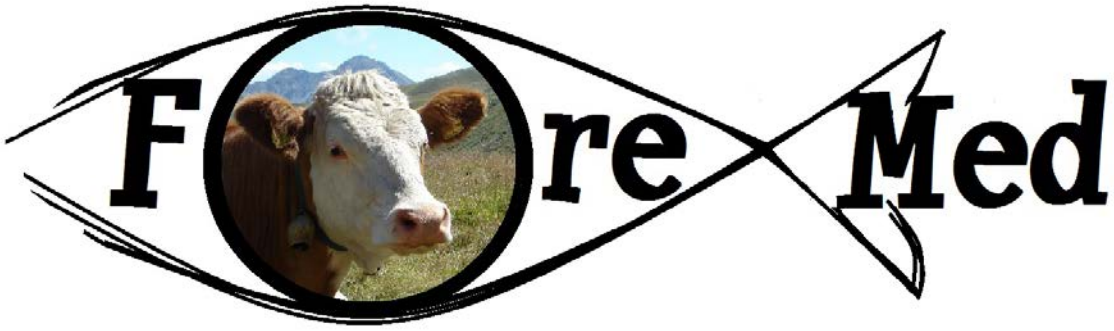
June 2014



ITALIAN MINISTRY OF HEALTH

FORE-MED REPORT

ANIMAL HEALTH FORESIGHT FOR THE MEDITERRANEAN

"The best way to predict your future is to create it"
(A. Lincoln)

Ministero della Salute

In collaboration with:

Istituto Zooprofilattico Sperimentale delle Regioni Lazio eToscana

M. Bagni, R. Zilli, S. Messori, V. Mariano

Authors

Marina Bagni[1]
Romano Zilli[2]
Stefano Messori[2]
Valeria Mariano[3]

[1]Ministero della Salute,
Segretariato Generale,
Ufficio II,
Via Giorgio Ribotta, 5- 0144
Roma,
Italy

[2]Istituto Zooprofilattico
Sperimentale delle Regioni
Lazio e Toscana, Ufficio Ricerca,
Sviluppo e Cooperazione
Internazionale,
via Appia Nuova, 1411- 0178
Ciampino, Roma,
Italy

[3]Istituto Zooprofilattico
Sperimentale delle Regioni
Lazio e Toscana, Laboratorio di
Diagnostica, Sezione di
Grosseto, Via Europa, 30-
58100 Grosseto, Italy

Acknowledgments

The authors wish to thank the following experts and institutions for their participation in the different steps of the project:

Last Name	Name	Institution/Company
Alborali	Giovanni Loris	IZS LER
Alessandrini	Barbara	IZS AM
Aleandri	Riccardo	CRA
Alonso-Hearn	Marta	Ikertzaile Produccion y Sanidad Animal/Animalia Ekoizpena eta Osasun
Amadori	Massimo	IZS LER
Aranaz	Alicia	VISAVET Health Surveillance Centre, Complutense University of Madrid
Arcangeli	Giuseppe	IZS VE
Autorino	Gianluca	IZS LT
Bagni	Marina	Ministry of Health (Italy)
Baldi	Loredana	IZS ME
Battisti	Antonio	IZS LT
Blanco	Jorge	Grupo Leche Pascual
Bossù	Teresa	IZS LT
Bozzetta	Elena	IZS PLV
Brener	Yakov	Kimron Institute
Briones	Victor	INIA
Busani	Luca	ISS
Buttazzoni	Luca	CRA
Calderone	Davide	ASSICA
Calistri	Paolo	IZS AM
Capoccioni	Fabrizio	Ministry of Agriculture (Italy)
Caracappa	Santo	IZS SI
Catania	Salvatore	IZS VE
Catarci	Pierfrancesco	Ministry of Health (Italy)
Chiavacci	Laura	IZS PLV
Corona	Cristiano	IZS PLV
Crespi	Valerio	FAO
Dayhum	Abdunaser	Director of National Centre of Animal health Libya
Deliberato	Claudio	IZS LT
Di Iacovo	Francesco	University of Pisa
Di Nocera	Fabio	IZS LT
Duranti	Anna	IZS UM
Esposito	Mauro	IZS ME
Ekateriniadou	Loukia	NAGREF
Esposito	Mauro	IZS ME
Fasanella	Antonio	IZS PB
Faye	Bernard	CIRAD
Ferrentino	Vincenzo	Ministry of Agriculture (Italy)
Ferri	Gaetana	Ministry of Health (Italy)
Formato	Giovanni	IZS LT
García González	Julio Carlos	Camar Agroalimentaria S.L.

Gonzalez	Antonio Bulnes	INIA
Gualdi	Silvio	CMCC
Guercio	Annalisa	IZS SI
Haddad	Nadia	ENVA
Hamilton	Keith	OIE
Higuera	Miguel	Anprogapor
Lancelot	Renaud	CIRAD
Latini	Mario	IZS UM
Lavazza	Antonio	IZS LER
Le Poder	Sophie	AFSSA-INRA-ENVA
Louza	Armando	FMV UTL
Lovatelli	Alessandro	FAO
Maresca	Carmen	IZS UM
Mariano	Valeria	IZS LT
Masala	Giovanna	IZS SA
Masci	Alberto	Ministry of Agriculture (Italy)
Massa	Fabio	GFCM FAO
Meloni	Daniela	IZS PLV
Merialdi	Giuseppe	IZS LER
Messori	Stefano	IZS LT
Miarelli	Maria	CRA
Moioli	Bianca	CRA
Morrow	Alex	DEFRA
Mulatti	Paolo	IZS VE
Mutinelli	Franco	IZS VE
Nonno	Romolo	ISS
O'Brien	Declan	IFAH
Pasquali	Paolo	ISS
Peletto	Simone	IZS PLV
Petrini	Antonio	OIE/IZS AM
Prearo	Marino	IZS PLV
Reantaso	Melba	FAO
Rolesu	Sandro	IZS SA
Santini	Nicola	Ministry of Health (Italy)
Savini	Giovanni	IZS AM
Scaramozzino	Paola	IZS LT
Scicluna	Maria Teresa	IZS LT
Tabbaa	Darem	Faculty of Veterinary Medicine Al Baath University
Torina	Alessandra	IZS SI
Troiano	Pasquale	IZS PB
Vaccari	Gabriele	ISS
Vitale	Fabrizio	IZS SI
Zecconi	Alfonso	University of Milan
Zientara	Stéphan	AFSSA
Zilli	Romano	IZS LT

A special thanks to:
ABMPhoto for creating the Logo, to CRA for hosting, on the 20th-21st March 2014 in Rome, the Workshop "*Costruzione di una SRA in Sanità Animale per il Mediterraneo*" (*Setting of a SRA for animal health in the Mediterranean*) and to the institutional communication department of IZS AM for editing and printing support.

Summary

List of Figures

List of Tables

Glossary

AFSSA	*Agence française de sécurité sanitaire des aliments*
ANPROGAPOR	*Asociación Nacional de Productores de Ganado Porcino*
ASSICA	*Associazione Industriali delle Carni e dei Salumi*
CIRAD	*Centre de coopération internationale en recherche agronomique pour le développement*
CMCC	*European-Mediterranean Centre for Climate Change*
CRA	*Centre for Research on Agronomics*
CVO	*Chief Veterinary Officer*
DEFRA	*Department for Environment, Food and Rural Affairs*
EMIDA	*Emerging and Major Infectious Disease of Livestock project*
ENVA	*École nationale vétérinaire d'Alfort*
ERA	*European Research Area*
EU	*European Union*
FAO	*Food and Agriculture Organisation*
FORE-Med	*Animal health foresight for the Mediterranean*
IFAH	*International Animal Health Organisation*
INCO	*International Cooperation*
INIA	*Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria*
INRA	*Institut National de la Recherche Agronomique*
ISS	*High Institute for Health*
IZS AM	*Istituto Zooprofilattico Sperimentale dell'Abruzzo e del Molise*
IZS LER	*Istituto Zooprofilattico Sperimentale della Lombardia e dell'Emilia Romagna*
IZS LT	*Istituto Zooprofilattico Sperimentale delle regioni Lazio e Toscana*
IZS ME	*Istituto Zooprofilattico Sperimentale del Mezzogiorno*
IZS PB	*Istituto Zooprofilattico Sperimentale di Puglia e Basilicata*
IZS PLV	*Istituto Zooprofilattico Sperimentale del Piemonte Liguria e Valle d'Aosta*
IZS SA	*Istituto Zooprofilattico Sperimentale della Sardegna*
IZS SI	*Istituto Zooprofilattico Sperimentale della Sicilia*
IZS UM	*Istituto Zooprofilattico Sperimentale dell'Umbria e delle Marche*
IZS VE	*Istituto Zooprofilattico Sperimentale delle Venezie*
JRC	*Joint Research Centre*
NAGREF	*National Agricultural Research Foundation*
NET	*Network*
OIE	*World Organisation for Animal Health*
R&D	*Research and Development*
S&T	*Science and Technology*
SCAR	*Standing Committee Agricultural Research*
SRA	*Strategic Research Agenda*
STAR-IDAZ	*Strategic Alliances for the Coordination of Research on the Major Infectious Diseases of Animal and Zoonoses*
STEEP	*Social, Technological, Economic, Environmental, Political*
UK	*United Kingdom*
USA	*United States of America*

FORE-Med Report

"The ability to lead and to manage strategically is the single most critical ingredient for success"
(Mercer 1991)

The aim of this report is to document the results of the FORE-Med project, a provisional study on research need in the field of animal health and aquaculture carried out in 2014. The project was promoted and financed by the Italian Ministry of Health within those actions addressed to the Internationalisation of animal health research. Scope of the project was the definition, through participative approach, the animal health and aquaculture research needs in the Mediterranean, in order to build a Strategic Research Agenda (SRA) satisfying the sectors' needs and coordinating research activities in the Mediterranean area, guaranteeing a more rational balance of available funding.

The Report presents four Sections:

1) Introduction
2) Methodology
3) Results
4) Discussion and conclusions

Section I: Introduction

The FORE-Med project and its objectives

The FORE-Med (*Foresight project for the Mediterranean area*) is a provisional study promoted by the Italian Ministry of Health with the aim of identifying future challenges on animal health in order to ensure an effective coordination of scientific research on animal health and aquaculture in the Mediterranean.

The provisional studies, or foresight, are acknowledged as useful decisional support tools for the definition of strategies in the public sector (de Lattre-Gasquet, 2006). These studies, in fact, help in identifying problems and opportunities in the field of analysis and support in the identification of intervention options, representing useful implementation and monitoring tools for political strategies (Bhimji, 2009). Foresight is defined as a tool that "provides an approach for making choices in relation to science and technology and for identifying priorities, it offers a mechanism for integrating research opportunities with economic and social needs and thereby linking science and technology more closely with innovation, wealth creation, and enhanced quality of life" (Martin and Johnston, 1999). In particular, provisional studies should be considered as participative and reasoned methods that, through the establishment of a common medium-long term vision among stakeholders, is able to support decision making process in the present and mobilise the necessary strengths to reach a desired future and to lead to a harmonic growth of the system, increasing collaboration and productive efficiency (Becker, 2002).

The need for starting the FORE-Med project was born in the framework of a global alliance for the coordination of research on production animal health and zoonosis, the STAR-IDAZ project. This study, among other activities, collects provisional studies from different geographical areas across the whole world with the aim of defining priorities for animal health and defines a global Strategic Research Agenda on animal health (delivery foreseen by the end of 2014). The results of the FORE-Med exercise will be presented, together with the results of the exercises from the other regions, at the final meeting of the STAR-IDAZ foresight group on June 2014 in Moscow, becoming part of the global strategy.

STAR-IDAZ is an European project funded under the 7th Framework Programme of the European Union (http://ec.europa.eu/research/fp7/). This project was launched bearing in mind that, since the main livestock diseases and zoonosis are a global concern, global strategies should be applied to tackle them. The STAR-IDAZ aim was to "improve coordination of research activities on the major infectious diseases of livestock and zoonoses so as to hasten the delivery of improved control methods". In particular, it aimed to enhance, on a global level, what has been started under two latter projects, initiated by the *Collaborative Working Group* (*CWG*) on animal health and welfare of the *Standing Committee on Agricultural Research (SCAR*): the EMIDA ERA-NET (*Emerging and Major Infectious Disease of Livestock- European Area Research Network*) project and some specific INCO-NET (*International Cooperation Network*) actions. The EMIDA project faced the need of having a participative approach through the definition of a SRA on animal health. The outcome of the project (the EMIDA SRA) highlighted among its main conclusions that a research agenda is strictly linked to the territory where it has been built and to other regional influences. Then, the insight of the produced SRA was relative, and it appeared as one of the main limit of the agenda itself.

The main FORE-Med objectives are:

- To identify and categorise factors and trends in the field of animal health being specific for the Mediterranean area;
- To plan plausible future scenarios in the field of animal health and aquaculture;
- To suggest research strategies aiming at the control, prevention or mitigation of animal health issues and zoonosis in particular;

- To establish a network of expert across the Mediterranean area;
- To test innovative methodologies for the implementation of research strategies in the animal health field in the Mediterranean area.

What are the reasons to conduct a *foresight* in the Mediterranean

The Mediterranean is the largest half-closed sea and is the joining point between Europe, Africa and Asia (Zenetos et al. 2013). The word 'Mediterranean' comes from the Latin '*Mediterraneus*', meaning 'between lands' (Agropolis international, 2011). The Mediterranean represents the juncture of three continents and more than 20 different countries, each one of those divided into several regions. This favours a great mixing of people belonging to different populations. Also, a variety of different climate co-exists in the area, where six of the twelve major climatic variations can be found at a relatively small distance (Mediterranean *sensu stricto*; maritime; humid and dry continental; tropical steppe; desert), alternating and mixing together. Different climate areas have both different populations and micro/macro flora inhabiting them.

Although the Mediterranean climate *sensu stricto* is known as mild and has four clearly defined seasons characterised by warm and dry summers with mild and rainy winters (http://beta.cmimarseille.org), this is starting to change. Climatic variation associated to extreme weather events (e.g. flooding, heavy rains) are getting increasingly frequent (Zenetos et al. 2013), as well as the exacerbation of seasonal conditions (e.g. extremely warm summer).

The Mediterranean is an open territory, crossroads of several migration patterns across the centuries. Together with human population, these movements introduced domestic animals. Some wild animals also followed these migrations, searching for food sources. Seasonal migration of several bird species take place every year, with a number of epidemiological implications. The area hosts nowadays about 450 million people, belonging to a wide range of cultures as well as different environmental background. All of these populations are linked not only by geographical proximity but also because of demographic movements, economy globalisation, transport and communication routes and, last but not least, climatic changes (Zenetos et al. 2013, Agropolis international, 2011).

Wide differences are present for what concern zootechnical practices in the area. If on one side familiar farming is widely diffused, entailing high human-animal relationship and increasing the risk for zoonosis diffusion, on the other side intensive farming and genetic selection for productivity decreased these bond, increasing disease susceptibility. Familiar slaughtering is widespread in some sub-areas, inducing circulation of food products without proper veterinary control. Offal are often fed to domestic carnivores roaming around farming places and often interacting with people, including children, exposing them to disease risk. The professional training of zootechnical workers and sanitary education of consumers are lacking, increasing the population to infection risks. The opposite situation can be found in the highly urbanised and industrialised areas, where the population, because of lack of contacts with the environment, has lower immunity defences as compared to the rural one.

The Mediterranean basin might be especially vulnerable to the rise of new pathogens, due to the acute consequences global changes will have in this key intercontinental interface region (Vittecoq et al., 2014). The risk that infectious diseases may pass national borders is well known and particularly relevant in areas, such as the Mediterranean one, characterised by high ecological similarities and huge movements of humans, animals and product of animal origin. A disease outbreak in one country becomes than an issue for all the neighbouring ones, making the coordination of human and veterinary health services of paramount importance. Moreover, on the veterinary side, these new threats represent challenges for a number of different disciplines and then require the cooperation of various organisations together. An holistic approach is therefore necessary to overcome barriers among the different disciplines and

organisations. This approach should involve a methodology being easily adaptable to the continuous changes of the society and targeting the problems innovatively, always adapting to new progresses in knowledge and technology.

A foresight is usually carried out when a Country, a region or an organisation are requested to take long-term decision (e.g. to develop programmes, to identify research priorities, to plan funding allocation, to take strategic decisions) or to face new challenges (e.g. to manage political or economic transition periods, to get to a long-term increase of competitiveness, to face environmental changes, to face demographic changes) (JRC, 2007).

In the last decade, the use of foresight exercise as participative approach is increasing worldwide to support political decisions in the field of innovation and R&D. This witnesses the awareness of the appropriateness, or even of the necessity, of involving all stakeholders in the formulation of policies both in the public and in the S&T sectors, where science and technological innovation have to face economic, environmental and social factors (Becker, 2002; Arnaldi, 2012).

The main reasons for conducting a foresight are (JRC, 2007):

1. to inform politicians on medium-long term developmental needs of the sector and on the best way of implementing them in the present;
2. to build a network, bringing together and stimulating confrontation among a number of experts in various sectors, hence creating intra-sectorial collaborations;
3. to develop competencies: the confrontation among different experts determines the creation of new competencies being useful to the global vision of the issue and builds capacities to change one's approach toward common needs;
4. to build a strategic vision and a common sense of belonging to a vision and to a commitment to the reaching of set common goals.

Moreover, the foresight carried out through participative approach develops a common conscience on the existence of different possible future and on the possibility of influencing the future through today's choices, helping a proactive approach to future problem solving.

It is also true that participative exercises can represent a social learning occasion, being stimulated also by the different opinions and points of view emerging from the discussions (Arnaldi 2012). In fact, this process stimulates participants to argument their own positions and opinions, to consider them critically and, eventually, to change them following debate and pair confrontation. In particular, learning processes stimulated by participative experiences might concern not only solutions to a given problem, but also a redefinition of the problem itself (Genus, 2006; Arnaldi, 2012). Foresight, if well managed, can represent optimal network building processes, since they encourage communication, collaboration and opinion exchange among individuals coming from different organisations, sectors and between private and public bodies (Becker 2002).

Main phases and techniques of a foresight applied to political choices

The development of a provisional study shall start with the definition of the scope, the setting of the period covered by the foresight exercise and the decision of an appropriate methodology, being fit for purpose and adapted to the available capacities, time and budget availability. The "*For-learn*[1]*"* platform developed a questionnaire very useful for setting the initial phases of a foresight (Annex I).

[1] Available at http://www.foresight-platform.eu/community/forlearn/

Once these elements are defined, the provisional study can start. Any foresight is usually build of three phases (Figure 1): *analysis* of the current situation, *formulation* of possible future scenarios and *implementation* of strategic choices (JRC, 2007; Horizon Scanning Centre, 2008).

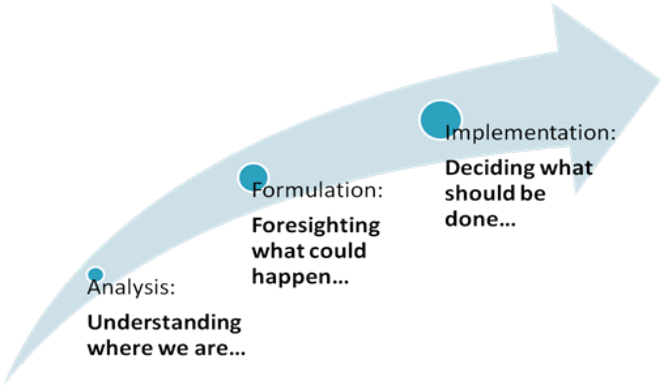


Figure 1: The three main phases of a provisional study.

Each of those phases can be carried out using one or more different techniques. In Table 1 some of the possible options are listed.

Table 1: Main techniques to be applied for each foresight phase (adapted from Horizon Scanning Centre, 2008).

Analysis	Formulation	Implementation
Causal layered analysis	Plausibility matrix	Backcasting
Delphi	Dialogue	Reverse engineering
Driver analysis	Gaming	Roadmaps
Folksonomies	Modelling and simulation	The Fifth scenario
Horizon scanning	Narrative	Windtunnelling
Issues trees	Scenarios	
Review of abstracts	Visioning	
Seven questions	Backcasting	
State of science reviews	Reverse engineering	
STEEP	Roadmaps	
Systems maps	The Fifth scenario	
Trend analysis	Windtunnelling.	
Plausibility matrix		

Those techniques can be combined in order to obtain the methodology being the most fit for the given purpose of the study. Figure 2 shows a diagram with hypothetical links between the techniques in the different phases and policy processes (JRC, 2007; Bhimji, 2009).

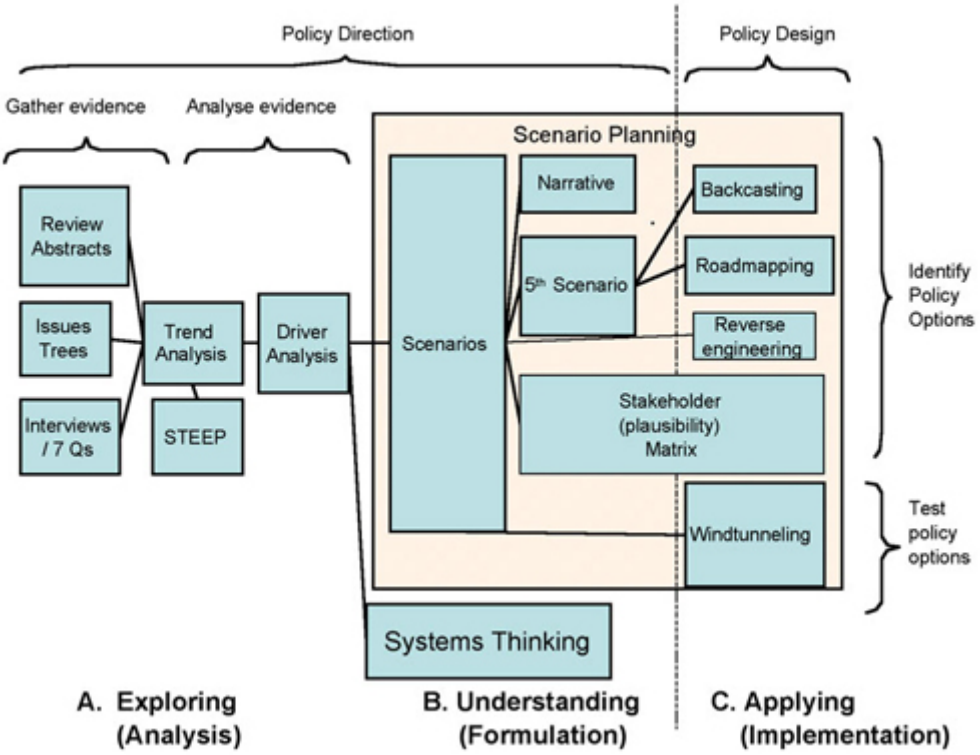


Figure 2: Breakdown of possible combinations of techniques for each phase (Bhimji, 2009).

This diagram highlights how the different phases of a foresight can support policy decisions. The identification of political choices represents only the end of a process that should be based on scientific evidences (concerning the field of competence) that can lead to the development of a determined political approach. The result of this new policy should be tested as well, in order to evaluate the appropriateness of the selected choices. The phases of analysis of the current situation and formulation of possible options in a foresight might represent appropriate tools to select an appropriate political direction. The last phase of the foresight, the implementation of strategic choices, can be used to identify appropriate policy options.

The growing awareness of the usefulness of the foresight exercises in policy processes in the scientific and technological sectors already induced various countries to use dedicated resources to the development of units dedicated to provisional activities. In Europe, the inside the "*Science and technology foresight*" unit was built, inside the ERA (European Research Area), with the aim of promoting and integrating foresight at all levels.

Section II: Methodology

The FORE-Med project was structured following the three main phases of any foresight study:

1) analysis of the current situation;
2) *formulation* of possible future scenarios;
3) *implementation* of strategic choices.

The analysis of the current situation was realised applying various techniques. The individuation of main drivers for the Mediterranean area was performed through bibliographical research and dedicated '7 questions' interviews to experts in different sectors, being active in the area, in a way of having covered all relevant STEEP aspects (Social, Technological, Economic, Environmental, and Political). The selected drivers were ranked through an on-line questionnaire, sent to 133 key experts in the Mediterranean area, in order to make the selection of the 2 most relevant and uncertain drivers for the area.

The formulation of possible (and probable) future scenarios was based on the two selected drivers. During a workshop, help in Rome on the 20-21st March 2014, the two drivers were used as Cartesian axis for the scenario building of Mediterranean 2030, originating four quarters, each being characterised by a combination of high/low variability of each of the two drivers identified. Then, participants were divided into groups and the four scenarios were build using a participative approach. Future plausible and favourable factors for 2030 were extracted from the four scenarios. Those were used to build a 5th scenario, being the most plausible and having an efficient Animal Health system.

The implementation of the strategic choices phase was started in the second day of the workshop. There, a backcasting from the 5th scenario was carried out and getting to the development of different intervention options that were translated into research areas by the various groups dedicated to animal health and aquaculture.

The specific objectives of the implemented methodology were:

- to promote mind openness toward possible future events;
- to favour dialogue and knowledge sharing between specialist in a number of different disciplines;
- to develop common knowledge on the main driving forces and uncertainties that contribute to model the future in the animal health sector;
- to build possible scenarios that represents challenges for the sector in 2030;
- to identify intervention options being useful to plan animal health research.

Phase 1: Analysis of the current situation: Mediterranean area scanning and *driver* identification

Before developing future strategies for animal health research in the Mediterranean it was fundamental to analyse the current situation, identifying the *trends* in the sector and the forces (*drivers*) that moves them. This was realised applying a multi-step approach. Firstly, the driver identification was performed.

Drivers can be classified in:

1. *Micro-environmental*: specific forces acting on the sector and having a direct influence on it (e.g. infectious disease evolution).
2. *Macro-environmental*: broader and more global forces impacting the sector indirectly (e.g. social, economic or environmental factors).

The identification of these drivers, both the macro- and micro-environmental ones, is fundamental to carry out a provisional study. In the FORE-Med, a bibliographic research on existing drivers on animal health, being already identified in other areas, was performed. Then, they were contextualised to the Mediterranean area through interviews to selected experts in relevant sectors.

Definition of the study area

At geo-political level, the Mediterranean basin comprehends all countries that overlooks it (Figure 3) and can be shared in three macro-areas (Table 2): Northern Mediterranean, Eastern Mediterranean and Southern Mediterranean.

Figure 3: Map of Mediterranean area and belonging countries.

Table 2: Mediterranean macro-areas and countries.

Northern Mediterranean (European)

- Albania
- Bosnia-Herzegovina
- Cyprus
- Croatia
- France
- Greece
- Italy
- Malta
- Montenegro
- Slovenia
- Spain

Eastern Mediterranean (Asian)

- Israel
- Lebanon
- Syria
- Turkey

Southern Mediterranean (African)

- Algeria
- Egypt
- Libya
- Morocco
- Tunisia

Bibliographical research

The bibliographic research consisted of a both a general web-browsing to detect innovative trends and drivers and of an analysis of the processes applied in other foresights in the sector:

1. Agriculture 2013 Foresight Study. Objectives and Methodology. https://www6.paris.inra.fr/depe/S-informer/Documents-in-English/Foresight (INRA 2008)
2. Animal health foresight project: Minneapolis Scenarios Workshop Report http://www.foresightfordevelopment.org/sobipro/download-file/46-535/54 (Spring 2005)
3. APEC project: Road-mapping converging technologies to combat emerging infectious diseases.http://publications.apec.org/publication-detail.php?pub_id=117 (APEC 2008)
4. FORE-CAN project: Healthy Animals | Healthy Future 2025. http://www.star-idaz.net/wp-content/uploads/2013/02/Fore-CAN-Healthy-final-e1.pdf (CFIA 2011)
5. Foresight infectious diseases china project: A novel approach to anticipating future trends in risk of infectious diseases in China: Methodology and results from an initial application http://www.eurosurveillance.org/ViewArticle.aspx?ArticleId=19261 (Nicoll, Huang et al. 2009)

6. OECD: Health Biotechnology to 2030. http://www.oecd.org/futures/long-termtechnologicalsocietalchallenges/40922867.pdf (Tait, Wield et al. 2007)

Expert interviews: STEEP and '7 questions'

The '7 questions' interview methodology was applied to find contextualised information about the study area from different sectors in an effective and fast way (Horizon Scanning Centre 2008). This technique consists of in-depth, one-on-one interviews with each of the selected participants belonging to different organisations. The information and insights gained from these conversations is much richer than what would be obtained through group interviews since the involvement of each participants is much higher and they are normally very much eager speaking about the future in their own sector, since it is linked to their own professional future (Nyewe, 2011). This method is usually applied to ease the involvement of the respondents in expressing their own perception and thoughts about the future, and offering them the opportunity of think out loud, gathering past experiences and imaging future scenarios.

In the FORE-Med the 7 questions were delivered to selected exerts in sectors being already considered relevant in the available bibliography and covering all the aspects of the STEEP analysis. This methodology consists of performing an active and structured analysis of a subject taking into consideration five different sectors:

- Social;
- Technological;
- Economical;
- Environmental;
- Political.

Eight experts in the above mentioned sectors were interviewed to gather information on the current situation and on future perspective in the animal health sector. The specialists were selected on the basis of their expertise and contacted by the project coordinator to agree on a suitable date and hour for the interview to be carried out. It allowed to ensure the complete availability of the expert for a given time, avoiding time pressure and allowing a better state of mind during the interview. Phone interviews were selected as the most profitable cost-benefit solution, allowing the interviewing of experts being in different countries across the Mediterranean containing travel costs and time. The questions were structured in order to allow the interview to last between 40 and 80 minutes. The content of the questions was developed to be similar to those of another foresight in animal health, carried out at Campo Grande (Brazil) in the framework of the STAR-IDAZ project, in order to allow, to some extent, an aggregation of the answers (Figure 4). In order to facilitate the free expression of the experts it was decided to guarantee the anonymity of the full interview contents.

The information gathered through the interviews were used to identify trends and drivers in the sector in the Mediterranean being useful to build the possible scenarios and were added to those previously identified in the availed bibliography concerning foresight studies carried out in different geographical areas.

1) Past Changes	Thinking back over the past 10 – 15 years, what changes in your sector have affected animal health in the Mediterranean area (and globally)? What's changed and what drove those changes?
2) Lessons from the Past	Reflecting on past changes, what have been the big "successes" in animal health? Are there lessons to be learned? Are there things we need "to forget"?
3) Current Constraints	What things need to be changed in your sector for the animal health system to be successful in the future? Are there barriers to innovation and change that need to be

	addressed?
4) Challenges	Are there near-term external challenges in your sector facing animal health that could have significant impact on longer-term outcomes?
5) Dark Spot	There is a dark spot on the horizon. It is not here now but could have a major impact on animal health in the Mediterranean area in the future. What is it?
6) Good Future	Suppose you were looking back 10 - 12 years from now and you were telling a story in which the animal health management system had done extremely well. How would the story go? What does a good future look like? What societal developments are needed for that good future to occur?
7) Oracle	The future is unknowable, but suppose you could ask two questions of an oracle who could predict the future, what would you ask about animal health sector?

Figure 4: Seven questions used for the phone interviews to experts in the social, economic, environmental and political sector in the Mediterranean area.

Selection of most uncertain and most relevant *drivers*

The identification of *key drivers* influencing the sector both at macro and micro level is necessary to give a methodological basis to the scenario building exercise. Usually, a number of key drivers between 5 and 10 are considered to be appropriate (JRC, 2007; Horizon Scanning Centre, 2008).

In order to ease the scenario building phase, it was then important to select two main drivers among the selected ones that would have represented the axis of the scenarios. The criteria used for the selection of the two drivers vary depending on the purpose of the study and on the foresight period to be investigated. In particular, two main typology of drivers are selected:

- Highly relevant/lowly uncertain: short period foresights;
- Highly relevant/highly uncertain: medium-long period foresights.

Since the aim of the FORE-Med was the development of a SRA for 2030 (medium-long term foresight), the applied criteria were high relevance and high uncertainty. Although the two selected drivers were then used as the basis for building the scenario, all other drivers were considered in their development in order to ensure the maximum possible degree of completeness and cohesion of the described stories.

On-line questionnaire

The selection of the most relevant and uncertain drivers were performed through an on-line questionnaire. The use of a web tool was thought to be the most effective way of reaching the expected aim, since it allowed to contact an high number of experts in a cheap and fast way. Moreover, this survey allowed data collection in a practical and effective manner, avoiding possible transcription errors during data uploading.

In order to improve the response rate to the maximum possible, the questionnaire recorded the information anonymously and was built in order to allow a fast completion process.

The participants were selected from already existing databases, containing contact information about experts in field of animal health in Mediterranean countries, that were produced with consultation purposes in similar European Union (EU) projects. Other contacts were obtained from the Italian Ministry of Health expert databases. Efforts were made to geographically cover all the Mediterranean area, involving specialists from the Northern, Eastern and Southern parts of the basin. The questionnaire was also send to all those who would have been invited to the scenario building workshop, to facilitate their involvement in the process and to make them familiarise with the drivers that they would have been asked to use during the work.

The questionnaire (Figure 5) was sent to 133 experts around the half of February 2014 giving the experts one month to fill it in. A reminder e-mail was sent two weeks after the on-line publication of the tool, to stimulate response rate. In order to avoid data duplication the survey was built allowing only one access from each computer.

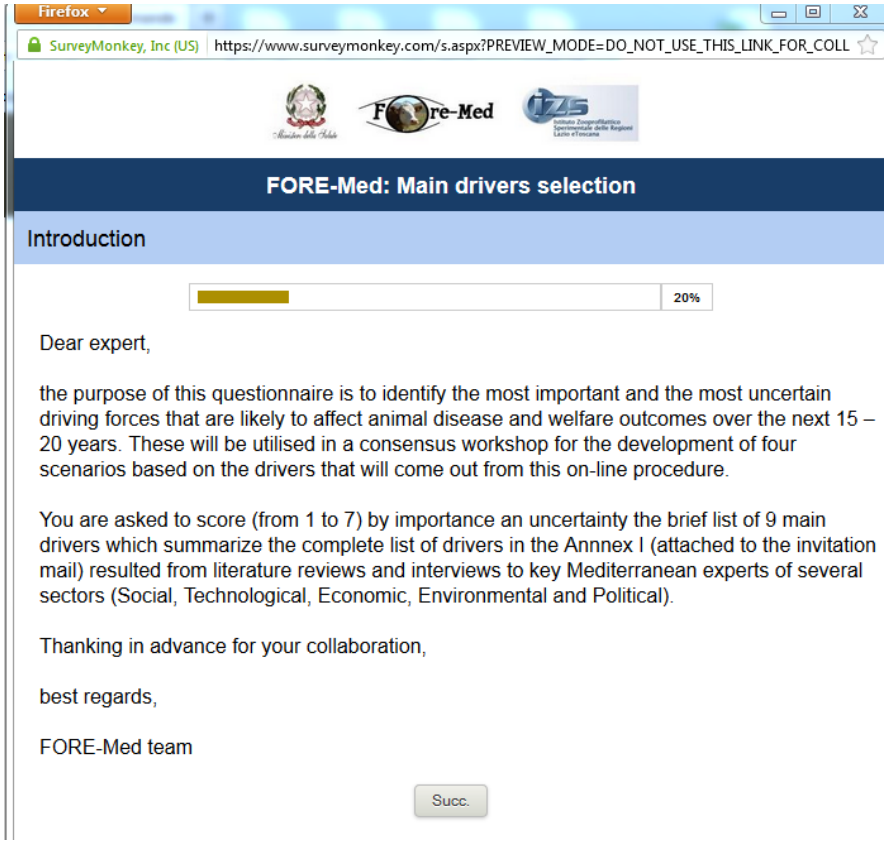
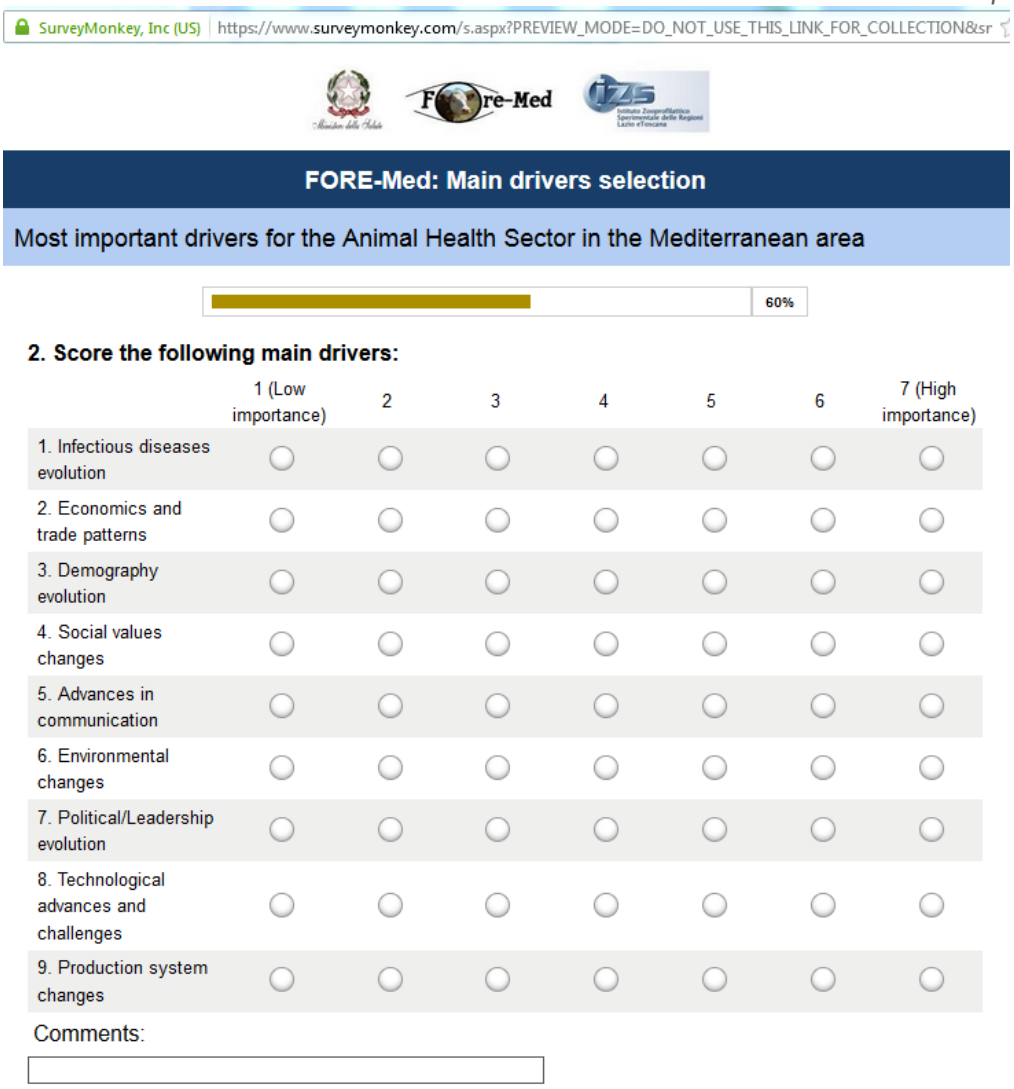


Figure 5: First page of the on line survey with the invitation to the experts.

The experts were asked to score, from 1 to 7, the relevance and uncertainty of each of the key drivers identified in the animal health sector (Figure 6).


SurveyMonkey, Inc (US) https://www.surveymonkey.com/s.aspx?PREVIEW_MODE=DO_NOT_USE_THIS_LINK_FOR_COLLECTION&sr

FORE-Med: Main drivers selection

Most important drivers for the Animal Health Sector in the Mediterranean area

60%

2. Score the following main drivers:

	1 (Low importance)	2	3	4	5	6	7 (High importance)
1. Infectious diseases evolution	○	○	○	○	○	○	○
2. Economics and trade patterns	○	○	○	○	○	○	○
3. Demography evolution	○	○	○	○	○	○	○
4. Social values changes	○	○	○	○	○	○	○
5. Advances in communication	○	○	○	○	○	○	○
6. Environmental changes	○	○	○	○	○	○	○
7. Political/Leadership evolution	○	○	○	○	○	○	○
8. Technological advances and challenges	○	○	○	○	○	○	○
9. Production system changes	○	○	○	○	○	○	○

Comments:

Figure 6: Screenshot of the on-line survey: key drivers relevance ranking.

Phase2: Scenarios' building

A scenario is a 'story' about how the future would possibly evolve in a way of affecting the area of interest. A fundamental aspects of the scenarios is that they deal with uncertainty (UNIDO 2004). The 'story', to be considered a proper scenario must fulfil five conditions: pertinence, coherence, likelihood, importance, and transparency (Durance and Godet, 2010). Scenarios are developed in a way of stimulate imagination and deep thinking on a given sector, creating future visions. Scenarios highlight assumptions and establish truths. They are often implemented in the development and innovation sectors to allow planning on an enterprise or even national and international level (Rialland, 2009).

Scenarios can be built using four main techniques (Horizon Scanning Centre 2008, Rialland, Wold 2009):

1. Descriptive: techniques that foresee the building of scenarios starting from an analysis of the present situation, as an answer to the question "what will happen?"; these helps to imagine possible futures being useful to adapt to changes.
2. Normative: techniques where scenarios are described starting from future expectations and tend to describe "how these futures will be realised?" in order to detail the steps to get to these scenarios.
3. Quantitative: techniques where probabilistic forecast, based on past events, are implemented.

4. Qualitative: intuitive techniques, mainly used as explorative methods since they offer good opportunities of opinion exchange and brainstorming among experts.

Building of the 4 scenarios

In the FORE-Med the technique for building the scenarios was focussed on how different plausible scenarios can be developed and how the different forces are originated and contribute to the development of these futures. A qualitative, and partly descriptive, approach was chosen to investigate a medium-long term time perspective (10-15 years).

The scenario building was performed during a workshop, held in Rome on the 20th-21st of March 2014, where a think tank of experts coming from different areas of the Mediterranean was involved. The think-tank was composed by **44** specialists, belonging to various sectors: veterinary sciences, epidemiology, climatology, agriculture and environment. Although the presence of Italian experts was predominant, those were belonging to institutions or research centres being active in the Mediterranean area, and had consolidated experience in working groups active in the area. During the two days of the meeting, opinion exchange and brainstorming among the experts was stimulated, in order to facilitate the creation of a common knowledge on the driving forces and critical uncertainties that will model the future of animal health.

The two selected drivers were used as Cartesian axis for the scenario building of Mediterranean 2030, originating four quarters, each being characterised by a combination of high/low variability of each of the two drivers identified (*Scenario1*: lowly variable driver1, lowly variable driver2, *Scenario2*: highly variable driver1, lowly variable driver2 etc..). During the first morning of the workshop (see the agenda reported in ANNEX 2), the think tank was divided in four working groups, each having balanced expertise, and the building of a scenario was assigned to each one of them. In every group, the discussion was animated by a facilitator.

The aim of any of the groups was to describe the extreme situation that can possibly happen in a future scenario being described by the two given trend of the key drivers, that were the peculiar aspects of the four different scenarios. In particular, the participants were asked to (Horizon Scanning Centre 2008):

- Define a short and highly descriptive title for the given scenario
- Develop a scenario description comprehensive of a narration of the events, decisions and choices that led from the present to that future in 2030.
- Briefly describe a list of the drivers that intervened and about the logic staying behind them.

A power point format containing standard tables to be filled was delivered to every group, in order to favour final reporting about the outcomes of the exercise in the afternoon.

In order to ensure that the obtained scenarios would have been appropriate to the programming of research in the animal health sector, some general suggestions to be followed were provided to every group. The suggestion was that the developed scenarios should have been (Horizon Scanning Centre 2008; Rialland and Wold, 2009):

1. plausible: showing something that could verisimilarly happen and being coherent with the given drivers;
2. different: one scenario should not be simply a variation of another one;
3. consistent: built following a logic that makes them credible and without contradictions;
4. useful: they should be useful from a decision making point of view, meaning that they should make intervention in the sector possible;
5. challenging: they should be challenging for the given sector.

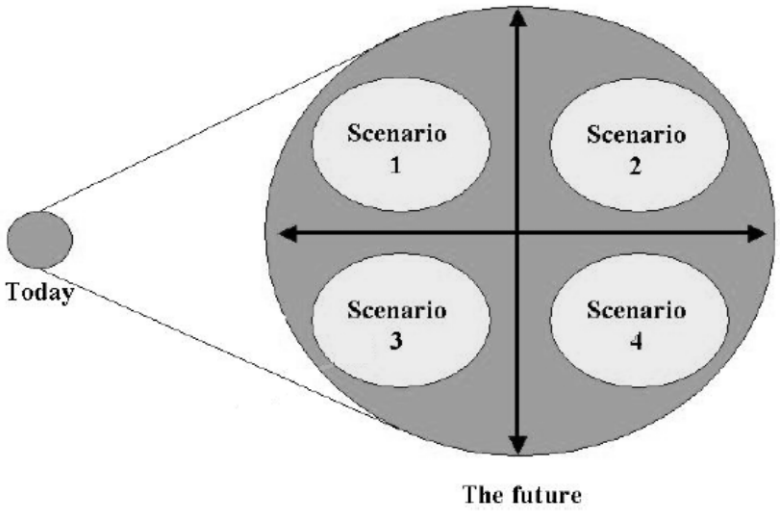


Figure 7: Scenarios as future projections (Rialland, A. & Wold, K.E., 2009).

Plausibility Matrix

The development of four different 'stories' is very useful to enhance the number of future options to be considered. Nevertheless, although these stories are good catalyser to stimulate thinking and to evaluate different options, they often end up to be lacking plausibility and, moreover, the definition of future steps toward a Strategic Research Agenda is difficult when starting from a plurality of various events (JRC, 2007).

Once the scenarios were created, a plausibility matrix was provided to each group to help them extract plausible and favourable factors from their scenarios. The matrix, filled with the inputs of the four groups, was discussed in plenary in order to provide all participants with a full overview of all scenarios and to stimulate discussion. This discussion and the inputs that emerged from it were used as the basis for the 5th scenario.

Building of the 5th scenario

On the morning of the second day of the workshop the 5th scenario was developed. It served both to stimulate a plenary discussion on the future and to allow the focussing on the various positive aspects whose obtaining was desired and on the ways to overcome the weaknesses of the sector.

In order to describe the 5th scenario, the discussion was focussed on the following questions (Horizon Scanning Centre, 2008):

- Which events will happen in the future?
- What should not happen in the future?
- What we desire to happen in the future?

Phase 3: Implementation of strategic choices

The implementation phase foresees the definition of appropriate strategies to be taken. The *backcasting* was applied to get to this result.

This technique consist of working backwards, starting from a desirable and plausible future (the 5th scenario), to identify policies and programmes connecting the future to the present. The last phase of the workshop was dedicated to the backcasting exercise. All participants, in plenary, were asked to identify

barriers and favourable factors to the realisation of a preferred future and, among them, the ones being, or being not, under human control. Starting from these assumptions, strategies to minimise the controllable barriers, to bypass the uncontrollable ones and to enhance favourable factors were developed.

Backcasting and participative approach toward a Strategic Agenda

On the second day of the workshop, for the backcasting exercise, the participants were divided, based on their expertise, in three focus groups:

- Aquaculture;
- Terrestrial animal: emergent infectious diseases (with major focus on vector borne diseases and zoonoses);
- Terrestrial animal: production diseases.

The aim of the working groups was to identify key issues, responsibilities and strategies to implement the desired future. In particular, they were asked to suggest research areas to be developed in the Mediterranean area in the sector. This represented the first step toward a Strategic research Agenda for animal health in the Mediterranean.

Section III: Results

The FORE-Med exercise results are reported in this section. These include both an analysis of the current situation, the building of future scenarios and the implementation of the strategic choices. The strategic choices that emerged from this study will become the basis for the development of a Strategic Research Agenda but this last one will not be presented in this report.

Geographical coverage

Overall, considering all the different phases, the FORE-Med exercise involved **85** experts across the Mediterranean area. Although participation from the North Mediterranean was more massive than from other sub-areas, representatives from at least two countries per each of the selected sub-area were involved in the process. In addition to country representative, a number of experts from inter-governmental organisations, such as the OIE and the FAO, were involved in the process, providing a wider overview of the study area. Lastly, some experts belonging to cutting edge research centres, governmental agencies and stakeholder group from non-Mediterranean countries were involved as well.

Animal Health research *drivers* in the Mediterranean

Following phone interviews, web browsing and bibliographic studies, **94** trend and drivers were identified. These were classified into 9 groups, as showed in Table 3, representing the key driving forces (*Key drivers*):

1. *Infectious diseases evolution*,
2. *Economics and trade patterns*,
3. *Demography evolution*,
4. *Social values changes*,
5. *Advances in communication*,
6. *Environmental changes*,
7. *Political/Leadership evolution*,
8. *Technological advances and challenges*,
9. *Production system changes*.

Table 3: Full list of the identified trends and drivers.

1. Infectious diseases evolution
a. New emerging diseases
b. Increasing number of infectious disease
c. Vector borne disease (vector movement, introduction and competence)
d. Wildlife borne disease (wildlife movement/migration; domestic/wildlife interface)
e. Labs release pathogens (bio-terrorism, lack of safety procedures)
f. Pathogen evolution (recombination; mutation; virulence; zoonotic potential)
g. Shifts in the ecology of pathogens
h. Reduced activity of drugs (Anti-microbial resistance)
i. Plant disease (e.g. wheat rust)

2. Economics and trade patterns
a. Economic depression
b. Changing of trade flow
c. Globalization
d. Trade agreements (WTO, bi-lateral agreements)
e. Local protectionism
f. Economics of farming (sustainability/profitability)
g. Land price and change of land use (biogas production vs animal feed)
h. Primary materials prices (land, feed, fuel…)
i. Underground market
j. Consolidation of big pharmaceutical companies
k. Connection between control system and economic productivity

3. Demography evolution
a. Population size
b. Ageing population
c. Migration patterns (Refugees; openness of EC country barriers…)
d. Illegal immigration
e. Lack of young in the agriculture sector (farmers, vets, politicians)
f. Urbanization

4. Social values changes
a. Multi ethnic and multicultural society (dietary, farming and food processing changes)
b. Education level (dietary changes: low fat, nutraceuticals, noble proteins, Ω3-6 balance…)
c. Vegetarianism
d. Rural/farming communities
e. Food security awareness
f. Food quality awareness
g. Animal welfare awareness
h. Domestic animals interactions
i. Attitudes to new technology
j. Increase in local/traditional products demands

5. Advances in communication
a. Globalization
b. Media as primary source of information
c. Modern mechanisms of communication
d. Advertising of products

e. Social networking
f. Effective knowledge transfer for all levels
g. Self-diagnosis/ prevention on media information
h. Speed of international communications (information/ communication)
i. Institutional response to change of communication patterns
j. Informatics tools availability

6. Environmental changes

a. Climate variability
b. Extreme weather events (Earthquakes/volcanoes/flooding/storms/drought/heat weaves)
c. Soil infertility and soil loss
d. Lack of water/water quality
e. Lack of energy sources
f. Disturbed ecosystems (biodiversity reduction, Changes in wildlife populations including fish stocks, Vector patterns changes, Interaction between domesticated and wild animals, human/animal interface)
g. Habitats changes (Urbanization, increased density of animal and human, Invasive species (plant, animals and insects),
h. Man-made disasters (nuclear, war, split of chemical substances…
i. Pollution and environment degradation (Waste management, disposal of carcasses and bio-products, contaminants, greenhouse gasses…)

7. Political/Leadership evolution

a. Political in/stability
b. EC regulation
c. International coordination from global institution (i.e.: OIE, FAO, WHO, WTO)
d. War
e. Integrated leadership
f. Leadership capacity at all levels
g. Defined competency among agencies
h. Emergency /complacency plan development
i. Long term political vision
j. Risk-based decision
k. International policy harmonisation/integration/standards
l. Public/private responsibility and independence

m. Political decision supported by scientific information
n. Balance between food security and food supply/affordable price
o. Official controls based on cost/efficacy policy
p. Inter-ministerial collaboration
q. One-health approach
r. Sustainable development approach
s. Openness to the use of new technology for control/prevention of disease
t. Simplified systems for investment in innovation (e.g.: simplified regulation in licensing drugs)

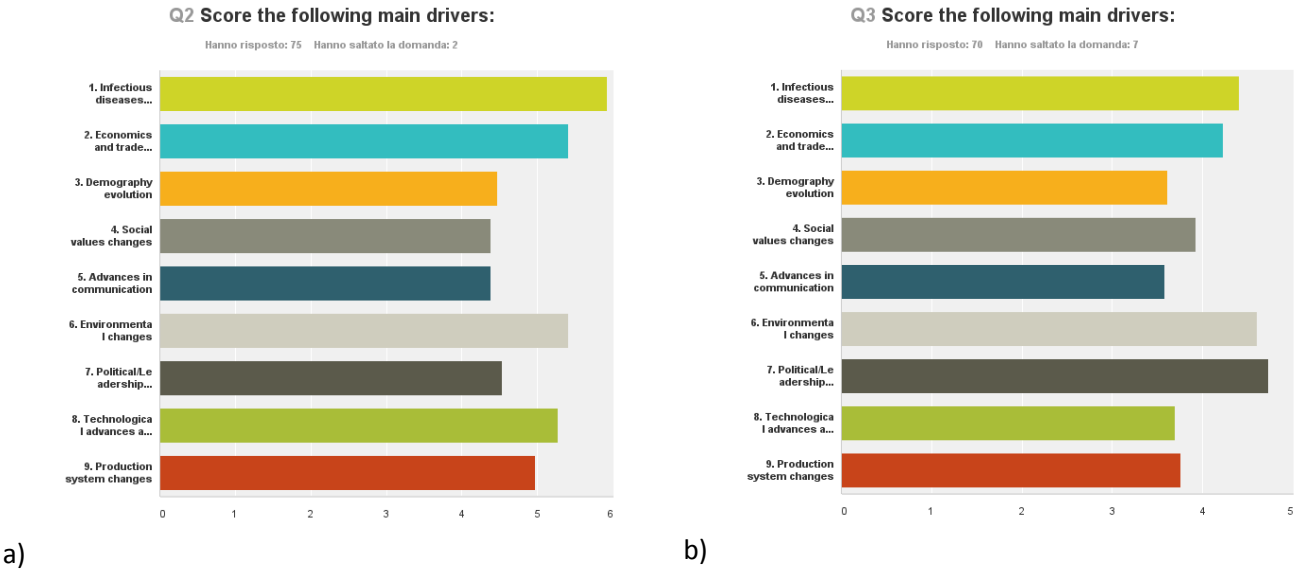
8. Technological advances and challenges

a. Cheap and easy identification of animal
b. Diagnostic/detection device non-invasive, fast, portable and cheap
c. Surveillance/monitoring systems coordinated, easy, cheap and effective
d. Easy sharing of information
e. New science: nano, GMO, artificial meat and alternative sources for animal proteins
f. Genetic modification for disease resistance
g. Disease eradication/herd immunity
h. Prevention trough affordable and efficient vaccine/medication
i. New therapeutics development to contrast drug resistance
j. Adequate infrastructure
k. Machine-bio intelligence integration
l. Multidisciplinary approach

9. Production system changes

a. Selection for diseases resistance, genetics uniformity
b. Changing farming systems
c. Structure of livestock sector
d. Intensification of animal density
e. Adequate labour force?
f. Segmentation/specialisation of food production
g. Alternative animal husbandry practice

Table 3 was sent to all the experts involved in the on-line survey that were asked to select, among those, the two most relevant and uncertain ones. On the 133 experts contacted, **75** fully answered the questionnaire. The average of the score provided by the experts are reported in Figure 8.



a) b)

Figure 8: Relevance (a) and uncertainty (b) scoring for the nine main drivers.

The scores attributed for relevance and uncertainty were added up (Table 4) to identify the two drivers being both the most relevant and uncertain. *Infectious diseases evolution* (10.34) and *Environmental changes* (10.01) were selected.

Table 4: Sum of the average relevance and variability score of the key drivers (ranking scale 0-7).

Key drivers	Average relevance score	Average variability score	Sum of average relevance and variability scores
1. *Infectious diseases evolution*	5,93	4,41	10,34
2. *Economics and trade patterns*	5,41	4,23	9,64
3. *Demography evolution*	4,47	3,61	8,08
4. *Social values changes*	4,38	3,93	8,31
5. *Advances in communication*	4,38	3,58	7,96
6. *Environmental changes*	5,41	4,60	10,01
7. *Political/Leadership evolution*	4,53	4,73	9,26
8. *Technological advances and challenges*	5,27	3,70	8,97
9. *Production system change*	4,97	3,76	8,73

These drivers were used as orthogonal axes for the creation of four quadrants, each representing a combination of critical uncertainties, on the basis of which scenarios were built.

4 scenarios

On the basis of the two selected drivers, the scheme for defining the four scenarios was developed as shown in Figure 9.

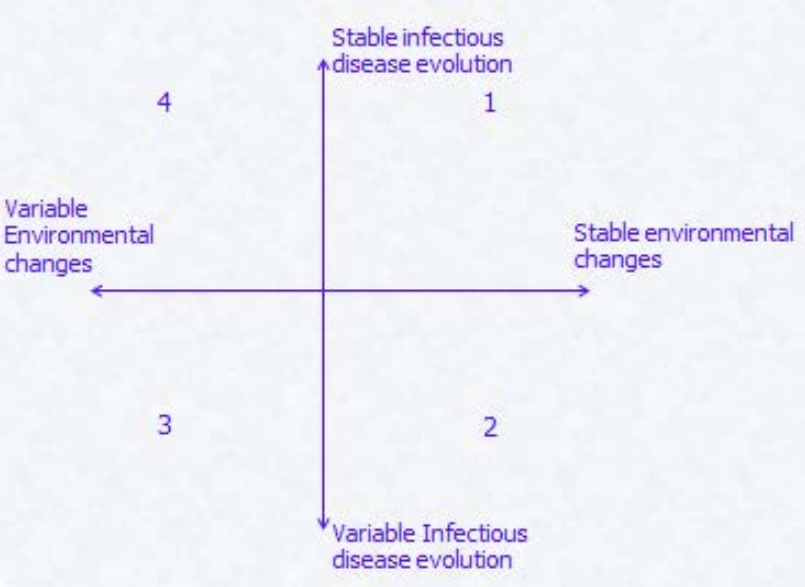


Figure 9: FORE-Med scenario axes.

The two drivers were considered as the main influencer of the scenarios and all other drivers and events in the scenario description were to be made consistent with them. The four groups were then assigned the following scenario:

Group 1:Stable infectious disease evolution and stable environmental changes.
Group 2: Variable infectious disease evolution and stable environmental changes.
Group 3: Variable infectious disease evolution and variable environmental changes.
Group 4: Stable infectious disease evolution and variable environmental changes.

On the basis of these instructions, the following scenarios were developed:

1st scenario

"*Tutto deve cambiare perché tutto resti come prima*[2] "

At the beginning of the 2010 decade the Mediterranean area was highly patchy, with the Northern part having higher economic welfare while the southern, although poorer and politically instable, having still several natural resources being unexploited. Under the pressure of an economic crisis whose end seemed always far and with the provision of some raw material (e.g. gas and oil) getting harder, and partly due to a growing disparity inside the EU, where northern countries were healthier and with different needs than southern ones, the politicians started looking for a Mediterranean approach.

On the Lampedusa Island (Italy), former door of entrance of the EU for most southern and eastern illegal immigrants and refugees, a Treaty was signed in 2016 by all Mediterranean countries Prime Ministers.

Under this treaty, the northern countries committed themselves in pushing cooperation activities in the south-eastern ones and tearing down economic barriers for intra-Mediterranean market. On the other side, the southern countries committed themselves in ensuring favour prices for raw materials, allowing the northern one to get rid of the dependencies on other countries (e.g. Russia) for their procurement. Agreements were taken on the building of common infrastructures (e.g. gas ducts) and on the implementation of common immigration regulation strategies.

The lowering of combustible material costs pushes the economy in the northern countries, that stimulate investment on the southern area. Economic welfare moves through a balance in the area. Social tension decreases, stabilising the political situation. The increased buying capacities in the south also creates new markets for northern Mediterranean countries. Trade inside the basin intensifies making harmonisation among the different population easier. New communication tools spread among all layers of the society, increasing information exchange and generally upgrading the level of education. The Mediterranean area moves toward self-sufficiency.

The rise in trade flows, especially form south-east to north, poses risks for the spreading of infectious diseases in the area. Nevertheless, the newly found wellness and the consolidated cooperation between countries allow the implementation of surveillance and monitoring plans in the area being effective to control the new situation. Illegal immigration control from outside the area become more effective too, decreasing the risk of introduction of new disease threat from outside the Mediterranean basin.

2nd scenario

"*At sight navigation in the Mediterranean Di-seas*"

The seasons still exist, as well as the succession of warm and cold weathers, of rain and drought, that is still constant and stable. Earthquakes, flooding and other natural disasters are only sporadic episodes having little impact in the region.

Incertitude and instability, on the other hand, are very well manifested in the political, societal and economic sectors. The periods of political stability are getting shorter and the loss of stable governments makes the planning and management of animal health very difficult, especially if based on a science sound basis (e.g. risk analysis).

Diseases are changing, evolving and moving very rapidly in the area, due to a number of factors. The global crisis still afflicting the world makes people move toward urbanised area and to the Northern part of the planet, in order to enhance chance of surviving. People that travel bring with them all their belongings, including live animals, that act as vectors for new or re-emerging diseases. The geographical society changes, with cities, as well as rural areas, being more and more multi-ethnic. The newcomers bring with them their own old traditions and feeding habits. Religions influence food demand, also for what concern food processing. Halal rites widespread, and official controls have sometimes troubles in controlling domestic slaughter. On the other side, some of the citizens of the megalopolis find their selfish way to get food out of the cities, both to find better prices and in an attempt to get more supposedly 'genuine' food. This again raises the risk of spreading of food-borne disease due to failure of official controls. Moreover,

[2] "Everything need to change to keep everything unchanged" *Il Gattopardo*, Tomasi di Lampedusa, 1958.

the lack of working opportunity leads new people to start working in the agricultural sector, without having the proper knowledge. The heath veterinary services strive to find adequate communication strategy to dialog with these new figures, lacking success.

The autochthonous population is ageing and children are mainly coming from immigrants. The demand for both health and food products consequently changes. The increase in diagnostic potential for human diseases and nutritional needs lead to the development of more tolerable aliments. Changes in the etic of alimentation stimulate strong social, cultural and phenomena. Vegetarians and vegans habits spread in the area, representing an important share of the market.

Both global crisis and globalisation impact animal commercial movements from east and south to northern countries, to satisfy the demand for cheaper products. Together with the price, food safety decrease as well. In the meanwhile, population increase challenges the carrying capacity of the environment, and new zootechnical systems are put in place. The lack of biosecurity due to the inappropriate training of the operators increases the spread of pathogens. Also, cost of energy, labour and raw materials increase for the operators in the sectors.

Governments suffer from the crisis as well, obliging them to cut and commitments. The investment in the innovation, research and technology are reduced. Funds are lacking to guarantee the application of biosecurity measures as well as to develop new and faster diagnostic tests. On the other hand, genetic selection for certain production parameters poses risk of exacerbating disease susceptibility.

Diseases move and changes, also due to an increasing influence of the wild animals, that migrate in search for food or fleeing from environmental disruption, due to pollution, urbanisation. New reservoirs emerge.

The lack of strategic and political long term vision impact greatly on the future: intervention planning is rarely implemented while reaction to emergencies is the norm. There is lack of solid risk-basis management. Nevertheless, the veterinary services across the countries, although having different capacities, organisation and resource availability, cooperate through the existing networks (e.g. the REMESA[3]), fighting to reach a common goal.

3rd scenario

"*Einstein theory*"

In the second decade of 2010 climate changes in the Mediterranean area caused a general warming and extreme wheatear events that destabilised local insect populations. Political instability and war events around the Black Sea cause strong migration flows from western Asian countries. With this population waves, a new corn parasite entered in the Mediterranean basin where it found good conditions for growth (lack of competition for resources and adequate climate). Corn production in the area was seriously compromised, with a high impact on food and feed in the whole area. Under a strong social pressure, the politicians allow the entrance on the market of a new insecticide "Crop saviour" imported from non-EU market.

The new product is used on large scale, apparently solving the insect epidemics and restoring food security and price in the area. Several months already passed by when the EU epidemiological observatory for bees signals uncommonly frequent epidemics events all over the area. Security tests on the "Crop saviour" product emerged to have been made inappropriately: the insecticide appears not to be target-selective and the normal usage concentration is sub-lethal for bees, where it strongly affect the immune system, stimulating the appearance of latent infections. The problem is initially spotted on bees, that are more controlled, but further analysis on other pollinating insects highlighted the same toxic effects on these population as well. Also, insects being disease vectors initially decrease in number. The lack of insect biomasses causes a shift also in bird migration, that needs to change their fluxes toward more adequate lands. Biodiversity in the basin is seriously compromised. Also, the change in migratory fluxes causes the entrance of disease in new areas.

New rules on the free trade needed to be set and new agreements on agricultural policy were taken. The power of vegetable and chemical producers lobbies increases, leading to deep changes in the political

[3] http://www.remesanetwork.org/.

framework. In order to ensure food security in the EU, import takes a giant leap forward, increasing the risk of entrance of new pathogens. In parallel, land usage shift, with depopulation of former rural areas. Granting adequate feed for zootechnical production became a great challenge. New feed sources enter in the production chain without adequate adapting of the animals, leading to an increase in infection (due to inadequate feeding and then inadequate immune response of the animals).
The prices of zootechnical products more than doubles and food security for people is threatened. High political instability is a direct consequence of it; new treaties among countries need to be set. The economy is affected by the new situation, causing lack of funding for appropriate surveillance and control activities. Biosecurity measures need to be re-discussed, together with surveillance systems and research investments.

Alternative ways of pollination need to be found to face the bees' disappearance, in order to avoid the realising of Einstein theory "If the bee disappears from the surface of the earth, man would have no more than four years to live".

4th Scenario

"*Old diseases new threats: don't worry be aware*"

In the second half of the 2020s, the economic crisis still deeply affects world economy as a whole. In order to try to find an exit strategy to the situation, several countries decided to push the industrial sector at its maximum, avoiding any investment in the reduction of pollution, trying this way to save money, and improving industrial productivity. The EU, together with several other countries, decided to withdraw from the Kyoto protocol, whose second commitment period never came into force. Pollution and greenhouse gas emission increased, accelerating climate change and environment destruction. Also, the new incentive to industrialisation drove through higher exploitation of resources and deforestation.

Climate changes around the Mediterranean: extreme day/night temperature, strong variations in annual cyclic nature and natural disasters became more common. Water shortage became an important issue in many Mediterranean countries. Population migrated toward big cities, in order to find working opportunity and to escape to areas where the environment became inhospitable. Big cities grown into megalopolis and rural area are abandoned. Overall arable land decreased, both because of the more profitability of the use for industrial purposes and for the climate modification making farming harder. Animal husbandry techniques changed dramatically, impairing food producing capacity. Food import from outside the area increased.

Also, desertification and political instability outside the Mediterranean basin stimulated immigration flows in the area, increasing population density and food demand.
On the other hand, gaps in food supply are covered by new technological development that brought wellness in the area, where people education level improved. New trade flows originated from southern/eastern Mediterranean countries toward north. Overall, these trends led to political stabilisation in North Africa and Middle East.

The renewed trust in technology, and the food prices incessantly growing, changed consumer attitude toward food production. Big investments are carried out in biotechnology.
The animal productions in the area turn toward environmental friendly and very high quality low scale business, while new techno-food (GMO feed and food and productions from cloned lines animals included) become available to consumers.

Mass consumption food is mainly ensured by imported products from third countries, with high level of clearance from points of entry and intensive EU audit programs on export countries.

The new stability in the area allows better coordination and integration of disease control systems. Risk communication is also well coordinated, and it end up in an increase in citizens awareness.
Despite the unfavourable environmental conditions, animal health status is under control thank to technological innovations like automated on line checks and biosecurity measures applied properly under strict community regulations.

Plausibility Matrix and 5th scenario

The developed scenarios allowed the identification of **22** plausible and **16** favourable drivers for animal health in the Mediterranean area, that are reported in Table 5.

Table 5: List of plausible and favourable drivers for animal health for Mediterranean 2030.

Plausible	Favourable
Attitudes To New Technology	Changing Of Trade Flow
Breeding For Genetic Resistance	Development Of Sustainable Politics
Change In Trade Pattern	Education Level Increase
Effective Knowledge Transfer At All Levels	Implementation Of An Identification System By Genomic
Globalisation	Improved Communication Strategy
Illegal Immigration	Increase Food Safety Awareness
Implementation Of A Common And Integrated Animal Identification Systems	Increase Of Farming Economics (Sustainability/Profitability)
Increase Food Safety Awareness	Informatics Tools Availability
Increase In Migration Patterns	Institutional Response To Communication Patterns
Increase In Population Size	Long Term Political Vision
Increase Primary Materials Prices	One Health Approach
Industrialisation	Political Decision Supported By Scientific Information
Intensification Of Animal Density	Positive Attitude To New Technology
Migration Patterns	Prevention Trough Affordable And Efficient Vaccine
Multidisciplinary Approach	Risk-Based Decision
Networking For Sharing Skill And Diagnostic Knowledge Between All Laboratories	Short Commercial Chain
New Therapeutics Development To Contrast Drug Resistance	Surveillance Coordinated
Political Instability	
Set Up Of A Strategic Agenda For Mediterranean Countries	
Short Commercial Chain	
New Ways Of Communication (Social Networking)	
Surveillance Activities Increase	
Urbanisation	

This list was presented on the morning of the second day of the workshop and served as a basis for starting the discussion. During the discussion itself, several addition and modifications were made, ending up with the fifth scenario for Mediterranean 2030:

5th Scenario
"*Mare nostrum*"

The economic crisis is still impacting on the global markets, that are facing a recovery being slighter than expected. Globalisation of markets leads to a price policy being disadvantageous for the European context, in particular for the agricultural sector. The climate changed, becoming more variable and making natural disasters more common. Inside the European Union, the gap between northern and eastern and southern countries increased, since these latter ones were more deeply affected by the global economic and climatic situation.

In the South-eastern part of the Mediterranean basin the political situation is still instable, with religious extremist still representing a problem that sometimes ends up in bioterrorism episodes. Nevertheless, the widespread of internet, the increase in trade exchanges and the continuation of cooperation activities in the area led to deep changes in the society. Women emancipation, in particular, took a great leap forward, with a high prevalence of women now arriving to the higher level of education and to leading position in the civil society.

In an attempt to bring more stability and prosperity in the area, the Barcelona Declaration and Euro-Mediterranean partnership[4] was brush up on, after more than 20 years. New trade flows grow in the Mediterranean area, in an attempt to solve the situation and find new markets, being able to absorb production stocks, and to bring to a more concerted policy. Trade barriers are tearing down. The gap between north and south-east Mediterranean decreased, making the area look like a "Mediterranean Union".

World population is increasing and, also due to climate changes and lack of water that decreased arable land in southern countries, immigrants fluxes from outside the area increased in the Mediterranean basin. Illegal immigration also increased, and it generally led to a compression of the population in the area. Different cultures and religions become more and more widespread, entailing changes in costumes and feeding habits. Population distribution in the area also changes. Cities grow bigger while rural and mountainous areas are abandoned, also due to lack of water. Megalopolises become more and more common.

The climatic situation deeply impact water availability. Dry periods and heavy sudden rains become usual, making water storage harder. Desertification in the Mediterranean area increase, decreasing the availability of arable lands. Water pollution becomes a serious issue. Water is now a resource for which people are fighting, and under this pressure water policies get stronger. New contingency plans and water and land use strategies are developed. Agricultural production highly water consuming, such us the zootechnical ones, become more costly and need to be reformed in a more sustainable way. Livestock genetic selection is pushed also in an attempt to have less impacting production. A genetic shift in the animal population is observed, and local breeds tend to disappear.

Food demand increases under the pressure of population rise. Farm intensification is observed in several areas. Feed provision gets harder, arising the need for the development of new protein sources (both for people and animal).

All the changes in feeding habits and agricultural sector (farm intensification in some areas and delocalisation of farms following water availability) represent great challenges for the veterinary public service, that need to be strongly reformed.

The increase in trade flow and the continuous entrance in the Mediterranean basin of people from Africa and Asia led to the entrance and stabilisation of new diseases. Also, the Sahara is no more representing a natural barrier, since men and livestock transport from south to north take nowadays far less than disease incubation time. The climate itself contributes to this situation. The higher climates, in fact, favour the establishment of vector population in the area and the survival of pathogens that once were considered tropical. Zoonosis spread become an increasingly serious risk and it is taken into consideration by the politicians. Planning of actions between medical doctors and veterinarians becomes highly relevant, and it pushes the 'One Health' approach.

[4] Available at http://www.eeas.europa.eu/euromed/docs/bd_en.pdf

Research needs for Mediterranean 2030: Aquaculture

The focus group on aquaculture identified **11** research areas and, for each one of them, several more detailed research topics. A full list of the identified areas and topic is reported in Table 6.

The identified research areas concern sea fish, fresh water fish, crustacean and shellfish. Although the main focus are aquaculture systems, some of the priorities identified also concern wild fish. Those were included both as reservoirs (or models) for diseases that can affect farmed fish and for biodiversity preservation.

Table 6: Research areas and topic on Aquaculture.

Research areas	Topics
Sustainable aquaculture	a) Study on new feed sources
	b) Development of alternative breeding methods on systems already impacting the system (e.g. oil plant, polyculture in lagoons)
	c) Development of prebiotics, herbal stimulants to improve a-specific immunity system
	d) Study on farmed fish technopathy
	e) Study on pathologies in off-shore shellfish farms
Development of new therapeutics and antibiotic resistance	a) Study on anti-parasite drugs (verification of efficacy and efficiency)
	b) Experimental studies of phago and herbal therapy
Host-pathogen interaction	a) Study on parassitosis on fish bred in sea cages
	b) Study on photo-bacteriosis in marine fish
	c) Study on Herpesvirosis in clams
	d) Study on atypical mycobacteriosis
Fish welfare	a) Identification of fish welfare indicators (e.g. biochemical, morphological)
Organic aquaculture	a) Development of new vaccines and alternative therapies
	b) Study on fish welfare in organic farms
	c) Development of protocols for the evaluation of organic farms terms of contract
Development of vaccines to reduce pathogen losses and environmental impact	a) Development of new vaccines for new diseases
	b) Study on the verification of the efficacy of vaccines
Biodiversity preservation	a) Health monitoring of wild fish
	b) Study on the vulnerability of wild fish to toxic pollutants
	c) Study on the mortality of natural schools of fish and shellfish (e.g. nodavirosis in stone bass in Italy and Libya)
Mediterranean aquatic animal health information system	a) Development of a Mediterranean traceability system to exchange data
	b) Development of GIS systems
Genetic selection for disease resistance	a) Genomic study for pathogen resistance
Climate change adaptation, to reduce production losses	a) Study on the interaction between cyanobacters, toxin production and mortality
	b) Study on the prevention of the weakening of clams' byssus
	c) Study on gill disease in murky fresh water fishes
Monitoring of imported exotic fishes to decrease the risk of introduction of new pathogens	a) Monitoring of imported ornamental fish
	b) Development of legal framework to improve disease surveillance

The group highlighted as future research areas also some specific diseases, both infectious and production ones, to be considered as relevant research focus in the next 15 years. Those are already included among the research topics reported in Table 6.

Research needs for Mediterranean 2030: Terrestrial animal, emergent infectious diseases

The focus group on emergent infectious diseases focussed its attention on the identification of researches being fundamental in order to reach three main goals for Mediterranean 2030: preparedness, sustainability and early warning. They identified **3** main research areas and, for each one of them, several more detailed research topics. A full list of the identified areas and topic is reported in Table 7.

Table 7: Research areas and topic on Emergent Infectious Diseases.

Research areas	Topics
Prevention and control	a) Implementation of specific interventions on the territory to increase prevention
	b) Implementation of control and monitoring on vectors, also using new products
	c) Implementation of economic evaluation of interventions, to obtain sustainability
	d) Development of a laboratory network for information and technology exchange
	e) Definition and application of effective and harmonised control measures in all countries of the area
	f) Implementation of training and education with multidisciplinary approach
	g) Establishment of a network with human medicine
	h) Development of mathematical and risk analysis models, also aiming at the development of contingency planning
	i) Development of identification and registration systems being adapted to the local situation
	j) Development of knowledge management systems allowing sharing and exchange of data
	k) Development of "participative epidemiology", using social networking as emergency management systems
	l) Study on the epidemiological role of companion animals
	m) Development of relegation systems for illegal movements
Basic research	a) Basic research on pathogens for better targeting of vaccines and therapeutics
	b) Study on the biology of vector insects to develop risk analysis and models
	a) Study of the epidemiology of "new pathogens"
Development of new tests, methods and vaccines	a) Development of new vaccines (e.g. DIVA, recombinants)
	b) Development of whole technology for rapid production and use of vaccines (e.g. antigen banks)
	c) Development of vaccines for extensive use (e.g. peptides, vegetal)
	d) Definition of appropriate sampling strategies
	e) Widening of the range of biological samples
	f) Development of robust and cheap field tests
	g) Increase of the applicability of the products, also involving drug producer in the projects
	h) Increase of diagnostic potential on bioterrorism potential agents

In addition to the topic identified, the group also drafted a separate list of priority diseases to be taken into account for future researches. The starting point for the list was a prioritisation of diseases already performed by the REMESA[5], a Mediterranean Animal health network including the CVOs from 10 Western

[5] http://www.remesanetwork.org/

Mediterranean countries. The identified diseases were *Foot and Mouth Disease, Rabies, Orbivirosis (Blue Tongue), Rift Valley Fever, Brucellosis, West Nile Disease, Avian Influenza, Peste des Petits Ruminants, Tuberculosis, Sheep and Goat Pox, African Horse Sickness, and Leishmaniasis*. The group then identified other diseases that would have required additional research for the next 15 years. These were: *Poxvirus* (Lumpy Skin Disease), *Congo-Crimean Haemorrhagic Fever*, *Rickettsiosis*, *Glanders*, *Anthrax*, *Coronavirosis* (MERS). The final list then comprehended **18** priority disease.

Research needs for Mediterranean 2030: Terrestrial animal, production diseases

The focus group on production diseases decided to target for their analysis both intensive and extensive/low input farming systems, since both of them are supposed to be a relevant reality in the 2030 scenario. They identified **4** main research areas and, for each one of them, several more detailed research topics. A full list of the identified areas and topic is reported in Table 8.

Table 8: Research areas and topic on Production Diseases.

Research areas	Topics
Traceability system for national and international exchange (Mediterranean area), with focus on disease control	a) Evaluation and implementation of traceability system being equivalent for international exchange
	b) Development of integrated system for using traceability information
Sustainability of the zootechnical production in the new socio-economic scenario	a) Development of alternative food sources
	b) Development of re-utilisation systems for system slurries and water recycle systems
	c) Study on the impact of the use of new areas for zootechnical purposes
	d) Development of biosecurity systems aiming at optimisation and increase of production
	e) Study on antibiotic reduction strategies
	f) Study on new vaccines for livestock
	g) Identification of genetic types being resistant to main disease
	h) Study on strategies to manage the impact of intensive farming
	i) Development of methods to forecast effect of weather and climate on animal health and welfare
	j) Development of factors influencing vectorial competency of arthropods to pathogens
	k) Development of management favouring animal health and welfare, including development of animal welfare indicators, reduction of antibiotic use, reduction of the impact of technopaties using alternative products
	l) Evidence based intervention on management and prevention of diseases, including evaluation methods for the interventions
Genetic selection and biodiversity to prevent and control major pathogens in the livestock sector	a) Study on genetic types being adapted to evolving farming systems
	b) Valorisation of biodiversity to develop local production
Development of new feed sources for animals	a) Evaluation of gut health using new feed sources
	b) Sustainability studies of farms with the new feeding sources

No specific diseases were identified by this focus group, that had the mandate of focussing on farming methods and their impact rather than on specific diseases.

Section IV: Discussion and conclusions

Strengths and weaknesses of the exercise

The FORE-Med exercise encountered a high level of appreciation across the scientific community involved in the study. Despite the novelty of the approach in the animal health sector in this area, the experts found the process appealing and were able to perform the different phases profitably. Moreover, the FORE-Med put together specialists in different areas and from different geographical origin, stimulating knowledge exchange across the issue but also leading to the building of new networks. These links across the Mediterranean area will be fundamental for getting common results across country borders.

On the other side, although a very high number of expert was involved, they were not perfectly geographically distributed, with some unbalance between the three sub-areas and inside some of them. For example, no Balkan countries representatives were involved in the activities. Also, Italian experts represented the majority of participants at the workshop, even if representative of the national excellence and with many profitable contacts with other Mediterranean realities. These events were mainly cost related. In fact, it is important to underline that this exercise was performed in a period of severe constrains of national budget for research and foresight studies have an average cost ranging between 100,000 and 250,000 euros (Von Schomberg et al., 2006). Although the participation in the STAR-IDAZ project allowed an optimisation of resources, the overall budget to be allocated to the activities was far below that sum. This made necessary to ask most participants to the workshop to attend on their own funding, reducing the possibility of participation for experts coming from abroad, in particular from the eastern and southern areas. Efforts were made, anyhow, to involve at least some key experts from each of the macro-areas, succeeding in this, and to invite to participate only specialists having strong experience internationally.

In order to obtain a good foresight exercise, it is important to take into consideration a range of different factors. The involvement of specialist belonging to different fields is then clear-cut. The FORE-Med succeeded in this objective, since it involved experts in bacteriology, virology, parasitology, aquaculture, antibiotic resistance, environment, risk analysis, epidemiology, statistics, climatology, zootechnical practices, training and education, food production, agro-economy and policy making. Nevertheless, the majority of the involved expertise belonged to the sphere of veterinary medicine, as it can be expected in an animal health foresight exercise, but it might have limited, to some extent, the vision leading to the outcomes of the exercise.

The panel of experts that participated up today was appropriate for the given study. Nevertheless, the allocation of a *dedicated budget* to foresight exercises could help in a more proficient involvement of experts coming from different areas, improving the added value of the results. Several countries, such as the USA and the UK, already provide their own governmental institutions organisation with *dedicated foresight units*. Due to the relevance of the topic, and to the possible impact on the population, a similar approach might be advised also for the animal health field in the Mediterranean area.

The four scenarios appeared to have many similarities among themselves, and also with the fifth one. This is due, most likely, to the time span investigated that was, although not short, not even very long.

Overall outcomes: what research will be needed in Mediterranean 2030?

The FORE-Med exercise involved **85** experts across the Mediterranean area, with the participation of at least two countries per each of the selected sub-area were involved in the process. The focus groups were able to identify, overall, **18** research areas and **70** research topics being priority for aquatic and terrestrial animal health in the Mediterranean in 2030. Moreover, a list of diseases that will need focus in the next 15 years was identified.

It is interesting to notice how the proposed topics were mostly **multidisciplinary researches**, merging expertise from different fields, since the traditional approach to animal health was seen as not adequate anymore. In fact, in a context of growing world human and animal populations and environmental change, the linkages between the human, animal, and environmental health are becoming more evident (Rabinowitz and Conti, 2014), making inter-professional collaboration more and more necessary to tackle the upcoming issues. This is in line with what observed in other recent studies, that highlighted as the One Health multidisciplinary approach, incorporating veterinary medical, ecological, sociological expertise can provide useful control strategies for a number of diseases (Hayman et al., 2013; Kaneene et al., 2014). Recent studies highlighted as the integration of different disciplines in a One Health framework, merging human, animals and environmental health, are already an argument of growing interest in the scientific community, being already mentioned in a relevant number of scientific papers (Rabinowitz et al., 2013). Of those articles, some provided evidence of feasibility for intersectoral cooperation between human, animal, and environmental health while others described such collaboration for disease prediction and disease control. Then, despite the fact that the FORE-Med study was focussing on animal health, it is not surprising that some research topics were identified out of the traditional veterinary area. As an example, the think tank pointed out the increasing relevance of having developed, in addition to more sensitive and rapid methods for disease control, new alert, monitoring systems, allowing faster responsiveness to new threats. Similar conclusions were obtained by Nichols and colleagues (2014), that stated that the reviewing of surveillance systems and the data they provide should be a relevant part of strategy to respond to these future risks. In their view, in fact, ensuring the adequateness of public health infrastructures would be the best preparation for future changes in infectious diseases that will derive from climate change and other relevant drivers in the future. Revised and enhanced monitoring systems, developed through the use of modern technologies (e.g. GPS technology to link outbreaks to geographical locations, satellite and remote sensing to monitor and develop early warning systems, new data collection and storage techniques) and will be of paramount importance to guarantee disease preparedness in the future.

The development of **communication** was also pointed out as an interdisciplinary area where researches should be focused in the future. In fact, efficient communication can reduce the costs of animal diseases losses by controlling emotions and preventing overreaction, while improving awareness and preparedness (Antòn et al., 2013). Veterinary officers strongly improve their communication skill over the last decade, also improving their collaboration with the non-veterinary sector, but gaps in the communication and information are still present. These gaps should be filled in “peace time”, developing established communication strategy, to ensure faster reactions when the need will arise.

Although all the three focus groups acted independently and each had different tasks, it is interesting to notice how some common features can be observed across the different outputs they provided.

The movement of people and animals around the Mediterranean was one of the features that characterised all the future scenarios developed during the FORE-MEd, including the fifth one. This movements were also identified as a possible risks for the introduction, or re-introduction, of diseases in the area or between countries. In fact, people immigration fluxes in the Mediterranean area in constant increase since the 1990s, and immigrants have an averagely lower health status than native population (Villalonga-Olives and Kawachi, 2014), highlighting their possible role in the disease spreading. Also, recent studies pointed out the possible role of the travellers in the emergence of infectious diseases of public

health concern (Odolini et al., 2011). In addition to people movement, animal movements are mooted to increase the incidence of emerging infectious animal diseases (Wentholt et al., 2012), as recently pointed out during an expert consultation carried out in the framework of the EMIDA ERA-Net. This is likely to be the reason underpinning why the development of new and **harmonised traceability systems** was identified as fundamental by all groups. In fact, harmonised and accessible systems would represent a corner stone for adequate disease control, improving the management of disease outbreaks, vaccination programs, early response and notification systems, animal movement controls, inspection, and certification for many species (OIE, 2014). Moreover, it could guarantee benefits such as granting of the ability to regionalise in case of an animal disease outbreak, potentially reducing the disease mitigation costs (Hegerman et al., 2013).

Another main topic, emerging from all groups, was the development of **sustainable productions**, intended both on the economic and environmental side. The intensification of agricultural production has been driven by a large use of non-renewable resources, often impairing environmental sustainability, as well as by a huge simplification of agricultural systems, making livestock production practices highly specialised and levelling land use. This had an impact both on the environment, both generating high concentrations of water pollution and emission of greenhouse gases, as well as entailing greater sensitivity to climate change (Lemaire et al., 2014). Nevertheless, to date, the push toward increasing "specialisation—higher productivity" was put into question by the numerous uncertainties with climate and commodity prices (Evans, 2009). During our foresight exercise, water scarcity and reduction of rural lands (or at least of adequate rural ones) have been seen as having a deep impact on the expected future, entailing the exigency of developing new farming strategies being able to re-use resources and being adaptable to the changing situation. Several strategies to mitigate the impact of livestock production on the environment have been drawn already in recent studies, e.g. by reducing food waste and consumption of livestock products (Bellarby et al., 2012) or developing integrated crop–livestock systems to increase food production at farm and regional levels (Lemaire et al., 2014), but further studies will be needed in order to detect options being adequate to sustain both the demand for food and the environmental side. Moreover, environment preservation is not the only aspect to be taken into account when talking about sustainability. In fact, a system could be considered sustainable if "it is acceptable now and if its effects will be acceptable in future, in particular in relation to resource availability, consequences of functioning and morality of action" (Broom et al., 2013). In this framework, animal welfare and good working conditions for the farmers should play a pivotal role in a sustainable system, and should also be considered when developing future strategies for livestock production.

Environmental changes were also supposed to play a major role in the future, modifying habitats and then stimulating biological drifts. The reduction of biodiversity, with species being endangered and at possible risk of extinction in the future, could be a consequence of these changes. The **preservation of local breeds and species** will be of paramount importance, in particular for terrestrial animals. Locally developed breeds are a pool of irreplaceable genetic material of unacknowledged value, whose loss would represent a serious hazard. In fact, the preservation of these gene pool would represent a valuable tool to face new and yet unforeseen circumstances (Yilmaz et al., 2012), being an insurance against unknown future events, such as climate change and disease outbreaks (Rege and Gibson, 2003). Research should focus on the characterisation and improvement of local breeds productive traits, beside the use of exotic breeds with possibly and potentially superior productivity but lower adaptability (Yilmaz et al., 2012). Also, efforts should be spent to develop conservation strategies being both focussed on general aspects and being flexible enough to be adapted to the country and breed specificities (Martin-Collado et al., 2013).

Several vector-borne diseases are spread in the European area and the effect of climate change on disease distribution is clear-cut (Skuce et al., 2013; Bouzid et al., 2014). In fact, many aspects of the transmission cycle are strongly influenced by environmental conditions, whose changes might entail (re-)emergence or (re-)introduction of vector-borne diseases in a suitable setting (Zeller et al., 2013). Environmental changes might contribute to the creation of favourable conditions for new vectors, or to the

enhancement of the favourable period for those that are present already over the year. Recent projections identified the Mediterranean area as one of the greatest at increased risk in the next future (Bouzid et al., 2014). The urgent need for further research and field studies on **vector-borne diseases** emerged as a priority from the FORE-Med exercise, as well as form other recent studies (Mencke, 2013). Several needs were identified already to face the issue in the upcoming years, such as the development of new vaccines and diagnostic tools (Skuce et al., 2013), the development of mathematical modelling systems (Maclachlan and Mayo, 2013), and the increase of coordination among human, veterinary, entomological and environmental surveillance in the different countries (Zeller et al., 2013).

As a consequence of climate change, water scarcity and population demography (e.g. population increase due to migration fluxes), food and feed availability was also perceived as an increasingly important issue in the future (Makkar et al., 2014). Then, the study of **new protein sources**, both for animals and for humans, was seen by all focus groups as a way to face the problem, getting to least requiring and environmental impacting solutions. Several options were preliminarily investigated already, such as co-products from the biofuel and vegetable oil industries, algae and insects, but research on the production process, efficacy, safety and social acceptability of these sources are still necessary (Boland et al., 2013; Makkar et al., 2014). The need for identifying new feed sources is strong even for aquaculture, where the growth of the sector in the last decade is making the use of fish meal no longer sustainable. Some preliminary, and promising, studies were conducted already to test the feasibility of insects as fish feed additives (Barroso et al., 2014).

Interestingly, In the opinion of the experts, **genetic research** should still be a major research area in the Mediterranean in the next 15 years. In particular, the selection toward disease resistant animals (and vectors) and animals being more adaptable to new production systems and climate, were mentioned as priorities by the focus groups, being in line with other researchers findings (Hunt et al., 2013; Skuce et al., 2013). The development of disease resistant animals and the enhanced knowledge of genes and bacterial pathogenic pathways will support in the reduction of antibiotic use, and then of antibiotic resistance, that is supposed to become even more widespread in the future, with positive effects on both animal and human health and on the environment, also contributing in reducing production costs (Diaz- Sanchez et al., 2013).

The study of animals being more adaptable to farming system, on the other hand, will improve the sustainability of zootechnical practices and will have positive consequences on the **welfare** of animals as well, that being also seen as increasingly important in the future (Fraser et al., 2014). In fact, the demand for more high-welfare products in the area is expected to grow, and it would represent a tool allowing producers potential competitive advantages (Dalla Villa et al., 2014).

In general, all groups highlighted the current **techno-economic gap** among the northern and south-eastern areas of the Mediterranean as an hurdle for the achievement of some of the expected results (e.g. traceability systems). Also, the presence of conflicts in the south-eastern areas, having detrimental impact on health institutions in general, might contribute to undermine the efficacy of surveillance programmes, increasing risk of emerging diseases. (Vittecoq et al., 2014). Notwithstanding, the plausible future scenario developed by the think tank foresaw, for 2030, the gap to be reduced and the wealth in the area to be more distributed, due to trade increase and cultural shift across the two sides of the sea. Anyhow, the development of cheap and scalable tools in the animal health field could help in accelerating the achievement of the set aims.

Future changes, both on the social and environmental side, will have major impacts on the risk of infectious disease emergence. Managing these risks should be a priority for all Mediterranean governments, since it would impact on both the health of their inhabitants and the country's economy (Vittecoq et al., 2014). Research to support policy development on animal health is mostly carried out at national level and dedicated transnational research programmes are still in its infancy (Wentholt et al., 2012). An increased collaboration in managing the risks of disease emergence, including in developing appropriate research, would represent a solid countermeasure to ensure human and animal health in the area in the future.

To date, the FORE-Med provided a first overview of the research needs on animal health for the Mediterranean area as a whole. The gathered information represent an important tool to allow the planning of research activities in the next 15 years in the area. In fact, these allow both national governments, international organisations, and other stakeholders to tailor animal health policies toward a *proactive* rather than reactive approach, being able to better allocate funding and select intervention strategies to get to timely solution of future animal health issues.

Nevertheless, in order to get to a proper SRA, modulation and further prioritisation actions should be implemented. The FORE-Med results represent a milestone through the obtaining of the agenda, but the process is not ended yet. The activities will continue in the next few months in order to allow the delivery of the SRA by the end of 2014.

A new on-line survey will be developed and delivered to the experts, allowing them to select among a given list, obtained through bibliographical studies and expert opinion, the criteria to be used to prioritise the research area and topic. The prioritisation exercise itself will be implemented in a new workshop, that will be held in November 2014, involving the same experts that already participated in the first one, together with a wider number of specialists from the previously less represented areas. The outcome of this exercise will be the ranking of the different areas and, to some extent, research topics to build a detailed SRA for Mediterranean 2030.

The FORE-Med exercise cannot be considered as completely ended, nor it would be after the delivery of the SRA: it should be considered a *continuous process*. The identified research areas and priorities should be, in fact, updated regularly, since the foresight predictive capacity decreases while time passes by, in particular if, in the meanwhile, different actions are made instead of those suggested or foreseen. Moreover, providing the possibility of periodic meeting to a range of experts in different fields in the area would consolidate the network, supporting the creation of a cohesive Mediterranean team.

References

AGROPOLIS INTERNATIONAL and ANR, 2011-last update, Workshop on Mediterranean Forward-thinking (ARP-PARME 2010-2011): Partnership and research in the Mediterranean. Avalable: http://www.agropolis.org/pdf/projects-management/fiches-synthese-arp-parme-2011-english-version-low-resolution.pdf.

ANTÓN, J., CARPENTER, T., PAARLBERG, P., RUSHTON, J., SUGIURA, K., and DEHOVE, A., 2013. Livestock Disease Risk Management: Highlights from a Multidisciplinary Policy Dialogue. Livestock Disease Policies: Building Bridges Between Science and Economics, 7.

APEC, 2008. Roadmapping Converging Technologies to Combat Emerging Infectious Diseases. APEC#208-IT-01.2.

ARNALDI, S., 2012. Oltre il microcosmo. Innovazione e valutazione tecnologica partecipata. In L'innovazione responsabile di Chiocca M., Valli L. (Eds.).

BARROSO, F. G., DE HARO, C., SÁNCHEZ-MUROS, M.J., VENEGAS, E., MARTÍNEZ-SÁNCHEZ, A. and PÉREZ-BAÑÓN, C., 2014. The potential of various insect species for use as food for fish. Aquaculture, 422, pp. 193-201.

BECKER, P., 2002. Corporate Foresight in Europe. A First Overview, RTK2 Scientific and Technological Foresight, European Commission.

BELLARBY, J., TIRADO, R., LEIP, A., WEISS, F., LESSCHEN, J. P., and SMITH, P., 2013. Livestock greenhouse gas emissions and mitigation potential in Europe. Global change biology, 19(1), pp. 3-18., .

BHIMJI, W., 2009. Guidance on the use of strategic futures analysis for policy development in government. Foresight Horizon Scanning Centre, London.

BOLAND, M.J., RAE, A.N., VEREIJKEN, J.M., MEUWISSEN, M.P., FISCHER, A.R., VAN BOEKEL, M.A., RUTHERFURD, S.M., GRUPPENF, H., MOUGHA, P.J., and HENDRIKS, W.H., 2013. The future supply of animal-derived protein for human consumption. Trends in Food Science & Technology, 29(1), pp. 62-73.

BOUZID, M., COLÓN-GONZÁLEZ, F.J., LUNG, T., LAKE, I.R., and HUNTER, P.R. 2014. Climate change and the emergence of vector-borne diseases in Europe: case study of dengue fever. BMC public health, 14(1), 781.

BROOM, D. M., GALINDO, F. A., and MURGUEITIO, E., 2013. Sustainable, efficient livestock production with high biodiversity and good welfare for animals. Proceedings of the Royal Society B: Biological Sciences, 280(1771), 20132025.

CFIA, 2011. FORE-CAN project: Healthy Animals | Healthy Future 2025.

DALLA VILLA, P., MATTHEWS, L.R., ALESSANDRINI, B., MESSORI, S., and MIGLIORATI, G., 2014. Drivers for animal welfare policies in Europe. Revue scientifique et technique (International Office of Epizootics), 33(1), pp. 39-46.

DE LATTRE-GASQUET, M., 2006. The use of foresight in setting agricultural research priorities. Science and Technology Policy for Development: Dialogues at the Interface, , pp. 191.

DIAZ-SANCHEZ, S., HANNING, I., PENDLETON, S., and D'SOUZA, D., 2013. Next-generation sequencing: The future of molecular genetics in poultry production and food safety. Poultry science, 92(2), pp. 562-572.

DURANCE, P. and GODET, M., 2010. Scenario building: uses and abuses. Technological Forecasting and Social Change, 77(9), pp. 1488-1492.

EVANS, N., 2009. Adjustment strategies revisited: agricultural change in the Welsh Marches. J. Rural Studies 25, pp. 217–230.

FRASER, D., 2014. The globalisation of farm animal welfare. Revue scientifique et technique (International Office of Epizootics), 33(1), pp. 33-38.

GENUS, A., 2006. Rethinking constructive technology assessment as democratic, reflective, discourse. Technological Forecasting and Social Change, 73(1), pp. 13-26.

HAYMAN, D.T., GURLEY, E. S., PULLIAM, J. R., and FIELD, H. E., 2013. The Application of One Health Approaches to Henipavirus Research. In One Health: The Human-Animal-Environment Interfaces in Emerging Infectious Diseases (pp. 155-170). Springer Berlin Heidelberg.

HORIZON SCANNING CENTRE, 2008-last update, Exploring the future: Tools for strategic thinking. Available: http://hsctoolkit.bis.gov.uk/Other-sources-and-toolkits.html [March, 2013].

HUNT, P.W., KIJAS, J., and INGHAM, A., 2013. Understanding parasitic infection in sheep to design more efficient animal selection strategies. The Veterinary Journal, 197(2), pp. 143-152.

INRA, 2008. Agriculture 2013 Foresight Study. Objectives and Methodology.

JRC EUROPEAN COMMISSION, 2007-last update, The FOR-LEARN Online Foresight Guide. Available: http://forlearn.jrc.ec.europa.eu/guide/0_home/index.htm [February, 2013].

KANEENE, J. B., KAPLAN, B., STEELE, J. H., and THOEN, C. O., 2014. One Health approach for preventing and controlling tuberculosis in animals and humans. Zoonotic Tuberculosis: Mycobacterium bovis and Other Pathogenic Mycobacteria, Third Edition, pp. 9-20.

LEMAIRE, G., FRANZLUEBBERS, A., CARVALHO, P.C.D.F., and DEDIEU, B., 2014. Integrated crop–livestock systems: strategies to achieve synergy between agricultural production and environmental quality. Agriculture, Ecosystems & Environment, 190,pp. 4-8.

MACLACHLAN, N.J. and MAYO, C.E., 2013. Potential strategies for control of bluetongue, a globally emerging,< i> Culicoides</i>-transmitted viral disease of ruminant livestock and wildlife. Antiviral research, 99(2), pp. 79-90.

MAKKAR, H.P., TRAN, G., HEUZÉ, V., and ANKERS, P., 2014. State-of-the-art on use of insects as animal feed. Animal Feed Science and Technology.

MARTIN, B.R. and JOHNSTON, R., 1999. Technology foresight for wiring up the national innovation system: experiences in Britain, Australia, and New Zealand. Technological Forecasting and Social Change, 60(1), pp. 37-54.

MARTIN-COLLADO, D., DIAZ, C., MÄKI-TANILA, A., COLINET, F., DUCLOS, D., HIEMSTRA, S.J., and GANDINI, G., 2013. The use of SWOT analysis to explore and prioritize conservation and development strategies for local cattle breeds. animal, 7(6), pp.885-894.

MENCKE, N., 2013. Future challenges for parasitology: vector control and 'One health' in Europe: the veterinary medicinal view on CVBDs such as tick borreliosis, rickettsiosis and canine leishmaniosis. Veterinary parasitology, 195(3), pp. 256-271.

MERCER, J., 1991. Strategic planning for public managers. ABC-CLIO.

NICHOLS, G.L., ANDERSSON, Y., LINDGREN, E., DEVAUX, I., and SEMENZA, J.C., 2014. European Monitoring Systems and Data for Assessing Environmental and Climate Impacts on Human Infectious Diseases. International journal of environmental research and public health, 11(4), pp. 3894-3936.

NICOLL, A., HUANG, J., XIE, Z. and FORESIGHT CHINA PROJECT GROUP, 2009. Foresight Infectious Diseases China Project--a novel approach to anticipating future trends in risk of infectious diseases in China: methodology and results from an initial application. Euro surveillance : bulletin Européen sur les maladies transmissibles = European communicable disease bulletin, 14(27), pp. 19261.

NYEWE, P.M., 2011. Design of a framework for implementing strategic foresight at south african state owned enterprises. Research report presented in partial fulfilment of the requirements for the degree of Master of Philosophy – Future Studies at the University of Stellenbosch, pp. 103.

ODOLINI, S., PAROLA, P., GKRANIA-KLOTSAS, E., CAUMES, E., SCHLAGENHAUF, P., LOPEZ-VELEZ, R., BURCHARD, G.D, SANTOS-O'CONNOR, F., WELD, L., VON SONNENBURG, F., FIELD, V., DE VRIES, P., JENSENIUS, M., LOUTAN, L. and CASTELLI, F., 2012. Travel-related imported infections in Europe, EuroTravNet 2009. Clinical Microbiology and Infection, 18(5), 468-474.

OIE, 2014. Chapter 4.1. General principles on identification and traceability of live animals. In: OIE (Ed.), Terrestrial Animal Health Code. World Animal Health Organisation, Paris.

RABINOWITZ, P, and CONTI, L., 2014. Links Among Human Health, Animal Health, and Ecosystem Health. Annual Review of Public Health, 34, pp.189-204.

RABINOWITZ, P.M., KOCK, R., KACHANI, M., KUNKEL, R., THOMAS, J., GILBERT, J., et al. 2013. Toward proof of concept of a One Health approach to disease prediction and control. Emerg Infect Dis [Internet]. http://dx.doi.org/10.3201/eid1912.130265.

REGE, J.E.O. and GIBSON, J.P., 2003. Animal genetic resources and economic development: issues in relation to economic valuation. Ecological Economics 45, pp. 319–330.

RIALLAND, A. and WOLD, K., 2009. Future Studies, Foresight and Scenarios as basis for better strategic decisions.

SKUCE, P.J., MORGAN, E.R., VAN DIJK, J. and MITCHELL, M., 2013. Animal health aspects of adaptation to climate change: beating the heat and parasites in a warming Europe. animal, 7(s2), pp. 333-345.

SPRING, L., 2005. Animal health foresight project: Minneapolis Scenarios Workshop Report. Science and technology foresight, pp. 1-64.

TAIT, J., WIELD, D., BRUCE, A. and CHATAWAY, J., 2007. Health biotechnology to 2030. Report to OECD International Futures Project "The Bio-Economy to, 2030, pp. 51.

UNIDO, 2004. Foresight methodology. Vienna, Austria: .

VILLALONGA-OLIVES, E., and KAWACHI, I., 2014. The changing health status of economic migrants to the European Union in the aftermath of the economic crisis. Journal of epidemiology and community health, jech-2014.

VITTECOQ, M., THOMAS, F., JOURDAIN, E., MOUTOU, F., RENAUD, F., and GAUTHIER-CLERC, M., 2014. Risks of emerging infectious diseases: Evolving threats in a changing area, the mediterranean basin. Transboundary and emerging diseases, 61(1), pp. 17-27.

VON SCHOMBERG, R., PEREIRA, Â.G. and FUNTOWICZ, S., 2006. Deliberating foresight knowledge for policy and foresight knowledge assessment. Interfaces between Science and Society, 1(48), pp. 146-174.

WENTHOLT, M.T.A., CARDOEN, S., IMBERECHTS, H., VAN HUFFEL, X., OOMS, B. W., and FREWER, L.J., 2012. Defining European preparedness and research needs regarding emerging infectious animal diseases: Results from a Delphi expert consultation. Preventive veterinary medicine, 103(2), pp. 81-92.

YILMAZ, O., KOR, A., ERTUGRUL, M., and WILSON, R.T., 2012. The domestic livestock resources of Turkey: goat breeds and types and their conservation status. Animal Genetic Resources/Ressources génétiques animales/Recursos genéticos animales, 51, pp. 105-116.

ZELLER, H., MARRAMA, L., SUDRE, B., BORTEL, W. and WARNS-PETIT, E., 2013. Mosquito-borne disease surveillance by the European Centre for Disease Prevention and Control. Clinical Microbiology and Infection, 19(8), pp. 693-698.

ZENETOS, A., SIOKOU-FRANGOU, I., GOTSIS-SKRETAS, O., GROOM, S., LA ROSA, D., SULIS, A. and PAOLILLO, P.L., 2013. -last update, Il Mare Mediterraneo. Available: http://www.arpalombardia.it/EEA/pdf/cap9.pdf.

Appendix I

FORLEARN

Template for Foresight exercise project plan	
Purpose:	The objective of this document is to schedule in detail the work, approach, planning and organization of the foresight exercise. Also a detailed description of the objectives and results are included.
Audience	Major clients who have the authority to make the decision to go ahead with setting up the organization of a foresight exercise (need for results, access to budgets).
Chapter 1	**Introduction to the exercise** • Global description of the problem within the organization where foresight has added value, what is the added value and what effect to the audience is the main focus? • What is the global approach of the foresight exercise? • What are the objectives and global results of the exercise? • What is the global audience of the exercise? • What is the purpose of the document?
Chapter 2	**Objectives of the exercise** • What is the overall objective of the exercise? • What is the effect it aims at to its audience (difference is that an objective can be realized within the project, but an effect is within the influence frame of the audience)? • What are underlying sub objectives, both process objectives and content objectives (domain, time horizon, DESTEP, etc.)? • What are concrete tangitable results of the exercise, both content and process (e.g. reports, workshops, websites, etc.)? • What are its stakeholders and audience, including small description of their relevant interests? • What is the communication strategy?
Chapter 3	**Background** • What is the policy framework it is in (policy domain, phase, central policy issues, etc.)? • What is the added value of using a foresight exercise and how does it fit in the policy framework (continuity)? • Choosing the focal method, designing a foresight. • List of used definitions
Chapter 4	**Foresight approach** • What are important limiting factors (budget, stakeholder involvement, time internal capacity, etc.)? • What are possible pitfalls and risks? • How are they addressed within the approach • Description of work packages, including communication and management
Chapter 5	**Planning and organization** • Description of the organization, including core team, working teams and their tasks and responsibilities. • Communication to client (who, when, about what). • Description of planning (GANTT), including a milestone planning.
Chapter 6	**Budget** • Description of the budget needed according to each work package and involved partners. • Financial and administrative statements.

Appendix II

In collaborazione con

Istituto Zooprofilattico Sperimentale delle Regioni Lazio e Toscana

Ministero della salute

Dipartimento della sanità pubblica veterinaria, della sicurezza alimentare e degli organi collegiali per la tutela della salute - Ufficio II

FOREMed Workshop:
costruzione di una SRA (Strategic Research Agenda)
in sanità animale per il Mediterraneo

Presso Ente CRA

Via Nazionale, 82 - Roma,

20-21 marzo 2014

FOREMed 21 marzo 2014

Giorno 2: Dalla teoria alla pratica: "E' ipotizzabile una Strategic Research Agenda mediterranea in sanità animale?"

(richiesta presenza prioritaria degli esperti del Settore Sanità Animale/Acquacoltura)

Orario	Attività	Output:
9.00-10.00	- Continua costruzione 5° scenario.	Focus sui passi decisivi per ottenere un futuro efficiente in Sanità Animale
10.00-11.00	***Suddivisione in due gruppi (animali terrestri/ acquatici)*** - Partendo dal 5° scenario: Identificare **fattori limitanti e favorenti**	
11.00 -11.30	Coffe break	
11.30-13.00	Traduzione delle necessità dei settori in aree di ricerca: - 20 aree di ricerca per il Settore della Sanità animale per gli **animali terrestri** - 20 aree di ricerca per il Settore della Sanità animale in **acquacoltura**	
13.00-14.00	Pranzo	
14.00-16.00	- Continua lavoro in due gruppi. - Presentazione dei risultati	Costruzione della SRA: principali aree di ricerca
16.00-16.30	- Termine dei lavori - Chiusura del workshop	

FOREMed 20 marzo 2014

Giorno 1: Quale futuro?

Orario	Attività	Output:
10.00- 10.30	Indirizzi di benvenuto Ministero della Salute Ente CRA, MIPAAF STAR-IDAZ Coordinator - Alex Morrow (DEFRA,UK)	
10.30-11.45	Introduzione alla giornata: - **Foresight** come metodo partecipativo all'agenda strategica dei progetti europei ERAnet (Marina Bagni, Ministero Salute) - Descrizione delle attività del workshop (Romano Zilli, IZSLT) - Brainstorming su **driver** e principali **patologie** identificati: *Definizione di driver* (Valeria Mariano, IZSLT/STARIDAZ); *Principali patologie per area mediterranea* (Stefano Messori, *ANIHWA)* - Presentazione lavoro di costruzione scenari (Marina Bagni, Ministero Salute) ***Suddivisione in 4 gruppi di lavoro***	Focalizzazione sugli obiettivi dei settori specifici per la Sanità Animale Confidenza con i driver della Sanità Animale.
11.45-12.15	Coffe break	
12.15- 13.30	- Esercizio di gruppo (4 gruppi) - Costruzione **4 scenari**	Apertura mentale nei confronti delle diverse possibilità tramite la costruzione di 4 scenari
11.45-12.15	Coffe break	
14.30-15.30	- Costruzione dei 4 scenari (continua) - Estrazione **driver plausibili e favorevoli** dai 4 scenari	
15.30-16.30	➢ Presentazione degli scenari	
16.30	Coffe break (formula open)	
16.30-18.00	Spiegazione 5° scenario (Romano Zilli, IZS LT) - Costruzione del **5° scenario**	
18.30-20.00	Social buffet	

Finalità ed Obiettivi di FOREMed:

FOREMed (Foresight project for the Mediterranean area) è un progetto del Ministero della Salute sviluppato allo scopo di identificare le sfide future del Settore di Sanità Animale, sia di animali terresti che in acquacoltura, per contribuire ad un effettivo coordinamento della attività di ricerca in Sanità Animale.

L'iniziativa si inquadra nel contesto delle attività collaborative svolte all'interno dell'alleanza globale per il coordinamento della ricerca sulle maggiori malattie infettive animali e zoonosi (ERAnet FP7 STAR-IDAZ,) che nel proprio Work Package 5 analizza i risultati di studi previsionali per le diverse aree geografiche con l'obiettivo di definire le priorità per lo sviluppo di un'Agenda Strategica di Ricerca globale nel settore di Sanità Animale.

I principali obiettivi di FOREMed sono i seguenti:

1. Identificare e categorizzare fattori e trend del settore di sanità animale nel Mediterraneo,
2. Pianificare scenari futuri plausibili del settore,
3. Suggerire strategie di ricerca al fine di prevenire, controllare o mitigare i problemi della Sanità Animale, incluse le zoonosi.

Coordinamento e organizzazione evento

- ***Marina Bagni***, *Ministero della Salute, DSVETOC, Ufficio II*
- ***Romano Zilli***, *IZS del Lazio e della Toscana, Task leader ERAnet STARIDAZ*
- ***Valeria Mariano***, *IZS del Lazio e della Toscana, collaboratore ERAnet EMIDA e STARIDAZ*
- ***Stefano Messori***, *Task leader ERAnet ANIHWA*
- ***Antonella Bozzano***, *Uff. Formazione, Comunicazione e Documentazione, IZS LT*

Referente evento

Marina Bagni, *Ministero della salute, DSVETOC Ufficio II*
Leader WP2 ERAnet ANIHWA, Leader WP5 ERAnet STARIDAZ
Viale Giorgio Ribotta, 5 - 00144 Roma
tel. 06 5994 6129 – cel. 320 4078131
email: marina.bagni@sanita.it

Si ringraziano l'Ente CRA per l'ospitalità e la collaborazione
e l'Ufficio Formazione IZS LT per il supporto operativo