts towards AMU reduction. Countries must also invest in increased knowledge, through their monitoring systems to identify the hotspots, sectors, farmers, and regions that should be prioritized for improving the cost-benefit ration of applied measures.

	ROADMAP Countries	Denmark	Netherlands	Sweden	Belgium	France	Switzerland	Italy	UK	Vietnam	Mozambique	ROADMAP	Japan	Germany	Spain	USA	Australia	Argentina	Brazil	India
	Total Score TrACSS	58	55	53	52	51	50	47	45	33	N.A	84%	54	52	51	50	41	33	32	32
	% of Max score	98%	93%	90%	88%	86%	85%	80%	76%	56%			92%	88%	86%	85%	69%	56%	54%	54%
Awareness	1) Progress on actions for raising awareness and understanding of AMR risks and response	5	5	5	4	5	4	4	4	3			5	4	5	4	4	3	3	3
Awareness	2) Training and professional education on AMR in the veterinary sector	5	5	4	4	5	4	4	4	2		75%	4	5	5	5	4	2	3	3
Awareness	3) Training and professional education on AMR in farming sector (animal and plant), food production, food safety and the environment	5	3	3	3	2	3	3	2	1			2	3	2	3	2	3	2	1
Evidence	4) National monitoring system for antimicrobials intended to be used (AMU) in animals (terrestrial and aquatic) (sales/use)	5	5	4	5	4	5	4	4	2			4	4	3	3	3	4	3	1
Evidence	5) National surveillance system for antimicrobial resistance (AMR) in animals (terrestrial and aquatic),	5	5	5	5	5	5	5	5	4		87%	5	5	5	5	4	4	2	4
Evidence	6) Level of the standardization and harmonization of procedures among laboratories included in the AMR surveillance system	5	5	5	5	5	3	5	2	1			5	5	2	4	2	2	1	2
Practices	7) Country has laws or regulations on prescription and sale of antimicrobials for animal use	3	3	3	3	3	3	3	3	3			3	3	3	3	3	3	3	3
Practices	8) Country has laws or regulations that prohibits the use of antimicrobials for growth promotion in the absence of risk analysis	3	3	3	3	3	3	3	3	3			3	3	3	3	3	0	3	3
Practices	9) Good health, management and hygiene practices to reduce the use of antimicrobials and minimize development and transmission of AMR in animal production (terrestrial and aquatic)	5	5	5	5	5	2	4	3	4		93%	5	3	5	4	3	3	3	2
Practices	10) Optimizing antimicrobial use in animal health (terrestrial and aquatic)	5	5	5	5	5	5	4	5	3			5	5	5	3	3	3	3	3
Governance	11) Progress stage of the Multi-sector and One Health collaboration/coordination	5	5	5	4	5	5	3	5	2			5	5	5	5	5	2	2	3
Governance	12) Progress with the development of a NAP on AMR	4	5	5	3	4	5	4	4	4			5	4	5	5	4	3	4	4
Governance	13) Is the country using relevant antimicrobial consumption/use and/or antimicrobial resistance data to amend national strategy and/or inform decision making, atleast annually [Animal heath (terrestrial and aquatic=1; food production=1 and food safety=1)]	3	1	1	3	0	3	1	1	1		78%	3	3	3	3	1	1	0	0
	ESVAC (sales in mg/PCU) 2018	38,2	57,5	12,5	113,1	64,2	40,2	244,0	29,5					88,4	219,2					
	TrACSS weighted by ESVAC (sales in mg/PCU) 2018	1,52	0,96	4,24	0,46	0,79	1,24	0,19	1,53					0,59	0,23					

↳ Description of system functions for MIS analysis, adapted from Wesseling and Meijerhof (2021)

Case-study specific systemic lock-ins

73 systemic lock-ins were identified across the different case studies. These lock-ins were related to different systems function, being (1) entrepreneurial activities; (2) knowledge development; (3) knowledge diffusion; (4) providing directionality; (5) market formation and destabilisation; (6) resources (re)allocation and; (7) legitimacy.

A systemic analysis was conducted using an **heuristic method based on the mission-oriented innovations systems approach presented by Wesseling and Meijerhof (2021).** This approach made it possible to analyse to what extent the actors of the different case studies were able to carry out important innovation activities (defined as system functions) given the current state of the case/system, which was also described by analysing infrastructures (financial, structural and knowledge), institutions (rules and norms), market structures, networks and the capacities of the identified actors of the different case studies.

Recommendations

Whereas specific recommendations held for all case studies cannot be drawn, because of the very different characteristics of all case studies, there are a number of more general recommendations for unlocking antimicrobial decision systems towards more prudent AMU. These are:

1. Strengtening existing collaborative approaches by increasing the participation of all case studies
2. More consideration of the need for radical changes to the system to overcome the limits of incremental changes to the system
3. More consideration of the potential of economic incentives that address the economic decision logic of actors.
4. Better implementation of smart combinations of voluntary and mandatory measures.
5. Strengthening the veterinary public health sector, including an effective monitoring and registration system.

System function	MIS interpretation
SF1: Entrepreneurial activities	Experiments with (clusters of) solutions to enable learning; entering markets for new solutions; engaging in business model innovations to the diffusion of solutions.
SF2: Knowledge development	Learning by searching and by 'doing', resulting in development and better understanding of new technical and social knowledge on problems and solutions, through R&D, social and behavioural science research.
SF3: Knowledge diffusion	Stakeholder meetings, conferences, governance structures, public consultations, mission progress reports and other forms of disseminating technical and social knowledge for the mission's solutions and societal problems.
SF4: Providing directionality **A: Problem directionality**	The direction provided to stakeholders' societal problem conceptions and the level of priority they give it.
B: Solution directionality	The direction provided, both by existing system structures and the mission arena, to the search for new and further development of existing technological and social solutions, as well as the coordination efforts needed to identify, select and exploit synergetic sets of solutions to the mission.
C: Reflexive governance	Reflexive deliberation, monitoring, anticipation, evaluation and impact assessment procedures, which provides the analytical and forward-looking basis for redirecting the system's problem framing and search for solutions based on lessons learned and changing context. It can be seen as second order directionality. Reflexive governance can be initiated by the mission arena or by critical outsiders.
SF5: Market formation and destabili-zation	Creating niche market and upscaling support for technical and social solutions; phasing out or destabilizing markets for practices and technologies harmful to the mission.
SF6: Resources (re) allocation	Mobilization of human, financial and material resources to enable all other system functions.
SF7: Creation and withdrawal of legit-imacy	Creating legitimacy for prioritizing a) the problem and b) the development and diffusion of its solutions, at the cost of harmful practices and technologies.

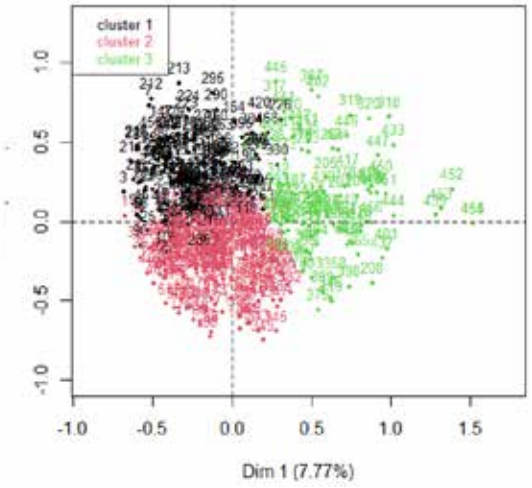
↳ Description of system functions for MIS analysis, adapted from Wesseling and Meijerhof (2021)

How to promote preventive approaches in veterinary medicine?

Encouraging the structural trends that are supporting the development of preventive approaches:

- Diversification of veterinary knowledge and services.
- Renewal of the working relationships with other livestock professionals.
- Protocolisation of animal health management.
- Emergence of new business models for veterinary practices.

Vets have different ways of caring for animals: considering the heterogeneity of the veterinary profession is essential to adapt tools and communication to the various practitioners' profiles.



↳ Factor map

Cluster 1: business-oriented vets, timidly supporting AMU reduction (young, UK & Italy, beef and sheep industry, corporate groups)

Cluster 2: public-health oriented vets, convinced by AMU reduction (women, Sweden, Italy & Denmark, dairy sector, salaried vets)

Cluster 3: disillusioned vets, considering most is done already (mid-career, Denmark, France & Spain, pig & poultry, large private practices)

Triggers of change

How major change to antimicrobial use occurs

- **Directly** – in response to state or supplier demands e.g. new regulations, company standards, veterinary restrictions, or antimicrobial free labelling.
- **Indirectly** – as a result of other on-farm changes (e.g. succession and staff changes, new barns or infrastructure).
- By someone other than the 'primary farmer'.
  - » Vulnerable young animals are often seen as most in need of antimicrobials; they may be cared for by women.
- Therefore, antimicrobial use can be reduced by:
  - » Providing grants to improve facilities.
  - » Working with the supply chain.
  - » Bundling anti-microbial use messaging within broader education around hygiene and disease prevention.
  - » Targeting training to the farm staff who administer antimicrobials, rather than the 'primary farmer'.

The influence of 'peer pressure'

'Good farmers' want to take good care of their livestock:

- » treating them when they are sick.
- » maintaining healthy living conditions in which to thrive.

Perception of what other farmers do can influence anti-microbial use:

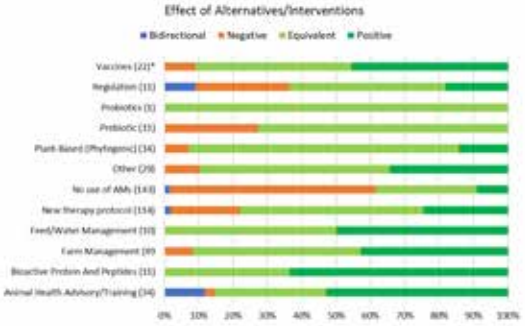
- » in some countries (e.g. Sweden) there is a social cost to using antimicrobials i.e. farmers see antimicrobial use as 'failure'.
- » in some countries there is a social cost to NOT using antimicrobials (e.g. France) i.e. farmers see antimicrobial use as necessary.
- » bench-marking and participatory initiatives can help farmers see how they compare to other farmers, and motivate change.

Fostering the reduction of AMU in animal production by informing cost-effective alternatives

How will a change in farming practices affect animal health and business performance?

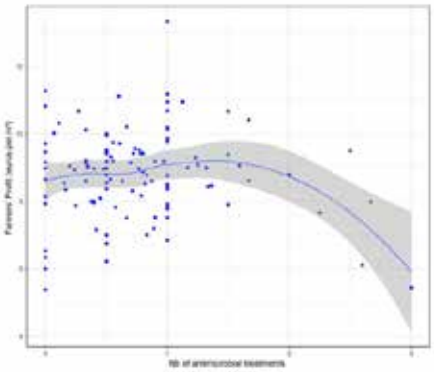
What will the change mean in monetary terms?

Information the cost-effectiveness of alternatives to AMs are scarce, which hampers the willingness/ability of farmers in changing their production practices. Bridging that knowledge gaps empowers farmers to take action.

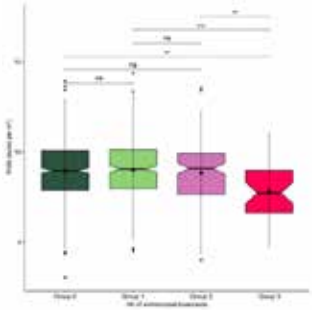


Relative distribution of the reported direction of effect in indicators across the different alternatives/intervention categories (*number of assessments within parenthesis)

Economic evaluation of antimicrobial use practices in animal agriculture: a case of poultry farming

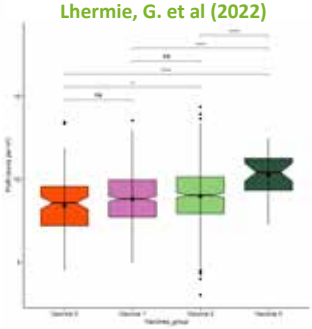


Generally, regardless of the indicator and the level of analysis (flock or farm), the profit first increases with AMU, before reaching a maximum where profit decreases with increased AMU.



Clear difference in profit between farmers using zero treatment per flock and those using three or more, the latter having a drop in profit of 12.6%

Lhermie, G. et al (2022)



Significant increase in profit, by 7.03% and 22.41%, when farmers vaccinate against two and three diseases, respectively

How to use ex-ante impact assessment to design interventions to improve antimicrobial use?

Build the narrative of your intervention

- Diagnose the initial situation.
- Define your **vision of the future** and **desirable impacts**.
- Build a **problem tree** listing all problems preventing this desirable future from happening.
- Choose the problem you intend to address and identify all it s related stakeholders.

Map the outcomes

- Identify the **outcomes** (changes that specific stakeholders need to implement in order to overcome this problem).
- Identify **obstacles** to these changes.
- Build **strategies** and activities to overcome these obstacles.
- Identify **outputs** needed for these strategies and activities.

Finalize the impact pathway & imagine alternative pathways

- Draw your **impact pathway**.
- Specify the assumptions and mechanisms that underlie the causal relationship between **inputs**, outputs, outcomes and impacts.
- Think of alternative pathways if your assumptions are not met.

Participatory monitoring, evaluation and learning

- Build **indicators** for outcomes and impact measurement.
- Finalize the narrative of your intervention.

Example of problem tree

Example of outcome map

Example of impact pathway

LOCAL VISION

Another important principle of ROADMAP is that there is no "one size fits all" solution. Since contexts matter, since structural and organisational dimensions (i.e. economic, social, political factors, etc.) are absolutely central to explaining what people do and think, it becomes quite clear that we need to work from local and concrete situations to understand how practices can evolve. This is why ROADMAP works from case studies and Living Labs, attentive to the specific parameters of certain countries, sectors, value chains or production modes.

The following pages present the different contexts from and with which we have worked. There are obviously a number of generic activities that were implemented in each country, such as the surveys and interviews of livestock farmers and veterinarians, and the methodologies used were of course framed at the project level. But the processes of change, and the reflections carried out directly in collaboration with the actors in the field, were necessarily context-sensitive. This is why the initiatives that were developed were specific to each situation, depending on the issues, concerns and expectations expressed by the local stakeholders and professionals. Our key results, presented previously, are therefore derived from the variety of these experiences and the cross-learnings that we have drawn from them.

SWEDEN

Overview

The Swedish ROADMAP work has been focused on dairy cattle and poultry. The use of antibiotics is very low in both these sectors. The main treatments in dairy production are for mastitis, where narrow-spectrum penicillin is the most commonly used substance. In poultry, antibiotics are rarely used, but a few outbreaks of necrotic enteritis have warranted treatments with penicillin and some cases of colibacillosis have prompted treatment with trimethoprim-sulphonamides. There is a high awareness among veterinarians and farmers of existing regulations and guidelines governing a restrictive use of antibiotics in animals, but we wanted to find out how the restrictive policy was perceived by these stakeholders.

We have interviewed veterinarians and farmers, and also discussed with policymakers and industry representatives in regular national meetings that were already in place.

The restrictive policy on antibiotic use does not seem to be an issue with most stakeholders, they feel that they understand the reason for it and that if the animals really need treatments, they will get it. Public health was perceived by the stakeholders as the main justification for the restrictive policy, very few mentioned the risk of antibiotic resistance causing non-treatable infections in animals.

The ROADMAP project is one of many projects related to antibiotic resistance in our university, and it has been brought up in various meetings where our research has been presented. It has also been mentioned in national discussions about the Swedish One Health Action Plan against AMR and in relation to input to international policies.

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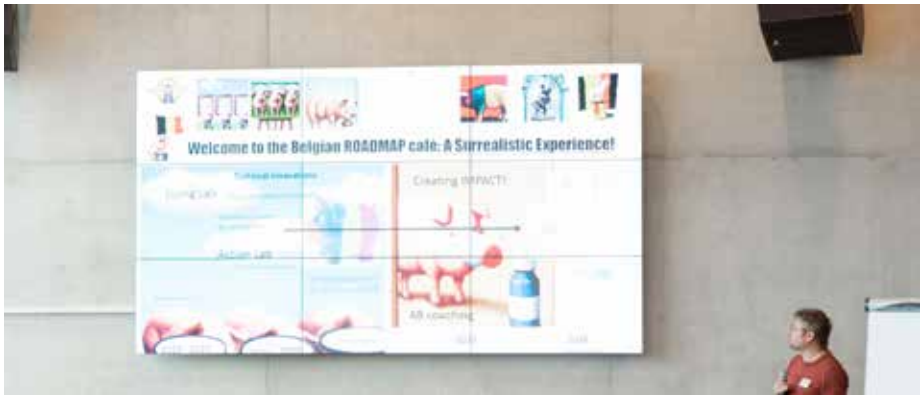
Overview

In ROADMAP, the Belgian team (ILVO and DGZ) worked on the pig and veal calf sectors, which are mainly located in the north of the country (Flanders). These sectors were chosen because of their contribution to Belgian consumption of veterinary drugs in animal production, which has decreased by 46% since 2011, but remains above the EU median as well as that of neighboring countries with similar production systems. More specifically, the pig sector is, due to its size, responsible for a large share of antimicrobial consumption in Belgian animal production. Conversely, the veal calf sector is quite small, but has a high AMU per animal. It is thus of interest that these sectors further reduce their AMU. To do so, the Belgian Knowledge centre on antibiotic use and resistance in animals (AMCRA) is coordinating efforts by publishing action plans with clear objectives, defined with representatives of key stakeholders from the different livestock sectors. The current main objective is to achieve a 65% reduction in AMU between 2011 and 2024.

To help achieve this objectives, we organized Living Labs for each sector in order to better understand why antimicrobials are used. Concretely, representatives of key stakeholders built a problem tree for each sector. In addition to this, we performed a systemic analysis in order to better understand the identified causes for AMU, as well as how to address these. This analysis was based on interviews with representatives of key stakeholders, veterinarians, farmers, the results of the living labs, and literature. Finally, we also organized an action lab for the pig sector, where participants co-developed a coaching project that is currently being implemented in ca. 20 Flemish pig farms.

The highlight of the project is a comprehensive view of the causes of AMU in the Flemish pig and veal calf sectors, providing leverage points to further reduce AMU. In addition, implementing on-farm coaching can help demonstrate its effectiveness to other farmers and help veterinarians better establish themselves as consultants.



Events

- Stakeholder introduction meeting in Oct. 2020 – presentation of project & Living Labs (56 participants).
- One year ROADMAP meeting (June 2021) – presentation of the results of the Living Labs & introducing the Action Lab.
- ISESSAH conference 2021 - Online presentation of systemic analysis.
- VEE studiedag (Nov. 2021) – Presentation of systemic analysis.
- 13th European Symposium of Porcine Health Management in Budapest (May 2022): poster with problem tree of the Flemish pig sector.

The Belgium Veal Calves Living Lab

The Belgian Veal Calves Living Lab (LL) consisted of approximately 20 stakeholders coming from industry, government, NPO's and farmer & veterinary organizations which online joined during 4 sessions to develop a problem tree 'why AMU'.

From the beginning of the LL it was decided the case study would not include testing innovations at the farm level. A project proposal was written to address the issues that were encountered during the living labs.

Coordinators	Evelyne van de Wouwer & Stefaan Ribbens
Sector	Marginal Care
Animal	Cattle

The strategy tested in the Living Lab

For the Belgian veal calf industry, the following main causes for antibiotic use were identified ('the problem tree of 'why AMU'): a high cross contamination rate and a hampered immunity status of veal calves originating >100 of different supplier herds within each round, infrastructural problems (biosecurity, ventilation, compartmentalization), business blindness (focussing on animals instead of the environment), lack of preventive management (time, sensor data, costs of vaccines) and lack of incentives (no prospects on long term results, conflicting advice), animal welfare), financial risks taken by vet and integrator).

The road to implementation

The main issue in the case study appeared to be the quality of the veal calves. Implementing solutions would require drastic changes, difficult to perform within the ROADMAP framework (within Belgium, it was decided to prioritise the pig living labs because of lack of resources). Participants were presented to write a common project proposal, initiated by the primary actors (veterinarians of veal calf integrators). Potential outcomes could be financial resources for follow-up and a strengthened common vision between research institutes, governmental institutes and the actor from the veal calf sector.

"A common understanding and motivating the entire (dairy) cattle chain"

The impact created by the Living Lab

A common project proposal was written and a small group of participants discussed intensively content and layout of the proposal. Ultimately, several stakeholders decided not to submit the project because a more international approach was more desirable than a local one. This showcases that more investment by primary producers is challenging within an international market with few opportunities to sell at a higher price.

CHALLENGES

- Solutions require efforts from the entire sector, including calf breeders.
- a common viewpoint between breeding farms and calf rearers, finding the right incentives.
- International markets within the veal calf industry.

SUCCESSES

- High level of understanding and agreement between different stakeholders.
- Motivating people.
- Open discussions, common understanding of barriers.
- Involvement of new stakeholders.

The Belgium Pig Living & Action Lab

The Belgian pig Living Lab (LL) consisted of approximately 20-25 stakeholders coming from Industry, Government, NGO's and farmer & veterinary organizations which online joined during 4 sessions to develop a problem tree 'why AMU'. Based on these discussions, strategies to be tested in "action labs" were chosen. 5 sessions with 8 vets and 6 farmers resulted in the recruitment of 22 pig farms that are currently in the process of implementing strategies with regular follow-up visits (Jan 2023).

Coordinators	Caroline Bonckaert & Stefaan Ribbens
Sector	Intensive pig production
Animal	Pigs

The strategy tested in the Living Lab

For the Belgian pig sector, the following main causes for antibiotic use were identified ('the problem tree of 'why AMU'): a poor animal gut health, a poor farm management, economic reasons and societal pressure. Following the identification of problems, several potential solutions or actions were identified: tailored advice, "measuring is knowing", decision tree AMU, consumers awareness, raising awareness concerning euthanasia, … Within the ROADMAP Project, it was decided to merge some of the solutions and to establish two action labs (advice + decision tree & Measuring is knowing + awareness regarding euthanasia).

The road to implementation

For each option, an initial action lab was held in May 2020 to discuss the purpose. After this, it was decided to stop the action lab on the demonstration of the advantages of preventive and alternative methods over the long run as farmers did not want to participate anymore due to the bad economic situation of the pig sector. For the action on the establishment of the advisory role of vets, 3 additional action labs were organised before a concrete strategy was being implemented and tested on farms in April 2022. Farm visits are currently ongoing (Jan 2023). Interventions tested are: optimalisation of colostrum management, cleaning and disinfection and the advisory role of the vet.

"Changing habits and innovation in AMU comes with a cost"

The impact created by the Living Lab

Action labs are not yet finalized and ongoing in 2023. Preliminary impact of the Belgian pig LL are situated in:

- Animal Health: the members of the LL were clear that still a lot of progress can be made here to demonstrate business/ farm blindness. Implementing change in health takes a while so it remains difficult to measure improvement within the time period of the project
- Costs and savings: during the economic crises, it become obvious that responsible AMU comes with a cost (e.g. vaccines, hygiene, etc.), where consumers/retail is not ready to contribute to this cost.
- It is within the scope to monitor the AMU of the pig herds enrolled within ROADMAP.
- Feedback loops towards the entire pig community should encourage further initiatives.

CHALLENGES

- "It takes a village to raise a child" vs "it takes the entire stakeholder community to change habits on AMU and motivate them..."
- Limits in time period and "economic malaise" of the pig industry hampering change.
- The recurring sentiment that solutions exclusively have to come from farmers and vet.

SUCCESSES

- High level of understanding and agreement between different stakeholders.
- Motivating people in difficult time (prospective of the industry).
- Open discussions, common understanding of barriers.
- Involvement of new stakeholders.

DENMARK

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Overview

The Danish pig sector consist of close to a million sows and a production of 30million piglets per year, 98-99% of which are born and raised in conventional indoor systems. Farmers' use of antibiotics is permitted, given that they have a Veterinary Advisory Service Agreement (VASC) The VASC sets the framework for access to prescription medicine and the number of herd visits the farmer needs to have by his veterinarian. At advisory visits, veterinarians prescribe medicine for the coming 1-2 months based on their knowledge about the farm and clinical judgements during the visit. If batch medication is prescribed for diarrhoea or airway-related problems, at least once a year, diagnostic samples have to be taken for identification of pathogens. In addition to mandatory VASCs further important legislative measures for farmers in Denmark is the Vetstat database, which was established in in 2000. Vetstat provides close to real-time data on all sales of prescriptionmedicine for production animals, at both the farm and the species level. The pig industry has voluntarily banned on 3rd and 4th generation cephalosporin. Regarding current use of AMs, in 2021, 72.3tonnes of active compound of antibiotics were used for pigs in Denmark. On any given day, approximately 2% of sows and 9% of weaners were treated with antibiotics. Denmark is doing quite well in comparison to other countries with intensive pig production, and by many considered a frontrunner country in terms of prudent use of antibiotics for production animals. Our challenge in the Danish pig Living Lab was to work with participants who to a large extent already felt "home safe" in terms of prudent use of antibiotics and who furthermore very much doubted a significant link between usage of antibiotics in animals and occurrence of AMR in human cases of disease.

The Danish dairy cattle sector consist of conventional and organic farms, and more than 85% of the Danish milk production is produced on conventional farms. Female calves and heifers are often kept in the herds, or in a collaborating so-called 'heifer hotel' in different types of arrangements and agreements between farmers.Bull calves are sold to so-called 'slaughter calf herds' at an age of around 3 weeks. The average milk production for conventional cows is just above 10.000 kg milk/year. Organic herds needs to comply with additional rules regarding management, space requirements, feed (organic), and access to pasture. In conventional herds, farmers can have access to initiate and complete treatments on cows and young stock/calves on approximately same conditions as conventional pig herds. The Danish regulations on organic farming state that the veterinarians must perform or initiate all treatments ,and there is double withdrawal period for milk and meat after treatment with antibiotics. The main challenge in the Danish Cattle Living Lab was to address the link between dairy and calf herds as the situations of both calves and those caring for them is complex and under pressure. Therefore, the focus of the Danish cattle LL was on different levels: (1) farm and herd practices, (2) education, (3) legislation, (4) societal awareness.

Events

In the Danish case study, we interviewed in total 16 different stakeholders from the two sectors, to make stakeholder maps, and we interviewed 13 organic dairy farmers from one dairy company, to understand their aim and process of minimizing antibiotic use. Furthermore, we conducted register studies based on Vetstat data from different production systems (conventional, organic and free-range (only pigs)) in the period 2016-2020. The Danish pig-LL core consisted of a core group of 11 participants from private farms, vet companies, farm advisory companies, Seges, Danish Agriculture & Food Council, Danish Crown, a supermarket chain and Aarhus University. The Danish Dairy Cattle Living Lab consisted of a core group of participants from 8 types of organisations (Seges, Industry-owned Research and Development), universities (Copenhagen) and companies (Arla Foods, Himmerlandskød, Calvex, vet.practices) to come up with ways to reduce antimicrobial use.. Both core groups worked as initiators of wider meetings, which sometimes were combined and covered both sectors, involving wider stakeholder groups to explore and find solutions to issues related to AMU and AMR.

Some important events:

- Exchange between the cattle and pig Living Labs (October 2021) and invited stakeholder representatives regarding structures in the two sectors, and how to work towards prudent use of antimicrobials.
- Two joint conferences (one online in January 2021 and one live in October 2022) on AMR, first focused on AMR in animals and humans and how they were related, set up by the pig LL, and one focused on AMR in the environment, organized by both Living Labs.
- The Roundtable debate (April 2022) set up by the Danish pig LL, where many different stakeholders were represented to identify common grounds and areas of disagreements, to foster solutions towards more prudent AMU.
- A workshop (March 2022) about calves from Danish dairy farms, held between the Living Lab and the researcher who worked on cost effectiveness (WP5), to establish and conclude which initiatives would be most beneficial to stimulate change and minimizing AMU among calves in Denmark.
- Both Living Labs were present and had a stand at the **National Danish Cattle Conference** (May 2022), and the **National Danish Pig Conference** (October 2022), respectively, from where dialogues were stimulated in the wider stakeholder community.

" The project highlighted how different the Danish cattle and pig sectors operated and worked and we realized how sectors are very much influenced by pre-history and pre-knowledge. Welearned how important it is to work very context specific and be very sensitive to how the actors in the environment maneuver."

The Danish Dairy Cattle Living Lab

The Danish Dairy Cattle Living Lab consisted of a new group of participants from 8 types of organisations (SEGES, Vet. Society), universities (Copenhagen and Aarhus) and companies (Arla Foods, Himmerlandskød, Calvex, vet.practices) to come up with ways to reduce antimicrobial use (AMU). They worked as a core group, under which three thematic groups were formed. They carried through different 'actions', which involved a number of other stakeholders, and were called 'Action Labs'. The Living Lab was initiated in October 2020 and the process is still on-going. We have had seven core group meetings and a number of thematic group meetings working with legislation, education and changes of practices).

Coordinators	Line Kollerup & Mette Vaarst
Sector	Dairy cow and calf sector
Animal	Dairy cattle

The strategy tested in the Living Lab

Small tests initiated by different Action Labs, and a larger more systemic and comprehensive change increasingly in focus on calves from dairy herds to calf herds.

Different strategies were implemented and are still in process, such as initiate dialogues with agricultural colleges, create debate in professional environments e.g. at the Danish Cattle Conference, and test how experience exchange groups among foreign farm workers could increase focus on animal health and reduced AMU. We started to produce inspiration videos from farmer to farmer. However, much focus was directed towards the calves, because they generally have a high AMU, and the situations of both calves and those caring for them was complex and under pressure.

The road to implementation

The Danish ROADMAP cattle LL initially focused on the necessity of changes in the systems and structures beyond the farms, instead of the usual 'things should be done better at farm level', although still acknowledging that the big difference between farms regarding AMU was also necessary to address. Many initiatives were discussed and partly broad out in the surroundings of the participants in the LLs. It was a challenge that analysis of 'the system' remained big and complex, and involved more actors and levels than what was represented in the LL core group. The Living Lab core group will follow up on the Action Lab activities and conclude, and if possible find funds to continue. This will happen during spring 2023.

"Reducing AMs means taking away something, on which the sector relies, and cannot be done without challenging systems changes. Innovations can be relevant, but we work with changes beyond innovations."

The impact created by the Living Lab

- Animal Health: Stronger focus among some actors in the sector regarding the imbalance between cows and calves in terms of focus and priority in the dairy herds and cattle sector.
- Costs and savings: To bring down AMU in calves will require some systemic changes, which in many cases will be costly. LL participants have been exploring potential strategies, and the ROADMAP team works on these strategies with a focus on cost-effectiveness of selected strategies out of the seven, which were debated. It was concluded that systemic changes were required, and these would be costly because they both implied physical changes (more space, air etc.), but in particular logistic changes to ensure that calves were mixed less, and had more similar health and disease status.
- AMU: We did not experience impact, as it requires a longer transition, but we continue to explore possibilities with actors to ensure stronger calves and more gentle transitions from dairy to calf herds in practice. Since that is where most AMU is used, an effort will impact the AMU in the sector, and the focus on this has increased among many actors.

CHALLENGES

- Time constraints, especially to do things between meetings for stakeholder representatives.
- The LL core group may need broader stakeholder participation, but this was not planned.
- Often the focus still is the primary sector rather than the entire sector / bigger system.

SUCCESSES

- Focused and well-structured dialogues with set goals on AMU between different stakeholders valuable to articulate issues.
- 'Rings in the water' / Ripple effect.
- Core group structure with bigger gatherings in Action Lab in-between created focus and interaction.

Living Lab in the Danish Pig Sector

The Danish Pig Living Lab consisted of a new group of 11 participants from private farms, vet companies, farm advisory companies, Seges, Danish Agriculture & Food Council, Danish Crown, a supermarket chain and Aarhus University. The LL participants formed a Core Group and within this group, two Action Labs were set up. The Action Labs involved several other stakeholders. The LL had its first core meeting in November 2020 and expects to have its last meeting around March 2023. We'll have six core meetings in total.

Coordinators	Merete Studnitz & Hanne Kongsted
Sector	Pig sector – Farm to Fork
Animal	Pigs

The strategy tested in the Living Lab

During the LL process, the aim was to approach a prudent use of antimicrobials. The approach of the Living Lab was to create dialogues about usage of antibiotics by different means. One strategy was to design an app to be used as a tool for evaluating and communicating about antibiotic treatments in the herds. The app was seen as a tool for communication between farm managers, employees, vets and advisers on prudent use of antibiotics. Another strategy was to create dialogue between a multiple of stakeholders with divergent backgrounds and positions, invited for a meeting where agreements and disagreements on subjects related to antibiotic usage in pig herds and resistance development were debated and written down in a published report.

The road to implementation

The Danish pig Living Lab was challenged by Denmark to some extend is a role model in achieving a low antibiotic usage, due to many years of regulation and industry focus on antibiotics. Among Danish pig professionals, there is no consensus, that decreasing the usage of antibiotics in pigherds will have any impact on resistance development in human pathogens. Furthermore, some fear that a further reduction in antibiotic usage in pigs will be harmful for the animals.

The above mentioned dialogue strategy was a success in terms of achieving a clearer picture on agreements and disagreements between stakeholders. The report from the dialogue meeting will be used as a starting point for following up.

"Challenging the structures that you are a part of yourself is difficult and requires time, effort and dialogue. Developing a LL into a trustful and creative forum requires time, effort and dialogue."

The impact created by the Living Lab

- Animal Health: By focusing on prevention and "as little as possible but as much as necessary" use of antibiotics, animal health should be unaffected or improved.
- Costs and savings: The project clearly established, that achieving a lower usage of antibiotics is something that needs investments and dedication from all sides, not the least the political side.
- AMU: By creating a focus on places where a lower usage is still possible and by pointing out the negative side effects of antibiotic usage – e.g. the environmental - the project supports a lowered use of antibiotics.

CHALLENGES

- Structural conditions like breeding, stables, financial restrictions and a difficult staff-situation are lock-ins for change.
- Without a sense of a burning platform, motivation for change is limited.
- The climate agenda has to a high degree overtaken the agenda when talking about change in the farming industry.
- Changes on personal and institutional levels causing that participants dropped out.

SUCCESSES

- A common ground for talking aboutprudent use of antibiotics was established.
- An openness towards doing things a bitdifferently was created.

FRANCE

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INRAE

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Overview

Many activities were carried out in France, where the various partners were involved in most of the project's WPs. The objectives were multiple and were in line with the measures implemented in the country since 2012 in the framework of the EcoAntibio plans, which have led to a reduction of almost 50% in the use of antibiotics in livestock farming as well as in the exposure of animals to antibiotics, all sectors combined.

Qualitative and quantitative surveys of farmers and veterinarians were used to better understand how reduction strategies were implemented, as well as the motivations and levers for promoting the prudent use of antibiotics. The objective was to understand how to support these dynamics in the long term and to accompany the actors in their transition path, according to their particular situation. Additional surveys were carried out with various stakeholders, in particular with production and distribution organisations that have implemented "antibiotic-free" labels and specifications. This made it possible to identify the technical and economic tools that encourage farmers to adopt a reduction approach that is regulated and valued on the market.

More particularly, INRAE has studied the development of preventive approaches in veterinary medicine to understand the structural dynamics underlying the current decrease in AMU. We have analyzed how veterinary services are being diversified and supported by the emergence of new business models. In the meantime, practices and labour organisation have changed as well, through the renewal of working relationships between veterinarians and other animal health professionals. IFIP studied the French “antibiotic-free” pig supply chains (characteristics, advantages, limits and prospects), based on interviews with veterinarians or quality managers from five producer organizations (PO), processors and retailers, and pig farmers. Unlike a GMO-free claim, the AB-free claim is not subject to any legal definition, leading to very diverse specifications, labelling and methods for calculating the quantities of antibiotics used at the farm level (if an indicator is used, which is not always the case). The AB-free lines represent approximately 15% of French pig production. ITAVI also studied different French “antibiotic-free” labels in poultry production through interviews with producer organizations, hatcheries, 1retailors, and farmers, in the particular cases of standard and certified broiler production. Although limited to a part of the production, these strategies seem to have benefited the whole poultry production. In fact, training, technical and moral support was carried out on the long term, for all farmers in order to improve their technical skills. The information collected also emphasizes the importance of formalizing objectives and the commitment of all actors of the sector for the success of these strategies.

This work has been complemented by participatory approaches in the framework of Living Labs carried out by INRAE (together with ONIRIS and ENVT) and CIRAD for the pig and poultry sector, and by IDELE for the dairy sector, which are presented in more detail hereafter. These multi-actor initiatives have made it possible to broaden

the scope of reflection and to better integrate the knowledge of stakeholders into the change process. More particularly, the first Living Lab involved representatives of veterinarians, the pig and poultry industries, technical institutes, the French Ministry of Agriculture and researchers to further improve how antimicrobials are used on farms. By successively defining a shared, long-term vision of future antimicrobial use on farms, identifying lock-in mechanisms impeding this future vision from being realized, and articulating practical questions on how to move in the desired direction, the group rapidly reached a consensus. The results highlight the need for consensual standardized monitoring tools that would allow farmers and veterinarians to jointly monitor health, welfare, antimicrobial resistance and antimicrobial use on farms. An "Action Lab" is being set up on this topic. Other results relate to better communication towards citizens regarding animal health, animal welfare, and proper antimicrobial use as well as the economic competitiveness of farms on international markets and the economic sustainability of farm animal veterinary practices. These results call for a concerted way to produce tools for farmers and veterinarians and the broader involvement of other food sector actors.

Events

The work we have carried out in our different activities has been presented and discussed with local stakeholders and professionals in different types of events.

There has been several interactions in events organized by the French pig and poultry professional organisations, such as *Journées de la Recherche Porcine* or *Journées de la recehrche avicole*. The veterinary profession has also invited us to discuss our work in events like C*ongrès de l'Association Française de Médecine Vétérinaire Porcine*, and the French Ministry of Agriculture has a prospective department with whom we had an interesting dialogue on the implications of our findings for future policies.

Several sessions with stakeholders of the pig sector have been organized in order to discuss more specifically about health monitoring tools, which has been the main theme treated within our related Living Lab. Similar interactions were also organized with the dairy sector. All Living labs meetings, presented in the next pages, were also very important to establishing fruitful relationship between the project partners and the local stakeholders and professionals.

Living Lab in the French Pig and Poultry sector

The French pig and poultry Living Lab (LL) consisted of a new group of 9 stakeholders of 9 different organizations (vets, technical institutes for pig and poultry farming, interbranch organizations of pig and poultry industry, Ministry of Agriculture). Indicators to improve measuring AMU together with animal health an welfare at farm level were identified as necessary, which resulted into the initiation of an 'action' in an 'Action Lab' to evaluate the efficacy of the indicators that were considered as most important in the LL. The LL was initiated in January 2021 and the process is still ongoing. Prior to the LL meetings, semi-structured interviews has been conducted with each participant to explain the method of the LL and the project. So far, 4 LL meetings have taken place.

Coordinator	Catherine Belloc
Sector	Pig and Poultry sector
Animal	Pig and poultry

The strategy tested in the Living Lab

Pork and poultry consumption choices by consumers do not systematically take into account the use of antimicrobials. Meanwhile, field actors lack data or make heterogeneous use of monitoring indicators of health, welfare and antimicrobial use on animals, which should allow them to tailor their practices in terms of treatment choices and farm management.

In the Action Lab on indicators (from February 2023) researchers, veterinarians and farmers will collaborate to identify and validate indicators useful to monitor minimal AMU while maintaining animal health and welfare.

The road to implementation

The **Impress *ex ante* method** was used to facilitate the LL. The steps were the following :

- Initial assessment
- Vision of the future
- **Central issue and problem tree**
  - **Problem tree** displaying the five main categories of lock-in mechanisms which result in the central issue regarding better use of antimicrobials and impede the vision of the future to be reached according to participants
- Ecosystem and scope of the intervention
- Typology of actors
- Outcomes mapping

"The LL approach proved efficient to gather stakeholders involved in AMU in pig and poultry sector and initiated a long-term collaboration between actors on this topic."

The impact created by the Living Lab

AMU and Animal Health: A new group of stakeholders was established that successfully collaborated to apply the Impress *ex ante* method to the AMU topic. They shared a common vision of the future and decided to further collaborate to initiate concrete actions through "actions labs". The first action lab (to be started in February 2023) will deal with combined indicators of AMU, health and welfare.

CHALLENGES

- To get stakeholders involved in the Action Lab related to indicators
- To be able to (i) produce a set of indicators in the coming months (Action Lab) then (ii) initiate a field study in pig farms for their validation

SUCCESSES

- Successful definition of a shared long-term vision of the future
- Identification of lock-in mechanisms
- Efficacy of Impress *ex ante* method

Implementing participatory approaches in the French dairy sector

The French Dairy Cattle meeting gathered 26 attendees of 8 types of organizations (farmers, veterinarians, health advisors). The goal was to work from results obtained in 2 other projects: IdEA, in which an approach to reduce AMU was created; and UniFilAnim Santé, in which the setting up of participatory meetings between breeders and vets was tested to improve herd health management. The interest of these approaches having been approved, it was henceforth necessary to find solutions to perpetuate them. Thus, breeders and advisers were gathered during a webinar, following which the results were deepened by contacting other professionals. This was held during 6 months in 2021-2022.

Coordinators	Manon Fuselier & Eleonore Pommier
Sector	Dairy cow sector
Animal	Dairy cattle

The strategy tested in the Living Lab

During the IdEA projects (which aimed to promote co-construction between breeders and veterinarians of an action plan to reduce AMU on farm level) and UniFilAnim Santé (which aimed to develop the organization of participatory meetings between breeders and health experts), a real interest from professionals had been shown concerning the usefulness of these participatory approaches, but the main obstacle to their implementation was economic. The meeting's strategy was therefore to find out whether other professionals from different organizations would be interested in these approaches and, if so, what solutions would they consider making them permanent. The "webinar" format permitted to bring together a greater number of people to obtain a greater diversity of points of view.

The road to implementation

During the webinar, 2 existing groups from the 2 previous projects (IdEA and UniFilAnim Santé) were merged into the group. Results of WP1 of ROADMAP, the IdEA and UniFilAnim Santé approaches were presented. Sub-working groups were then organized to discuss sustainability solutions. The participants showed real interest in the results and provided solutions. We had planned to organize 2 other webinars to deepen the solutions for each of the projects, but the partners of IdEA first wanted to obtain data on the impact of the approach before continuing the sustainability and, for UniFilAnim, the solutions provided and their deepening through contact with other professionals after the webinar showed that only training funds could respond to the problem. So, for this project, it was not necessary to bring the participants together again because only one solution exists and its implementation is governed by an established protocol.

"In order to reduce the use of antibiotics, a systemic approach of the herd is essential, as well as mutual knowledge between the stakeholders and taking into account the needs of each. This requires time, therefore funding, that could be found through training funds to set up participatory meetings."

The impact created by the Living Lab

- Animal Health and AMU: The main impact was to observe that the breeders as well as the advisers are motivated to create more dialogue, more inter-knowledge during participatory meetings or during co-construction of a cattle health approach. Constructive communication between breeders and with advisors seems to be an expected and effective lever for improving herd health and reducing AMU. Offering stakeholders training in counseling pedagogy including the 2 presented approaches would be a first step.
- Costs and savings: However, breeders don't want to incur additional costs to participate in these long-term approaches. It is therefore necessary to find financial aids, but the solutions are limited.

CHALLENGES

- Bring farmers and advisers together in a webinar on a project they don't know.
- Presented a lot of results and have sufficient time to discuss in 1h30.
- Find a wide range of solutions for the sustainability of the approaches.
- The will of the partners of the IdEA project not to continue for the moment.

SUCCESSES

- Many professionals in the sector were interested in the subject
- The desire to create dialogue between breeders and between breeders and advisers
- The desire to have a global approach to herd health

ITALY

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Overview

In Italy, the ROADMAP project developed cases studies and living labs for the pig and the poultry sectors.

Pig sector

According to European statistics, Italy is among the countries making the most use of antibiotics in farms compared to the amount of livestock production. In this context, the pig sector, for the presence of many small individual farms scarcely integrated and predominant production of heavy pigs destined to designated of origin dry-cured ham, shows non-negligible criticalities but also considerable margins of improvement. In the past decade, the Regional Administration of Emilia-Romagna made a significant effort by issuing, as the first Region in Italy, in 2018, its Guidelines for the prudent use of antibiotics in pig farming. The Guidelines were also implemented by other Italian regions within the Interregional Coordination of Disease Prevention and Public Health with the approval of the Centre of National Reference for Antibiotic Resistance and the Ministry of Health.

In 2021, nearing the entry into force of the new European regulations on veterinary medicines and medicated feeds and the starting of the new cycle of the Common Agricultural Policy, which included the contrast to antimicrobials resistance (AMR) in the agri-food supply chain among the priorities of the Farm-to-Fork Strategy, the Project ROADMAP, in collaboration with the Emilia-Romagna Region, dedicated a Living Lab to the Guidelines, to evaluate their use in farms and possibly improve them with the institutional and private stakeholders that, in part, already participated to the design of the 2018 version.

Poultry sector

In the 2010s, Italian poultry farming consolidated significant improvements in animal welfare and biosecurity conditions. In 2015, the National Association of the Poultry Industry (Unaitalia), with the support of the Ministry of Health, launched a National Plan for the responsible use of veterinary medicines and the fight against AMR in poultry farming. The National Plan was updated in 2017 due to the achievement, some years in advance, of the targets set in 2015. In 2020, antibiotic use in Italian poultry farms had decreased by more than 90% compared to 2011, and the sales of poultry meat and eggs produced without antibiotics had remarkably increased. In the Italian context and beyond, such improvements have been considerable. The ROADMAP project, in collaboration with Unaitalia and the FAO, organized a living lab to evaluate with private and public stakeholders of the poultry industry the results obtained by the National Plan and conceive actions to increase further the efficient use of antibiotics and reduce the risks to human and animal health due to emergence of pathogens resistant to these drugs.

The ROADMAP Living Lab on Italian poultry farming made use of the Progressive Management Pathway against Antimicrobial Resistance (FAO-PMP-AMR), an operational tool developed by FAO to support self-assessment processes and participatory planning between public and private stakeholders for the prevention and control of antimicrobial resistance in farms. The FAO-PMP-AMR is a method that orients public administrations and private sector operators in conceiving and implementing actions within coordinated National Plans against AMR and gradually progressing towards sustainable use of antimicrobials. Thanks to the PMP, the participants of the Living Lab were able to identify the topics on which to operate, the specific initiatives to be implemented, and the key performance indicators (KPI) in four areas of action:

- Awareness, i.e., increasing the awareness of the operators of the supply chain on the risks of AMR;
- Evidence, i.e., developing systems for monitoring the use of antimicrobials in farms and surveillance on AMR along the supply chain;
- Practices, i.e., promoting good practices and the prudent use of antimicrobials on farms;
- Governance, i.e., strengthening the coordination and effectiveness of the actions implemented.

The KPIs activate a dashboard which synthetically describes the progress made in the four action areas. Before this experience, the FAO had used the PMP to evaluate the correctness of AMU practices and AMR prevention for the whole agricultural activities in one country: the Living Lab was an opportunity to test the effectiveness of this tool for a specific livestock sector.

Events

- Pig sector Living Lab workshop in July 2021. 29 participants.
- Poultry sector Living Lab workshop in December 2021. 39 participants.
- 6th World One Health Conference (Edinburgh, October 2020) – Poster presentation on the willingness to pay of Italian consumers for antibiotic-free poultry meat.
- 5th International Conference on Responsible Use of Antibiotics in Animals 2021 (Amsterdam, June 2021):
  - Poster presentation on the impacts on production performances and costs from the development of antibiotic-free poultry farming in Italy;
  - Poster presentation on the effects of the Porcine Reproductive and Respiratory Syndrome on the antibiotic consumption in weaning and fattening farms in Italy.
- International Society for Economics and Social Sciences of Animal Health - ISESSAH 2021 Conference (Kuala Lumpur, N\ovember 2021) – Oral presentation on policy mixes to control AMR in livestock production: a comparative analysis of National Action Plan implementation in relevant countries.
- Conference of the Italian Society of Swine Pathology (Lazise, June 2022) – Oral presentation on pattern of antibiotic consumption in two Italian pig production chains differing for the endemic status of PRRS.
- Conference of the Italian Society of Agricultural Economics (Palermo, September 2022) – Oral presentation on Stakeholders' perceptions about AMU practices and AMR issues in the Italian poultry sector.

Living Lab about the check-up of the regional guidelines for the prudent use of antibiotics in pig farms in Emilia-Romagna

Based on a previous working group, the Italian Living Lab (LL) on pig pro-duction included fifteen organizations representing all the main stake-holders in Emilia-Romagna (ER): i.e. the Regional Health Authority (HA) and Agricultural Services, Local HAs (ASL Modena), the National Veterinary Labs (IZS), pharmaceutical groups (MSD and Elanco), pig industry integra-tors (Amadori Group and Veronesi Group), producer organizations (Gran Suino Italiano and Consorzio Prosciutto di Parma), farmer unions (Coldiretti and Confagricoltura), big retailers (CoopItalia), expert consul-tancies (CRPA), and the University of Bologna. Thirty experts and profes-sionals were involved. The LL checked the Regional Guidelines on prudent AMU in pig farming within the framework of the new European legislation on veterinary medicines and the 2023-2027 Common Agricultural Policy (CAP) cycle. The LL organized one main event and several restricted meet-ings to prepare discussions and finalize the results.

Coordinators	Paolo Trevisi, Massimo Canali, Diana Luise & Giovanna Trambajolo
Sector	Pig sector
Animal	Pig and poultry

The strategy tested in the Living Lab

Main points of the strategy discussed in the LL: 1) Support a Ministry of Health (MH) action for a complete har-monization of the risk categorization from veterinary AMU in the EU (Resp. ER Region); 2) Support small farms to create AMR archives for to improve early diagnosis and first therapies' effectiveness (Resp. IZS); 3) Reduce time for diagnoses from AMR lab tests (Resp. IZS); 4) Support training for all supply chain operators dealing with AMR issues (Resp. ER Region and agricultural training institutions); 5) Clarify the criteria for the application of meta-phylaxis (Resp. ER Region and MH); 6) Promote the evaluation of pigs' anatomopathological lesions at slaughter-ing to support therapeutic choices in farms (Resp. IZS and MH); 7) Foster transparency and data sharing (Resp. IZS and MH).

The road to implementation

In 2018, Regional administrations adopted the ER Guidelines on AMU in pig farming as Guidelines for this sector. In 2021, within the LL, the ER Regional HA started to adapt the Guidelines to the evolution of the EU Regulations on AMU in animal farming (Reg. 2019/4 and 2019/6). National experts examined the new Guidelines draft. The revised document was publicly presented in November 2022, starting the discussion to adopt the new ER Guide-lines at the national level within the Italian strategy against AMR in the pig sector. The Ministry of Health (MH) is now reviewing the document with this purpose. The MH and professional counterparts are evaluating the possi-bility of farm access to AMU data in the national vet database. In the Italian Strategic Plan for the 2023-2027 CAP, the ER Region has proposed and obtained the conditionality of Eco-Scheme 1 for direct payments to farms' com-pliance with animal welfare improvements and AMU reduction.

"Animal health management in farms cannot rely on routine preventive AMU. Significantly reducing AMU in farms is possible, and the pig industry operators are willing to cooperate toward this achievement."

The impact created by the Living Lab

- AMU: the LL led all major swine players to discuss with public health professionals the reduction of AMU in herds as a common goal, despite their divergent business and professional interests. The agreed actions aim to reduce AMU in ER pig farms within the new European sectoral legislation and extend the good practices envisaged at the national level;
- Animal Health: the envisaged measures also imply significant improvements in farm structures, health management, biosecurity and animal welfare, with positive impacts for the containment of infections from both types of pathogens: resistant and susceptible to drugs;
- Costs and savings: the positive impacts on animal health imply savings on disease-related costs, such as production losses, management of health emergencies in livestock and direct health care costs. The new dedicated Eco-scheme in the Italian CAP 2023-2027 will provide an economic advantage to farmers willing to adapt to this trend, in addition to the finance available for farm investments in the CAP 2nd Pillar.

CHALLENGES

- The considerable fragmentation of pig production in Italy, i.e. many small individual farms (non-operating with big integrators);
- The presence of many obsolete farm structures, difficult to adapt for significant biosecurity and animal welfare improvements;
- Because of the above, bottom-up initiatives have little chance of having a significant impacts;
- And ultimate responsibility for high-impact actions is dispersed among several highly centralized decision-making bodies.

SUCCESSES

- Succeed in bringing together all the most relevant stakeholders of the pig industry, despite their divergent business and
- professional interests;
- Bring all stakeholders to share the common goal of reducing AMU and combating AMR, and jointly identify actions capable of having a significant impacts, contributing the Guidelines re-vision;
- Identify the entities responsible for the desired actions;
- Having contributed to addressing the application of the CAP in Italy to these objectives, in line with the farm2fork strategy.

Living Lab on the FAO PMP-AMR assessment of the National Plan for Responsible AMU and Contrast AMR in the Italian Poultry Industry

The Italian Living Lab (LL) on poultry production assessed the National Plan for the Responsible Use of Veterinary Medicines and Contrast Antimicrobial Resistance (AMR) in the Poultry Industry. The assessment applied the meth-odology of the FAO Progressive Management Pathway for AMR (PMP-AMR) that, for the first time, was used to analyze a single livestock sector. The LL included twenty-four organizations representing all the relevant Italian stakeholders: i.e., five organizations from the poultry industry, two from the pharma industry, one retailer chain, one consumer association, three scien-tific and professional vet associations, four public vet labs (including the Na-tional Reference Centre for AMR and the ClassyFarm), the Ministries of Health and Agriculture, the Research Centre of the Ministry of Agriculture, the Regional Health Authorities of Emilia-Romagna and Veneto, the FAO, two academia and research institutions. Forty-eight experts and professionals were involved. The LL organized one main event (Rome, December 2021) and several restricted meetings to prepare discussions and finalize the results.

The strategy tested in the Living Lab

The National Plan is an initiative of the Italian association of the poultry industry (UnaItalia) supported by the Ministry of Health that started in 2015. In 2020, the plan achieved an AMU reduction of 88% in poultry farms (more than 90% in chickens) compared to the 2011 levels. The PMP-AMR is an assessment tool developed by FAO to support governments in implementing the National Action Plans (NAPs). The LL was the occasion to apply the PMP-AMR to a single livestock sector for the first time. The tool examines NAPs' measures under four aspects: AWARENESS (of stakeholders), EVIDENCE (monitoring AMU and AMR), PRACTICES (farms' animal health management), and GOVERNANCE (coordination of measures). The LL objectives were: to consolidate the national strategy to reduce AMU; (2) support the refinement of the FAO-PMP-AMR poultry-sector-specific component for further deployment in FAO Members; (3) assess the progress of implementation of the national AMR activities; and (4) agree on actions to be taken in the short term to enhance the plan.

The road to implementation

The National Plan had a high PMP-AMR evaluation. Concerning the measures planned, compared to the FAO standards, the Plan reached an average fulfilment of 81% for AWARENESS, 82% for EVIDENCE, 94% for PRACTICES, and 67% for GOVERN-ANCE. Regarding the implementation of the measures, the scores were 75%, 68%, 89%, and 67% in the four intervention areas, respectively. The short-term actions envisaged to fill the gaps were: (1) for AWARENESS: assess the level of education on AMR at high school for zootechnicians and animal heath operators; (2) for EVIDENCE: review/develop AMR surveillance on the poultry farms' environment; Develop national reporting of AMR surveillance in bacterial pathogens associated with clinical cases; and conduct AM residue testing in the environment; (3) for PRACTICES: set up a benchmarking system for veterinarians through ClassyFarm; implement regulation to guide high users identified through the benchmarking system; (4) for GOVERNANCE: allocate national funding for AMR/AMU research in the poultry sector. During the LL, the participant experts identified the organizations responsible for the envisaged actions (mostly public health entities).

"The LL has been an effective tool to independently assess the relevant improvements of the Italian poultry sector in AMR and AMU in the last decade and to identify margins for further progress."

Coordinators	Massimo Canali, Caetano Luiz Beber & Frédérique Pasquali
Sector	Poultry sector
Animal	Poultry

The impact created by the Living Lab

- AMU: The LL brought all the main Italian stakeholders to discuss with FAO experts the adequacy of the Poultry National Plan to the global objectives of the Quadripartite and FAO Action Plans. The PMP-AMR assessment showed that the National Plan promoted by UnaItalia meets the best international standards for these actions. A confirmation of the relevant results already obtained by Italian poultry farms in reducing the total AMU and the usage of Critically Important Antimicrobials (CIAs). The weaknesses highlighted in the LL mostly call the public animal health operators to activate the necessary measures to fill the existing gaps. The Poultry National Plan anticipated by a few years the issue of the first Italian National Plan against AMR (PNCAR 2017). The LL allowed national health authorities to receive the poultry sector's expectations regarding the new PNCAR (2023-2025), whose draft is currently under examination by regional administrations.
- Animal Health, costs and savings: the suggested improvements imply positive effects on farm health management and the costs of animal diseases. The FAO had the opportunity to test the application of its PMP-AMR tool for specific poultry sector assessments.

CHALLENGES

The capacity of animal public health authorities and the other public bodies involved to implement the envisaged improvements, especially regarding: (1) the systematic monitoring and reporting of AMR related to the poultry farm environment and supply chain and from clinical cases; (2) the benchmarking of vet prescription activities and the consequent corrective actions; (3) the allocation of national funding for AMR research specific for the poultry sector.

SUCCESSES

(1) Succeed in bringing together all the most relevant stakeholders of the poultry industry, despite their divergent business and professional interests; (2) Engage all stakeholders to address the highest international standards for national action plans against AMR and jointly identify actions that can further improve the good results already achieved; (3) Pro-vide indications to the public health authorities for the re-newal of the PNCAR in the 2023-2025 period.

NETHERLANDS

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Overview

Within ROADMAP, the Dutch team (ZLTO and WLR) have been working on the turkey and pig sector.

ROADMAP was connected to the turkey sector from June 2019 to December 2022. The turkey sector was interested in the coaching approach, a way of social intervention of ZLTO, because of the experience and positive results obtained in the pig sector. The turkey sector was using relatively more antimicrobials compared to other poultry sectors and were opted as an interesting case to work with the coaching approach. On-farm multi-actor coaching was tested in 4 farms as part of the Living Lab (Action Lab). Multiple stakeholders were involved in the Living Lab: farmers, veterinarians, and sector organization delegates. In addition, systemic lock-ins that hamper AMU reduction were identified by the Dutch ROADMAP team by conducting a systemic analysis. Lastly, interviews were conducted to gain more insight in the turkey sector, and to discuss the possibilities and limitations to reduce the antimicrobial use.

Highlighted results of the ROADMAP trajectory in the Dutch turkey sector are:

1. When choosing measures to reduce antibiotic use, it is very important to know the expected impact to consider additional costs and labour investment.
2. Dutch turkey farmers are already doing a lot to deal with antibiotics responsibly; as a result, there is limited scope for action. Part of the action perspective lie with links in the chain abroad. Some farmers see more opportunities than others.
3. It is the wish of the turkey farmer and all stakeholders to cure animals that are ill as soon as possible, while innovations are more focussed on preventative were results are less straightforward. Opportunities must be found to create room for taking correlated risks and mitigate them as much as possible.
4. Finally, the turkey sector started an initiative as a follow-up of the ROADMAP project to see if different breeds, with better health and hopefully less need for antimicrobials, can be included in the Dutch animal welfare label.

Within the ROADMAP project we started working on the plans for the Dutch pig sector from October 2020 onwards. In this sector the ROADMAP work focuses on a technical innovation to reduce antimicrobial use in young animals, since AMU is highest in this age class. An experiment was set up on 2 commercial farms to study the effects of providing the sow with more freedom to move around farrowing on colostrum intake, piglet survival, growth, health and antimicrobial use under field conditions. Study results will be finalized in April 2023.

Events

Highlighted ROADMAP events in the Netherlands:

1. The last Living Lab meeting, held in September 2022, resulted in an open, constructive meeting in which a SWOT analysis of the Dutch Turkey sector in relation to AMU was created
2. Several on-farm coaching meetings with the farmer, the veterinarian, the feed advisor and the ZLTO coach resulted in conversations and action plans about how to proceed with AMU reduction on farm level
3. During the ArMoR cluster event of WUR in February 2023, ZLTO was able to present the ROADMAP Living Labs methodology and results
4. During the ROADMAP project connections between research institutes and researchers were formed and resulted in knowledge transfer and great discussions.

Living lab in the Dutch turkey sector

Based on a previous working group, the Italian Living Lab (LL) on pig pro-duction included fifteen organizations representing all the main stake-holders in Emilia-Romagna (ER): i.e. the Regional Health Authority (HA) and Agricultural Services, Local HAs (ASL Modena), the National Veterinary Labs (IZS), pharmaceutical groups (MSD and Elanco), pig industry integra-tors (Amadori Group and Veronesi Group), producer organizations (Gran Suino Italiano and Consorzio Prosciutto di Parma), farmer unions (Coldiretti and Confagricoltura), big retailers (CoopItalia), expert consul-tancies (CRPA), and the University of Bologna. Thirty experts and profes-sionals were involved. The LL checked the Regional Guidelines on prudent AMU in pig farming within the framework of the new European legislation on veterinary medicines and the 2023-2027 Common Agricultural Policy (CAP) cycle. The LL organized one main event and several restricted meet-ings to prepare discussions and finalize the results.

Coordinators	Paolo Trevisi, Massimo Canali, Diana Luise & Trambajolo Giovanna
Sector	Pig sector
Animals	Pig and poultry

The strategy tested in the Living Lab

During the LL process, the aim was to come up with solutions to reduce antimicrobial use. Before the ROADMAP project started, interest in the ZLTO coaching trajectory to reduce antibiotic use was shown by the turkey sector. Therefore, this strategy was tested in Action Labs with four turkey farmer teams (farmer, veterinarian, feed advisor). Two farmer teams had 2 coaching sessions, and the other two teams had 3 sessions.

Guided by a coach, these teams worked on farm-specific solutions to reduce antimicrobial use and to improve animal health. Actions were discussed and if possible implemented, such as improving water and feed quality (more fibre) and changing the business model of the farm. However, it was not always possible to find solutions, stressing the complexity of the problem.

The road to implementation

During the first meeting in May 2020 the ROADMAP project, the concept of LL, the tasks and plans for the coaching trajectory were introduced to the group. In September 2020 a second meeting was held to start the conversation on possible directions and ways to implement technical interventions for AMU reduction in turkey farms, in which it was decided not to focus on experimenting with technical interventions in the Action Labs, but to focus on the coaching trajectory only. Due to COVID-19, these first two meetings were held online. The final LL meeting was held live in September 2022. In addition to the WAAK group, turkey farmers that participated in the Action Labs joined this meeting. During this meeting a SWOT analysis of the turkey sector have been made which resulted in new action points, such as finding opportunities to increase animal health within the boundaries of a quality mark. If opportunities will be found, this action will be followed up by the turkey sector in 2023.

"Many different stakeholders are involved on the road to reducing antimicrobial use in the Dutch turkey sector. Multiple possibilities and directions for change seem to exist, but it is of importance to seek for ways to implement these possibilities in practice keeping different interests of stakeholders in mind."

The impact created by the Living Lab

- AMU and animal health: the main impact of the LL is that AMU has again become a topic of discussion in times of other pressing issues such as Avian Influenza. By having in-depth discussions about AMU, new perspectives and opportunities emerged. Possibly the LL led to fresh energy to move forward again on this complex topic for the turkey sector. During the coaching trajectory, a dialogue was started on on-farm actions and improvements to reduce AMU and to increase animal health.
- Costs and savings: It has been concluded that to bring down AMU in turkeys significantly it will require systemic changes, which will be costly (e.g. change in genetics, intensive-extensive, nature-inclusive agriculture, new types of housing/management). In addition, Dutch turkey farmers are highly dependent on regulation in Germany, where important parts of the value chain are located, which gives them little room for change.

CHALLENGES

- Setting up a LL with a balanced group of influential stakeholders with all interests represented (also beyond borders)
- Clarity of the goal and conditions of the LL beforehand for all participants
- Establishing a LL in a very small sector
- Awareness of hidden agendas or fears of participants in a LL
- Creating a shared responsibility for the problem of AMR

SUCCESSES

The learnings during the process about the importance of:

- Having an independent facilitator to guide the LL meetings
- Open and bottom-up conversations, based on trust and mutual commitment
- Live instead of online LL meetings
- Being flexible in the plan of action during the process
- Identify needs, difficulties and possibilities in the sector

SWITZERLAND

Overview

The legal basis for organic farming in Switzerland and the EU requires a restrained use of AM.

The Swiss organic sector works already a long time on strategies to reduce AMU in livestock production with a focus on dairy farms. There are around 60'000 organic dairy cows in Switzerland on approximately 3330 farms. In several projects, we focus to mitigate AMU in this sector by prevention, adapted performance, complementary medicine.

However, the strategies are mainly focused on cows and udder health. Out of the 60'000 calves born on a dairy farm, only 16% are marketed as organic veal. The reasons behind the sale of organic calves to the conventional sector are 1) that there is no market for organic veal in Switzerland and 2) that the conventional sector is looking for calves as the overall number of cows in Switzerland is decreasing. Organic calves therefore go from the dairy farm into the conventional calf fattening system with the corresponding treatments with antimicrobials.

In Switzerland, 41.3 % of the meat consumed in Switzerland is pork. However, organic pork production remains a niche with a share of 1.7 % (42'640 pigs). Different from the dairy sector, much less is done about pig health in the organic sector. Our analysis identified, that AMU is mainly for piglet diarrhoea on the breeding farm due to weaning too early. ROADMAP allowed to discuss strategies for to reduce AMU in the organic pork sector.

RESPONSIBLE PARTNER

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Events

In Switzerland interactions found place in the form of LLs in the two sectors with farmers, vets, organic farmers associations, animal welfare organisations, animal trade and retail to find leverage points for AMR. An output of the activities are date about the AMU in the organic sector, educations of vets on alternatives and prevention of AMU in dairy calve and pig rearing. Feedback was positive with actors saying that they want to continue working on solutions.

- 31.03.2022: FIRST lesson of the further training for veterinarians on organic pig farming with more than 30 vets joining by Barbara Früh, Coordinator Pig LL.
- 07.09.2022: Webinar out the Living Lab. Phytotherapy “Don't wait, drink the tea: herbs and medicinal plants for cattle diseases” by Michael Walkenhorst, Coordinator Calf LL; 80 farmers and vets joined.
- 23./24.05.2022 «Der tierärztliche Einsatz auf dem Biobetrieb» - Training for Students of veterinary medicine– 8 participants for 14 lessons.
- 07.09.2022: Training for vets about phytohterapie. 60 participants .

Living lab in the Swiss organic veal and beef sector

FiBL conducted a Living Lab (LL) with stakeholders in the Swiss organic beef and veal sector to come up with ways to reduce antimicrobial use (AMU). Subsequently, a Living Lab of 12 stakeholders was established. The stakeholders represented organic veal and beef farmers, vets of the Swiss Calf health service (SCHS) and the organic farmers association Bio Suisse (BS). The LL was based on an existing group. The focus of the group was mainly on conventional calf / beef systems. ROADMAP allowed to focus also on the needs of organic farmers and bring in their perspectives. The first LL meeting started already in May 2019 and the last LL meeting takes places in February 2023. In between the Action Labs were established to implement strategies as discussed in the LL.

Coordinators	Michael Walkenhorst & Bernadette Oehen
Sector	Organic Cattle sector
Animals	Organic beef and veal

The strategy tested in the Living Lab

There were two main aims of the LL: (a) an adaption of the SCHS management advisory tool to organic principle and regulations (including the aim of reducing antibiotics) and (b) a standard visit of a representative number of Swiss organic veal and beef farms via SCHS (including registration of the used antibiotics).

Therefore we intended in Action Labs (a) to gain a representative overview over the management and antimicrobial input on >100 organic cattle farms, (b) to implement at least one elective course during the Swiss veterinary education with regard to the particularities of veterinary action on organic livestock farms and (c) to promote the use of complementary medicine, mainly phytotherapy and homeopathy, in veterinary education and post graduate training to reach a maximum of active veterinarian practitioners in Switzerland.

The road to implementation

The LL focused on education and training of veterinarians, in the overall handling of cattle health on organic farms and in issues of complementary medicine. During the process the following points were experienced:

Adjust the management recording scheme to the needs and regulations of organic cattle farms was successful and an important base for the ongoing cooperation between BS and SCHS.

In the first phase (on farm evaluation of the health situation and the antimicrobial input) the contracted veterinarians of the SCHS experienced a broad spectrum of feedbacks of the randomly chosen farms. Even if the participation in the project was voluntary, some farmers showed a “demonstrative disinterest” in the supervision. In contrast, others were highly interested and very satisfied with the measure, which they would not have requested on their own initiative.

While farms with suckler cows show good management, dairy, beef and veal farms show an average management compared to the experience of the SCHS.

In the second LL representatives of organic dairy, beef and veal farmers participated which leads to fruitful discussions about future cooperations.

"The organic cattle sector could be an interesting example of how the use of antimicrobials can be reduced through a combination of preventive herd health management measures and complementary veterinary medicine. The basis for this is close cooperation and dialogue between farmers of different cattle sectors, veterinarians and health services, and for a long-term impact, the inclusion of Universities as veterinary training institutions."

The impact created by the Living Lab

AMU:

- Establish a close cooperation between SCHS and BS
- Adjusted management recording scheme to organic dairy, veal and beef production and provide a feedback to farmers
- Reach about 80 participants with practical basic information about veterinary herbal medicine via an online course

Animal Health:

- Initiating cooperation between organic dairy and organic veal and beef farmers with the aim to keep calves which were born on organic dairy farms as often as possible in the organic sector for veal and beef production.
- Establish an ongoing two-day elective course for veterinary students with regard to the particularities of veterinary action on organic livestock farms as well as an ongoing two-day elective course for veterinary students with basic information in veterinary phytotherapy together with the University of Berne

Costs and savings:

- Awareness about the differences in margins between conventional and organic milk and its consequences for calf rearing and animal health.

CHALLENGES

- Organizing LL in a pandemic situation.
- Selection of measures that can realistically be implemented.
- Establish a cooperation between dairy and veal or beef farms respectively to keep as much as possible calves of dairy farms in the organic sector.

SUCCESSES

- Starting point to include the goals and needs of organic livestock production in the veterinary education
- Reaching a high number of veterinary cattle practitioners with some basic information of veterinary phytotherapy
- Establishing a close cooperation between a health service and the organic livestock sector
- To cooperate with two large stakeholder groups of the sector was inspiring.

Living lab in the Swiss organic pork sector

FiBL conducted a Living Lab (LL) with stakeholders in the Swiss organic pork sector to come up with ways to document and reduce antimicrobial use (AMU). Subsequently, a LL of 8 stakeholders representing organic pig breeders and finishers, delegates from the organic farmers association Bio Suisse (BS), vets, pig traders and animal welfare organization was set up. It was a new group, but the participants were well known to the LL coordinators.

The LL meetings started in November 2021 and ended in January 2023. So far, there were three LL meetings.

An Action Lab consisting of BS and the LL coordinators was initiated from the LL. Other actions were implemented by FiBL. All these actions were communicated and evaluated in the LL.

Coordinators	Barbara Früh & Mirjam Holinger
Sector	Organic Pig sector
Animal	Organic pork

The strategy tested in the Living Lab

During the first LL meeting three domains of activities were decided: (a) monitor / document AMU on the piglet / pig farm, (b) What about AMU in organic pork in other countries? (c) collaboration of organic farmers with vets. Based on the domains of activities identified, we developed jointly a strategy to reduce AMU in the organic pork sector:

(a) analyzing existing data about AMU with a focus on organic piglets / pigs – action performed by FiBL

(b) discussing the potential of electric eartags to document AMU on the piglet / pig farm, the tool was already in use by one of the pig traders – action performed by FiBL

(c) to interview organic pig producers across Europe on how they document AMU – action performed by FiBL

(d) develop a training for vets about organic farming. Including the knowledge of farmers, FiBL and vets for a suiting syllabus – Action lab of BS and FiBL.

The road to implementation

During the process the following points were experienced:

- To establish the LL, the existing network of the organic advisors at FiBL was crucial. They were able to bring people from different contexts together.
- There was a very clear task / challenge at the beginning of the LL process. The challenge has been widely discussed in the sector and a pressure to improve the situation, e. g. increase the transparency about AMU and collaboration between breeders and finishers in the Swiss organic pork sector.
- Vets are missing knowledge about organic farming.
- The LL brought together a group of motivated peoples, some with quite similar visions and perspectives.
- During the LL, animal welfare was a topic intensively discussed. It resulted in the invitation of a philosopher and ethicists to give a talk at the annual meeting of the association of the organic pig producers. The talk was about the societal discussion on animal husbandry, animal welfare and how this discussion affects farmers.

"The Living Lab about the Swiss organic pork sector is an example of how the use of antimicrobials can be reduced through a combination of measures e.g. establish a knowledge base among the different stakeholders e.g. the identification of leverage points. Based on the learnings during ROADMAP, trainings for farmers and vets were designed."

The impact created by the Living Lab

- AMU: The most important outcome of the Living Lab in Swiss organic pig farming is that there is a better understanding of where AMU takes place: the main leverage point to reduce AMU in organic pig production is the weaning period. Even though there are clear instruction on how to design this period in organic farming, the data revealed, that the implementation on the different farms is not done properly.
- Animal health: Based on this result, FiBL, the organic farmers association and the Swiss organic pork producers will start with different activities to improve the piglet management during weaning, e.g. a technical leaflet, a learning video and farmer stable schools. Furthermore, we inspired a cooperation between organic dairy and organic pig farmers with the aim to exchange about AMU based on data collection, monitoring but also dialog. Establish the training for vets about the particularities of veterinary action on organic livestock farms will improve the collaboration between farmers and vet.
- Costs and savings: Awareness have been created about the costs and savings related to implementing actions (e.g. increase of labour, time).

CHALLENGES

- Organizing LL in a pandemic situation
- Maintain the motivation to participate in the LL during a challenging situation on the organic pork market.
- Selecting measures that can realistically be implemented, e.g. the electronic earmark to document AMU in real time was not ready to use during the course of the project.
- Get the attention of the pig producers, even though they face a big challenge of changing the feeding regime at the same time.

SUCCESSES

- Relevant tasks / questions as a starting point for the LL.
- The diversity of actors involved in the Living Lab and the different perspectives.
- The support of members in the Living Lab to conduct the training for vets.
- The access to data about AMU in the organic sector and the connected option to identify leverage points for the reduction.
- The cooperation in the LL was inspiring.

UK

Overview

In the UK, action on fostering more prudent use of antimicrobials in has been primarily industry led: the Responsible Use of Medicines in Agriculture Alliance (RUMA) sets industry reduction targets. For cattle farms, these approaches have been focused on productive animals (such as dairy cows). Youngstock (such as calves) have not received the same attention: the UK case study therefore focused on calf rearing.

In the ROADMAP project we interviewed key stakeholders from academia, industry, government and charities, as well as farmers and vets, and held key stakeholder meetings. We carried out a 'bottom up' approach to the living lab, convening a group of calf rearers and inviting stakeholders to speak to them about industry challenges.

A key result from the project is that the burgeoning market in contract calf rearing is leading to disease challenges through the mixing of calves. A cross-country online meeting about calf sectors across the UK, Belgium, Denmark and Switzerland highlighted the challenges that exist in other countries when this market is further developed. Another key result is the need to raise the status of calves and those responsible for their care. A paper was published by the UK team on the gender dynamics of calf rearing and the marginalisation of calves and their female rearers (Enticott et al., 2022).

The Living Lab focused on the goal of empowering calf rearers to influence change on AMU. Key events included a living lab cross-country visit to Denmark, where the calf rearers learned about other systems and shared their views with influential UK decision makers. Two members of the living lab became calf rearing representatives with RUMA. Living lab members produced videos on their farm to raise awareness about the importance of calf rearing in the industry which were shared on social media as part of GB Calf Week. The living lab members have been involved in trying to increase uptake of an eMedicines Hub launched in 2022 for beef and dairy farmers to record their AMU, as lack of data on AMU is a problem in fostering more prudent use in calves.

RESPONSIBLE PARTNERS

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Events

- We organised an online key stakeholder event in 2021 to introduce the project, the living lab and explore challenges to fostering prudent use of antimicrobials in calf rearing.
- Four UK stakeholders attended an online event about health challenges facing calf rearing sectors in the UK, Belgium, Denmark and Switzerland in 2021.
- Eight UK calf rearers and key stakeholders attended an in person cross country living lab visit in Denmark in 2022.
- Ten UK calf rearers and key stakeholders will attend a knowledge sharing cross country visit this week about calf rearing in the south west of England with attendees from Belgium, Denmark and Switzerland.

Living Lab about antimicrobial use in the UK dairy calf rearing industry

The UK Living Lab consists of a newly created core group of 8 calf rearers (6 females, 2 males). 11 Key stakeholders of 7 organizations including academics, vets, government representatives, industry representatives and other farmers were invited to join some meetings to give presentations and undertake knowledge exchange with the Living Lab participants. A 'bottom up' approach was used because the case study was 'marginal care': calves and their carers tend not to be considered the most important actors on the farm. Starting from January 2021, 11 Living Lab virtual meetings were held. Based on the discussions in the Living Lab, an Action Lab was established to start a trial. Both the Living Lab and the Action Lab are still ongoing.

Coordinators	Carol Kyle, Orla Shortall & Claire Hardy
Sector	Calf rearing
Animal	Cattle

The strategy tested in the Living Lab

The Living Lab was focused on empowering and raising the status of calf rearers. This is achieved through the members increasing their own learning, exchanging views with influential decision makers and participating in public facing knowledge exchange activities. Currently videos by the calf rearers about their experiences of being a calf rearer are in progress to share.

In the Action Lab, two members of the Living Lab are working with Responsible Use of Medicines in Agriculture Alliance (RUMA), the body tasked with setting and achieving AMU targets, to trial a central data hub to record AMU and identify challenges and solutions. Currently in the UK actors record AMU in different systems and data are not shared. The organization Agriculture and Horticulture Development Board (AHDB) launched an eMedicines hub in 2021 to record medicine use in the beef and dairy sectors, and the Action Lab is trialing and evaluating it and devising strategies to further its uptake.

The road to implementation

During the Living Lab stakeholders presented topics of interest to the group, followed by a group discussion. Reports are sent to participants summarizing the presentation and discussion. In late 2021 the group decided they would like to keep this format but also move towards being an Action Lab. During this phase, the presentation and discussion is followed by an hour of discussion about the group about Action Lab activities.

In terms of empowerment, the Living Lab participants benefited from a co-learning event in Denmark where they discussed issues with other Living Labs and visited farms. Members of the Living Lab had the opportunity to share their views and ideas with influential UK decision makers who also attended the event.

In the Action Lab, two members of the Living Lab became calf rearer representatives with RUMA and feed back to the Living Lab about their activities during the last 5 Living Lab meetings.

"A 'bottom up' Living Lab approach allows calf rearers to set the agenda and have their voices heard but relies on the enthusiasm of people who are already busy. The Living Lab process facilitated group members' access to influential industry groups to share their perspectives on the dairy industry."

The impact created by the Living Lab

- Animal Health: Improving the health of calves involves raising the profile and status of calf rearers on the farm enabling calf rearers to have greater decision-making power in relation to allocation of resources. The Living Lab participants have been empowering themselves by learning more about calf rearing, and sharing their views through videos and with key stakeholders. A video shared during GB calf week communicated the importance of calf rearing to the farming community.
- Costs and Savings: The Living Lab has involved knowledge exchange on the cost effectiveness of different calf husbandry practices and systems, including contract calf rearing which is a growing sector in the UK.
- AMU: In the UK an important step towards meeting AMU reduction targets is having adequate data on AMU in the beef and dairy sectors. The ongoing input from the Action Lab is valuable in helping RUMA and AHDB identify challenges and implement strategies in increasing uptake of the eMedicines Hub among farmers.

CHALLENGES

- Relying on the energy and unpaid time of already busy calf rearers and key stakeholders.
- Finding pathways for the calf rearers to have influence in the sector through the 'bottom up' approach.
- Creating focus on particular issues when members of the Living Lab have diverse interests.

SUCCESSES

- Calf rearers as an 'untapped resource' with energy and enthusiasm for learning and bringing about change in the sector.
- Industry bodies (e.g., RUMA and AHDB) embrace calf rearer collaboration which opened doors for the Action Lab to have input.
- Cross-country co-learning was experienced as energizing and informative.

VIETNAM

Overview

Vietnam's animal production sector consumes antibiotics at a rate six times that of Europe. It is also a sector undergoing rapid expansion and mutation, with breeding practises shifting towards intensification of production. As a result, strategies tailored to the Vietnamese context and developed by the stakeholders involved are required to support changes in practise towards more rational use.

To that end, the project's Vietnam case study aims to answer the following questions: How can we collaborate to develop integrated strategies to reduce antibiotic use in Vietnamese poultry farms? What factors influenced the decision to change antibiotic use practises? What are the stakeholders' barriers and motivations for implementing this change in practise? What levers and incentives should be put in place to encourage antibiotic use reduction?

The main goal is to collaborate with stakeholders in the chicken production and veterinary medicine chains to co-develop integrated strategies for reducing antibiotic use in Vietnamese chicken farms. To that end, we first conducted an exploratory study on the conditions of chicken farms as well as the situation of antibiotic use (UAB) and antibiotic resistance (RAB) in northern and southern Vietnam using a literature review and semi-structured interviews (n = 34). Then, using closed interviews (n = 125) in North and South Vietnam, we investigated the links between livestock practises and antibiotic use. Then, to determine the factors influencing the implementation of new antibiotic-use regulations, we mapped and analysed the actors in the chicken production chain (1 focus group and 39 semistructured interviews, North and South Vietnam). Then, to better understand the process of farmer transition to antibiotic reduction, we used anthropological approaches to conduct 35 individual interviews with farmers, drug sellers, and chicken dealers in a district in northern Vietnam. Finally, by adapting the Impress ex ante method to northern Vietnam, we co-developed strategies with stakeholders in the chicken production and veterinary medicine chains.

In Hanoi, we collaborated with the National Institute of Animal Sciences (NIAS), the Vietnamese National University of Agriculture (VNUA), and the Institute of Anthropology (IoA), as well as Nong Lam University (NLU) in Ho Chi Minh City and the Thai Nguyen University of Agriculture and Forestry (TUAF) in Phu Binh District, Thai Nguyen Province.




RESPONSIBLE PARTNER

CIRAD

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Events

Important events:

- Three co-construction workshops were held one week apart in one commune in Phu Binh district, Thai Nguyen province, in April 2022 with 18 participants from public, private and gouvernemental sectors;
- Two final restitution workshops in the Thai Nguyen provence and in Hanoi, in February 2023 with farmers, district officers, researchers and policy makers (>30 participants);
- Two presentations during the 16th International Symposium of Veterinary Epidemiology and Economics (ISVEE 16), 08-12 août 2022, Halifax, Canada:
  - » Toward a reduction of antimicrobials in Vietnam: understanding the transition process of chicken farmers. Oral presentation.
  - » Policy development to reduce antibiotic usage in Vietnam: understanding its implementation from the actors of the veterinary drug value chain perspectives. Poster.
- Online presentation during the Society for Veterinary Epidemiology and Preventive Medicine (SVEPM), 24-26 March 2021 about "Patterns of antibiotic usage among chicken farmers in North and South Vietnam".
- Online presentation during the International Society for Economics and Social Sciences of Animal Health, Conference 2020 (ISESSAH), 11 -13 November about "Stakeholder analysis of animal health decision systems to understand antimicrobial use in livestock production in Europe, Mozambique and Vietnam".

Living Lab in the Poultry Sector in Vietnam

The Vietnamese poultry Living Lab consisted of 15 people from seven different organizations (veterinary services at the provincial, district, and communal levels; farmers; veterinarians; drug sellers; drug companies; chicken retailers; and university professors) to brainstorm ways to reduce antimicrobial use (AMU) at the local level. Half of the group had participated in individual interviews, and more participants were invited to represent the entire sector. The Living Lab developped various strategies, and two plans of action for a 'Action Lab' were developed. The Living Lab consisted of three meetings at the local level over the course of three weeks in April 2022. The Action Lab could be implemented in the near future.

Coordinators	Flavie Goutard & Chloé Bâtie
Sector	Poultry sector
Animal	Chicken

The strategy tested in the Living Lab

The first strategy aimed to raise awareness among farmers and consumers about the importance of reducing AMU, practicing good biosecurity, and producing organically by broadcasting videos on national television twice a week in the evening. The content of the videos will be based on a preliminary survey to assess the needs of the targeted audience, and will be produced by television channels in accordance with the recommendations of the Ministry of Agriculture. The livestream will take place on model farms that have implemented good biosecurity and/or organic production practices. The second strategy aimed to organize AMU, AMR, biosecurity, and organic production training for drug sellers who will be then able to train breeders. Drug companies, university professors, provincial veterinary services and agricultural service centers will provide training. Training will also be available online, and flyers will be distributed.

The road to implementation

The ImpresS ex ante methodology was used to co-develop strategies to reduce AMU in poultry production in Vietnam. This methodology started with the development of a shared vision of the future in order to improve biosecurity and develop organic production on farms. Participants identified several barriers to reach this common vision, including a lack of organic product outputs, a lack of sciences and technologies, inadequate training, and a high proportion of small-scale farms.Participants decided to focus on improving biosecurity and organic production training and awareness for farmers, drug sellers, and consumers. Training courses should be better adapted to field constraints by assessing farmer needs.

"Reducing AMU in Vietnam requires a variety of solutions, including improved training and awareness programs, the development of alternative forms of socioeconomic organization such as cooperatives, and the adoption of new quality standards. The developed strategies must now be shared with policymakers and implemented."

The impact created by the Living Lab

- AMU: The Living Lab established an AMU and AMR discussion group comprised of various stakeholders from the public and private sectors. Solutions to reduce AMU could be shared with other actors via the participant's network. Improving biosecurity will help to reduce disease incidence, which will reduce AMU, and organic production standards will also help to reduce AMU.
- Animal health: Training courses will help to reduce animal burden on farms by improving biosecurity practices as well as using alternative feed additives.
- Expenses and savings: The costs of animal diseases and the costs of antibiotics will be reduced thanks to the changes created by the Living Lab, which will contribute to an increase in the livelihood of farmers. The growth of organic farming might also result in a higher valorization of the products, which would be accomplished through the establishment of specialized distribution channels.

CHALLENGES

- Consumers, small-scale farmers, and drug companies (that only sell AB) were omitted from the discussions.
- Time constraints prevented the ImpresS exante method and the Action Lab from being fully implemented.
- The results have not yet been disseminated at the national level.

SUCCESSES

- Everyone had the opportunity to voice their opinion.
- Meeting attendance did not decrease over time, with 15 people attending each meeting and 12 attending all three.
- Knowledge and experience exchange between various types of organizations.
- The research team owns the methodology and the results.

MOZAMBIQUE

RESPONSIBLE PARTNERS

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Overview

Mozambique has been experiencing an important growth in poultry production (it doubled in the last 5 years), mostly represented by a growing number of commercial broiler farmers with no or little experience. Accompanying this growth, the number of vet drugs sellers and the diversity of drugs available in the market has skyrocketed. The challenge for the country is to regulate and support these rapid economic and technical changes, despite the low resources available. In particular, the limited number of veterinarians and adequate regulation on veterinary drugs trade and prescription are major issues.

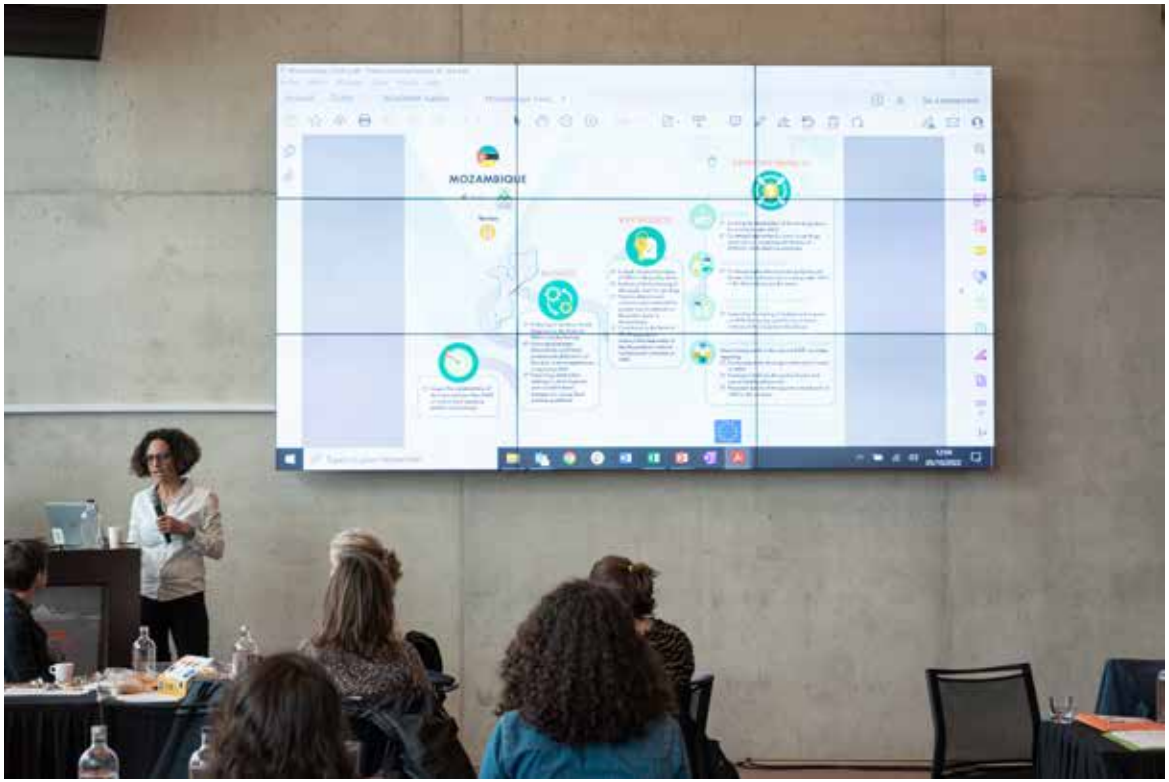
The project in Mozambique was implemented through collaboration with the Ministry of Agriculture and Food Security (MADER) and an association of poultry producers (ADAM). Various methods were used for data collection and reporting, including interviews, surveys, group discussions, field visits with interactive meetings on the functioning of the vet drugs market, the use of AB by poultry producers, the involvement of the veterinary profession and authorities in the management of the risk of AMR.

Our study highlights that poultry production in Mozambique is based on a single production system which is highly-dependant on AB to circumvent the low quality of feed and one-day chicks commercialized in the country. AB are used as a quick fix measure to compensate the lack of adequate hygiene and biosecurity measures as well as the shortage of competent technical support by veterinarians. Moreover, our study of the vet drugs market (including an exhaustive inventory of the circulating veterinary drugs), fuelled the MADER with much-needed information that contributes for updating and revising regulatory tools such as the “National Veterinary Formulary”, and the “National Registration for Veterinary Drugs”.

Events

Important events:

- One-week field trip to La Reunion (France) for 10 Mozambican stakeholders, for experiences sharing on AMR risk management with French poultry farmers and agriculture authorities.
- Participation to two documentaries related to the trip to La Reunion by a regional TV channel;
- One-day workshop during World AMR Awareness Week (>100 participants);
- Project coordinator participation in regular meetings of the Inter-ministerial AMR Committee (2021-2023);
- Multistakeholder meetings with local representatives of EU, WHO, FAO, WOAH Focal Point, MADER, ADAM, the Order of Veterinarians and the French Embassy;
- Academic seminars at the Veterinary Faculty and Faculty of Art and Social Sciences, Eduardo Mondlane University for results sharing;
- Partial support for the participation of one researcher to an AMR Conference and Course, in France.



A multi-stakeholder initiative for a more prudent use of antibiotics in the Poultry Sector in Mozambique

This multi-stakeholder initiative gathered a dozen participants from 4 types of organisations: the Mozambican Ministry of Agriculture and Rural Development (MADER), Association of poultry farmers (ADAM), University Eduardo Mondlane (Faculties of Veterinary Sciences, and of arts and social sciences) and Cirad (French research institute). From October 2019, 5 meetings have been organised and also larger events have taken place, involving various other stakeholders (students, farmers, veterinarians, veterinary drugs sellers, policy makers…). This process is still ongoing.

Coordinators	Carlos Cuinhane, Cristiano Macuamule & Muriel Figuié
Sector	Poultry sector
Animal	Broilers

The strategy tested in the Living Lab

The global objective of the Mozambican multistakeholder initiative was to influence the national policies on AMR in the livestock sector. Different strategies were implemented: research (surveys with farmers, vets, drugs sellers; drugs market analysis, 2020-2023), events for the AMR awareness week (2022), international field trip to La Reunion (2022), training (quantifying AB use, 2021), and regular meetings with the national committee on AMR. Some actions are still in progress, such as sharing our research results (on AMU by poultry farmers, and on drugs market) with the national committee on AMR; promoting exchanges of experiences with French farmers involved in AMU reduction in La Reunion; and promoting debate between authorities, farmers, vets and drugs sellers on the vet drugs legislation and other issues (during the awareness week). The aim is to promote, through the definition of a set of Best Practices Guidelines, alternatives to the on-going and rapid process of industrialisation of the poultry sector: this process relies on a growing use of AB and is supported by part of the national agricultural policies and the agricultural inputs sectors (chicks, drugs and feed sellers).

The road to implementation

The multi-stakeholder initiative focused on the necessity of changes in the systems and structures beyond the farms, instead of focusing only on farmers levels. The first meeting was the kick-off meeting of the ROADMAP project in Mozambique (November 2019). The following meeting and actions mainly focused on codesigning research activities and sharing and discussing the results. Our process was slowed down by the Covid-19 context and the low mobilisation of the vet drugs sector. The next step is to build alliances to support the development of less ABdependant poultry production systems. The second step is to support a regulation of access to AB without compromising the access to vet drugs which is limited for the majority of farmers in rural areas.

"It is a huge challenge to manage AMR in a country where there is an ongoing unregulated process of modernization of the agricultural sector, relying on an increasing use of industrial inputs such as antibiotics. The issue of AMR needs to be addressed not only as a One Health issue but as an agroecological one."

The impact created by the Living Lab

- AMU: The ROADMAP Mozambican collective action created a community of stakeholders (practitioners -farmers, vets-, policy makers, researchers). This proximity made easier access to data, and share of information and research results. This multistakeholder initiative contributed to build a shared diagnosis of the situation in the Mozambican poultry and vet drugs sectors. This diagnosis can influence the decision markers: for example, data produced on AB markets contributed to support decisions taken by the Ministry of Agriculture on drugs imports.
- Animal Health and agroecological transition: This multistakeholder community was strengthened during the field trip organized in La Reunion. Moreover, during this field trip, the group was able to set the basis for potential collaboration with the directorate of Agriculture in La Reunion (DAAF) to support a 5 years training program for agroecological production systems in Mozambican poultry sector.
- A One Health approach of AMR has been strengthened by our multistakeholder initiative since our group is active in raising the issue in relation to the animal sector in the mostly human health sector National AMR committee.

CHALLENGES

- Systemic changes are needed to shift towards agroecological production systems, but require long lasting intervention, and the mobilization of a more diverse and larger number of stakeholders.
- Technicians and veterinarians are not in enough numbers to support farmers towards this shift.
- The actors of the poultry sectors are influential but have no interest in reducing AB use.

SUCCESSES

- This initiative created a unique community of stakeholders involved in managing AMR in the Mozambican livestock sector.
- Members of this initiative have been invited as permanent members of the National AMR Committee, based on their expertise built in the ROADMAP project.
- Graduate and postgraduate students completed their training at Eduardo Mondlane University.

SPAIN

Overview

Even though Spain has neither developed a specific case study nor a living lab within the ROADMAP project measures need to be taken by all sectors of government and society towards antimicrobial resistance as an increasing threat.

The National Plan against Antimicrobial Resistance (PRAN) is a strategic and action plan whose objective is to reduce the risk of selection and dissemination of antibiotic resistance and, consequently, to reduce the impact of this problem on human and animal health, preserving the effectiveness of existing antibiotics in a sustainable way. This strategy is necessary because isolated efforts by different sectors are not sufficient to tackle the problem of resistance.

It is coordinated by the Spanish Agency for Medicines and Health Products (AEMPS) and has recently published a summary of the main priorities identified in the different sectors: aquaculture, rabbit farming, beekeeping, cattle, dogs and cats, sheep and goats, chickens and turkeys, laying hens, pigs, bees and horses. The document responds to the demands of the sector and has been prioritised according to the most urgent problems such as respiratory infections, red mite infestations or cestode infestations focus on laying hens, whilst rotavirus diarrhoea in piglets, swine dysentery or neonatal diarrhoea for pigs.

The PRAN works through six strategic lines of action. All of them are based on the One Health concept, which recognises that human health, animal health and the environment are intertwined. The contribution of health and environmental professionals in the different areas of work is a key element.

The recent appearance in Spain of cases of avian influenza with a high mortality rate in mammals, which are generating the logical concern among the international scientific community, is clear proof of the close relationship between animal health, human health and the environment, which makes it necessary to reinforce health policies based on the One Health concept.

Biosecurity, hygiene of facilities, animal management, surveillance plans, early detection of diseases or vaccination programmes as some of the most effective measures highlighted by the Veterinary College Organisation (OCV) to prevent the emergence of diseases and to guarantee the health and welfare of animals on farms, which depends on the joint work of farmers and veterinary services.

Some interesting figures from the Spanish context are:

- National consumption of antibiotics fell by 25.5% in human health and 62.5% in animal health between 2014 and 2021.
- Spanish production represents 22% in the pig sector and 9% in the bovine sector compared to Europe, according to Eurostat.

RESPONSIBLE PARTNER

FEUGA

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Events

Important events:

- On the 9th and 10th of June 2021, FEUGA organised an online conference framed in the European Green Week under the title “Zero pollution society: citizens & industry to climb on a circular strategy” where ROADMAP was presented to potential stakeholders. Both national and European projects shared the stage to show their contribution to the objective set by the European Commission on achieving zero pollution. The majority of the participants were veterinarians, technicians and journalists, who identified the main barriers to achieve AMU reduction as economic issues with 86% and political reasons with 57%. Alternatives emerged as prevention and animal welfare, and participants identified Sweden and Denmark as countries with the least antibiotic use versus Italy and Great Britain as the most abusive. The participants shared that for the future, they would like to have more direct, personal training and discussions about the project.
- Between 25th to 29th October 2021, FEUGA organised an online match-making event bringing together companies, researchers, universities, investors, consulting firms from different European countries and abroad under the title “Galicia Innovation Days- Towards Horizon Europe”. On 27 October, ROADMAP held a stakeholder meeting towards antimicrobial use reduction.
- Va de Agro: the big event for co-innovation in the agri-food and forestry sector, was a national event focused on agricultural projects including operational groups and pilot projects at a national scale and European projects. 16 projects participated in the round table and up to 33 projects in the exhibition area. It was celebrated on person on the 8th September 2022 at the FEUGA´s venues in Santiago de Compostela and attended by more than 130 people.
- Related to the One Health strategy, ROADMAP representatives from Spain attend the RIES21 event, a meeting forum for the main actors in the public and private and socio-health stakeholders from the public and private sectors at European level, in collaboration with the ECHAlliance network of health ecosystems network ECHAlliance. ROADMAP project was displayed on a stand and a video were main project objetives were showed.

TRAININGS

After three years analysing the socio-economic drivers of **Antimicrobial Use (AMU)**, developing tailored strategies for change and proposing transition scenarios in diverse farm animal production systems in Europe and low- and middle-income countries the project launched training activities addressed to different targets to ensure acceptability of AMU change.

4 Training modules to update knowledge

Training workshops were organised from January to April 2023 to **target animal health professionals and end-users** to facilitate the uptake of the integrated strategies by using the material generated within the project through case studies and living labs.

Stable schools as a participatory method to work towards reduced AMU at farm level | 17th of January 2023

Mette Vaarst (AU-ICROFS) explained the methodology of the so-called 'Stable Schools' which is a farmer-advice-farmer methodology, applied by actors in the Danish and Swiss Living Labs during the ROADMAP project to minimize antibiotic use. It was addressed to advisors and vets interested on working with stable schools.

Living lab methodologies and examples from working in agriculture | 14th of February 2023

Bernadette Oehen (FIBL), Mette Vaarst (AU-ICROFS), Annick Spaans (ZLTO) and Florence Beaugrand (ONIRIS) presented how the Living Lab methodology was used to find ways forward to move towards a more prudent use of antimicrobials in the ROADMAP project in seven countries. It was addressed to researchers in EU projects or people working with living labs.

On-farm multi-actor coaching | 14th of March 2023

By Annick Spaans (ZLTO) and Arthi Amalraj (Ghent University/Ugent) from the NETPOULSAFE Project. This webinar explains the coaching methodology applied to Dutch and Belgian farms during the ROADMAP project to reduce antibiotic use together with the farmer, veterinarian and advisor. It is addressed to advisors and vets interested in coaching as part of their advisory service, and farmers.

Promoting preventive approaches to animal health | 4th of April 2023

Nicolas Fortané (INRAE) highlighted the results of the ROADMAP project regarding the issues faced by the veterinary profession, related to the development of preventive approaches to animal health. It included discussions about the levers and breaks for such a development and proposed to work on identifying the efficient key messages to encourage veterinarians to support and adopt such approaches. This training was addressed to veterinarians.

MINI WEBINARS

Mini webinars are **short pre-recorded hyper-focused video presentations**, direct-to-camera or slides only, that addresses our project top objectives.

A larger impact towards farmers which weren't directly involved in the project will be reached through the dissemination and communication activities, such as these mini webinars series focus on the results on each Work package.

Within this videos ROADMAP ensures effective outreach of the project towards a large community of stakeholders and end-users, and facilitate the exchange of information and knowledge.

WP1: Massimo Canali

Stakeholders' behaviours and strategies towards AMU

WP2 Lee-Ann Sutherland

Identifying actors' motivations

WP3 Mette Vaarst

Co-building levers and incentives

WP4 Bernadette Oehen

Implementing and further development of strategies to reduce AMU

WP5 João Sucena Afonso

Key learnings on the impact of alternatives in livestock and aquaculture production

WP6: Sophie Molia

Creating impact from the assessed strategies

PRACTICE ABSTRACTS

A “practice abstract” is a **short summary** which describes a main information/ recommendation/practice that **can be used by the end-users in their daily practice**.

- “Antibiotic-free labelled poultry meat” UNIBO
- “Antibiotic free labels in the French pig industry” IFIP
- “Antibiotic reduction schemes in the French poultry industry” ITAVI
- "Phytotherapy – A strategy to reduce AMU" FiBL
- "Cow based calf rearing as a strategy to reduce AMU in dairy production" FiBL
- "Changing antimicrobial use in animal production" ICROFS and CIRAD
- "Roadblocks and drivers for a prudent use of antibiotics in the Mozambican poultry sector" CIRAD and UEM
- "Designing good practice guidelines for a prudent use of antibiotics in the poultry sector in Mozambique" CIRAD and University Eduardo Mondlane
- “Mapping of stakeholders of veterinary medicine products’ value chain to analyze their interactions and position regarding changes in AMU policy in Vietnam” CIRAD and UMR ASTRE
- "Improving veterinarian's knowledge of animal husbandry in organic agriculture in Switzerland" FiBL
- "Why are antibiotics used in the flemish prok and white veal industry" ILVO and WUR
- "Succesfull weaning of piglets — without AMU" FiBL
- "Importação de medicamentos veterinários em Moçambique 2018-2020" CIRAD and UEM

“ Communicating about projects, activities and results is much easier through the use of a common format. The EIP-AGRI common format facilitates knowledge flows on innovative and practice-oriented projects from the start till the end of the project. The use of this format also enables farmers, advisors, researchers and all other actors across the EU to contact each other."

↳ EIP-AGRI
https://ec.europa.eu/eip/agriculture/en/eip-agri-common-format

POLICY BRIEFS

A policy brief consists on a **concise summary of an issue**. It grants policy options to deal with said problem and also brings recommendations on the best option to resolve it.

The policy brief has a clear structure, it brings out the context and the importance of the issue as an introduction. Then, it shows the flaws in the current policy options and ends up with some policy recommendations (knowledge transfer, dissemination activities, homogenising standards and regulations).

ROADMAP developed several policy briefs that addressed multiple issues the project encountered.

"How to promote preventive approaches in veterinary medicine?" Nicolas Fortané, Clémentine Comer, Joséphine Eberhart (INRAE)

"How to enable farmers to reduce antimicrobial use?" Lee-Ann Sutherland, Orla Shortall (The James Hutton Institute), Gareth Enticott (Cardiff University)

"Learnings from 12 Living Labs" Mette Vaarst (Aarhus University), Bernadette Oehen (FiBL), Annick Spaans (ZLTO), Florence Bonnet-Beaugrand (INRAE)

"How to consider impact when planning interventions to improve AMU" Sophie Molia (CIRAD), Merete Studnitz (ICROFS)

"Intensive Danish pig farming faces structural lock-ins for achieving a prudent AMU" Hanne Kongsted (AU), Merete Studnitz (ICROFS)

"How to meet the public health challenge of antibiotic resistance in a context of rapid intensification of poultry production" Muriel Figué (CIRAD), Cristiano Macuamule, Carlos Cuinhane (UEM)

"Improving the use of antimicrobials in the French pig and poultry sectors" Sophie Molia (CIRAD) Christian Ducrot (INRAE), Mathilde Paul (ENVT), Catherine Belloc (ONIRIS Nantes)

"Recommendations from the Danish Living Lab on AMU in cows and calves from dairy herds" Mette Vaarst, Line Kollerup (AU)

Popular articles:

"Changing antimicrobial use in animal production "

Merete Studnitz (ICROFS-AU), Sophie Molia (CIRAD), Marie-Jeanne Guenin (CIRAD)

"Create your own Living Lab to meet complex challenges in the agricultural sector "

Annick Spaans (ZLTO), Bernadette Oehen (FiBL), Mette Vaarts (AU), Florence Beaugrand (INRAE)

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