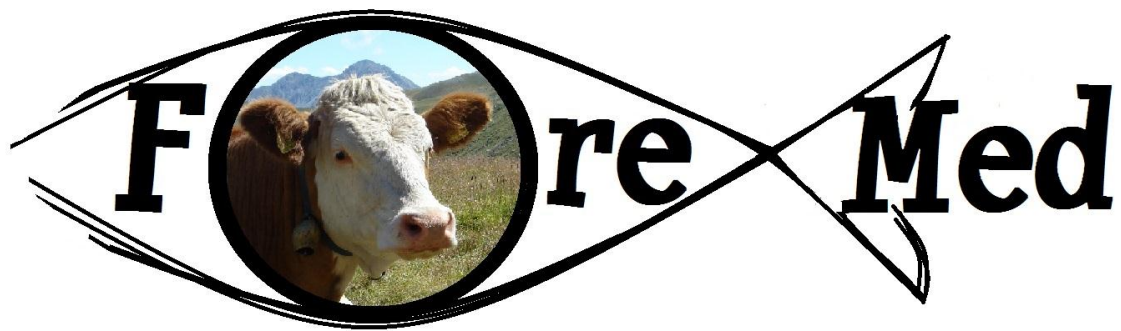


March 2015



ITALIAN
MINISTRY
OF HEALTH

FORE-MED REPORT
BUILDING A STRATEGIC RESEARCH AGENDA FOR
ANIMAL HEALTH FOR THE MEDITERRANEAN

RESULTS FROM THE II° WORKSHOP

*“Préparer l'avenir ce n'est que fonder le présent.
L'avenir, tu n'as point à le prévoir mais à le permettre ”
(A. de Saint Exupéry)*



In collaboration with:



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

Authors

Stefano Messori¹
Romano Zilli¹
Valeria Mariano¹
Marina Bagni²

¹Istituto Zooprofilattico
Sperimentale delle Regioni
Lazio e Toscana, Ufficio Ricerca,
Sviluppo e Cooperazione
Internazionale,
via Appia Nuova, 1411- 0178
Ciampino, Roma,
Italy

²Ministero della Salute,
Segretariato Generale,
Ufficio II,
Via Giorgio Ribotta, 5- 0144
Roma,
Italy

About the authors

Dr. Stefano Messori, DVM (2006), PhD in Animal Nutrition, has a multi-year experience as a researcher at the OIE Collaborating Centre for Veterinary Training, Epidemiology, Food Safety and Animal Welfare (Istituto Zooprofilattico Sperimentale dell'Abruzzo e del Molise). In the last 3 years, he has been working for the Italian Ministry of Health as task leader on the ANIHWA ERA-NET project, being involved in the mapping and analysing of national research programmes on animal health and welfare, in the identification of research gaps and in supporting decision-makers in research prioritising.

Dr. Romano Zilli, DVM (1987), post-graduate three years specialisation in Veterinary Public Health, has 20 years of professional experience. Since 2003 he has been senior veterinary officer at the Istituto Zooprofilattico Sperimentale Lazio e Toscana and, since 2007, he is head of the Research and International Affairs Office, where he manages averagely 25 research projects/year. He was backstop officer in EMIDA and ANIHWA ERAnets and STAR-IDAZ Global-Net on behalf of Ministry of Health. He is currently President of European Association of State Veterinary Officers.

Dr. Valeria Mariano, DVM (2005), MSc in Veterinary Public health, post graduate three years specialisation in Animal Health with a thesis concerning participatory decision-making methods. Since 2008 she has been working at the Istituto Zooprofilattico Sperimentale Lazio e Toscana as researcher and, before FORE-Med, she has been involved in the international research coordination projects in the field of Animal Health EMIDA ERAnet and STAR-IDAZ, providing input respectively in mapping European research perceived needs and in design criteria for global research priority-setting.

Dr. Marina Bagni, DVM (1993), PhD in Obstetrics and Immunology, post-doc traineeship at Kimron Veterinary Institute in Israel, specialisation in Zoo-prophylaxis. She has almost 10 years research experience on the evaluation of animal wellbeing and welfare on terrestrial and aquatic farmed species. She was involved in the implementation of several research programmes on food safety and animal health management in developing countries (Bolivia, March-April 1994; Ethiopia, April 1995; Ghana, March 1998; Lebanon, May 2001.) Since 2004, she is in charge at Office II - General Secretariat (ex DSVET), Ministry of health- dealing with the coordination of veterinary research activity; the management of research proposals evaluation; the promotion of European research. She has been work package leader in all the ERAnet on animal health that involved the Italian Ministry of health (EMIDA, ANIHWA, STARIDAZ) and in several other European research coordination tools (such as SCAR CWGs; JPI) that contributed to the realisation of the SRAs in most of these EU actions.

Contributors

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Last Name	Name	Affiliation
Alessandrini	Barbara	IZS AM, IT
Arcangeli	Giuseppe	IZS VE, IT
Astiz	Susan	INIA, ES
Bagni	Marina	MINSAL, IT
Baldi	Loredana	IZS ME, IT
Bossù	Teresa	IZS LT, IT
Brener	Yakov	KIMRON VETERINARY INSTITUT, IL
Caracappa	Santo	IZS SI, IT
Catania	Salvatore	IZS VE, IT
Catarci	Pierfrancesco	MINSAL, IT
Cherchi	Simonetta	IZS SA, IT
Chiavacci	Laura	IZS PLV, IT
Di Nocera	Fabio	IZS ME, IT
Fasanella	Antonio	IZS PB, IT
Formato	Giovanni	IZS LT, IT
Jestin	André	ANSES, FR
Lavazza	Antonio	IZS LER, IT
Loufti	Chafiqal	BIOPHARMA, MA
Marchitelli	Cinzia	CRA, IT
Messori	Stefano	MINSAL, IT
Mezher	Ziad	LEBANON/IZS LT, LB/IT
Miarelli	Maria Teresa	CRA, IT
Moioli	Bianca	CRA, IT
Pavlak	Marina	FACULTY OF VETERINARY MEDICINE ZAGREB, HR
Petrini	Antonio	IZS AM/OIE
Pezzotti	Giovanni	IZS UM, IT
Pomilio	Francesco	IZS AM, IT
Prearo	Marino	IZS PLV, IT
Savini	Giovanni	IZS AM, IT
Scaramozzino	Paola	IZS LT, IT
Scicluna	Maria Teresa	MALTA/IZS LT, MT/IT
Sellers	Scott	DEFRA, UK
Sghaier	Soufie	INSTITUT DE LA RECHERCHE VETERINAIRE DE TUNISIE, TN
Sotiraki	Somaro	NAGREF, GR
Torina	Alessandra	IZS SI, IT
Touil	Nadia	HOPITAL MILITAIRE D'INSTRUCTION MED. VET., MA
Vaccari	Gabriele	ISS, IT
Yazicioglu	Nahit	MINISTRY OF AGRICULTURE, TR
Zilli	Romano	IZS LT, IT



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Glossary

AI	<i>Avian Influenza</i>
AMR	<i>Anti-Microbial Resistance</i>
ANSES	<i>Agence nationale de sécurité sanitaire de l'alimentation, de l'environnement et du travail</i>
AO	<i>Animal Origin</i>
BT	<i>Blue Tongue</i>
BVD	<i>Bovine Viral Diarrhoea</i>
CCHF	<i>Congo Crimean Haemorrhagic Fever</i>
CRA	<i>Centre for Research on Agronomics</i>
CVO	<i>Chief Veterinary Officer</i>
DEFRA	<i>Department for Environment, Food and Rural Affairs</i>
EMIDA	<i>Emerging and Major Infectious Disease of Livestock project</i>
ERA Net	<i>European Research Area Network</i>
EU	<i>European Union</i>
FAO	<i>Food and Agriculture Organisation</i>
FMD	<i>Foot and Mouth Disease</i>
FORE-Med	<i>Animal health foresight for the Mediterranean</i>
I&R	<i>Identification and Registration</i>
IBR	<i>Infectious Bovine Rhinotracheitis</i>
INIA	<i>Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria</i>
ISS	<i>Istituto Superiore di Sanità</i>
IZS AM	<i>Istituto Zooprofilattico Sperimentale dell'Abruzzo e del Molise</i>
IZS LER	<i>Istituto Zooprofilattico Sperimentale della Lombardia e dell'Emilia Romagna</i>
IZS LT	<i>Istituto Zooprofilattico Sperimentale delle regioni Lazio e Toscana</i>
IZS ME	<i>Istituto Zooprofilattico Sperimentale del Mezzogiorno</i>
IZS PB	<i>Istituto Zooprofilattico Sperimentale di Puglia e Basilicata</i>
IZS PLV	<i>Istituto Zooprofilattico Sperimentale del Piemonte Liguria e Valle d'Aosta</i>
IZS SA	<i>Istituto Zooprofilattico Sperimentale della Sardegna</i>
IZS SI	<i>Istituto Zooprofilattico Sperimentale della Sicilia</i>
IZS UM	<i>Istituto Zooprofilattico Sperimentale dell'Umbria e delle Marche</i>
IZS VE	<i>Istituto Zooprofilattico Sperimentale delle Venezie</i>
JRC	<i>Joint Research Centre</i>
NAGREF	<i>National Agricultural Research Foundation</i>
OIE	<i>World Organisation for Animal Health</i>
RVF	<i>Rift Valley Fever</i>
SCAR	<i>Standing Committee Agricultural Research</i>
SOP	<i>Standard Operating Procedures</i>
SRA	<i>Strategic Research Agenda</i>
STAR-IDAZ	<i>Strategic Alliances for the Coordination of Research on the Major Infectious Diseases of Animal and Zoonoses</i>
STEEP	<i>Social, Technological, Economic, Environmental, Political</i>
TB	<i>Tuberculosis</i>
UK	<i>United Kingdom</i>
WND	<i>West Nile Disease</i>

Executive Summary

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

This report presents the outcomes of the second workshop of the FORE-Med initiative (*Foresight project for the Mediterranean area*), that was held in November 2014. The project, carried out between 2013-2014, under the auspices of the Italian Ministry of Health, has the aim of producing the first Strategic Research Agenda (SRA) for animal health for the Mediterranean.

Climate change and increasing movement of humans, animals and goods pose risks of emergency and re-emergence of diseases across countries. The Mediterranean area, due to its peculiar geographical, climatic and social characteristics, is particularly subjected to these risks, and the current reduction of financial availability across the different countries might exacerbate the crisis in case of outbreaks. Adequate research in the animal health field will constitute the only possibility of having adequate strategies and control tools to ensure preparedness for future challenges.

The need for a transnational cooperation in research on animal health is well recognised, both to ensure research quality and to reduce costs (i.e. avoiding duplication of efforts). Disease don't respect borders, and the nature of the threats itself make cooperation indispensable to allow funders to address the problems appropriately.

The FORE-Med project was launched to stimulate the coordination of research in the Mediterranean area, providing a 15-years forward look on future scenarios for the Mediterranean area, to identify research needs that would enable preparedness for future challenges. A full foresight study was carried out, involving 100 experts belonging to 11 Mediterranean countries and belonging to a broad range of professional fields.

The process allowed the identification of priority research areas and topics in the field of animal health, that will constitute the basis for the SRA. The aim of the SRA is to provide animal health research funders in the Mediterranean area a framework against which plan and coordinate future activities, in order to get prepared for future scenarios and best mitigate against likely future threats. As for the EMIDA SRA (EMIDA, 2011), its aim is not to dictate specific future research calls, but rather to provide relevant advice, that may be considered and acted upon in line with the funders' own priorities.

The indications provided regard both terrestrial and aquatic animals, and include animal health topics considered from a broad perspective, including both infectious and production diseases. Although animal welfare is somehow mentioned among the topics, it was not one of the main objectives of the initiative, and should be considered as a component of animal health for the purpose of the SRA. This might imply that relevant aspects concerning animal welfare might not be included among the listed priorities.

Aim of this report is to provide guidance to the policy makers and research funders in national and transnational research programming. The broadness of the covered field, and the large variety of cultures and organisations in the countries included in the area within the scope of this initiative, suggest the potential recipients of the SRA to be belonging to a wide range of organisations, both public and private.



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Section I: Background and aims

The FORE-Med (*Foresight project for the Mediterranean area*) is a provisional study (foresight) 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. Final outcome of this project will be a Mediterranean Strategic Research Agenda (SRA) on animal health.

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). Also, it is considered as an useful decisional support tools for the definition of strategies in the public sector (de Lattre-Gasquet, 2006).

Recent studies investigated the embedding of foresight in transnational research programming, highlighting as this can lead to novel networking and cross-feeding of research and innovation initiatives across sectors (Könnölä and Haegeman, 2012). Also, foresight appeared to play an even more beneficial role, when applied to transnational programming in a non-European context. Then, foresight appeared to be the tool of choice for framing an SRA for animal health in the Mediterranean. The temporal scope of the FORE-Med study was **15 years** (Mediterranean 2030).

The Mediterranean area represents the joining point of three continents and more than 20 different countries. Despite the presence of strong differences on the climatic and socio-political background among the countries in the area, strong interlinks exist among the populations, due to geographical proximity, movements of persons, animals and goods, economy globalisation, transport and communication routes. Climatic variation associated to extreme weather events, as well as the exacerbation of seasonal conditions, are getting increasingly frequent in the area (Zenetos et al. 2013). The acute consequences of these changes would make the Mediterranean especially vulnerable to the rise of new pathogens (Vittecoq et al., 2014). Also, the risk that infectious diseases may pass national borders in the area is well known, due to the ecological similarities, exacerbated by the climate changes (Dhama et al., 2013a), and to the movements of humans, animals and product of animal origin.

Cross-border diseases, as well as emerging and re-emerging ones, create an urge to increase cooperation and strategic harmonisation of actions at global and regional level (Dhama et al., 2013b). Also, a concerted approach to animal health in the area is deemed necessary to ensure food security and profitability of zootechnical production despite climatic changes.

Provisional studies should be considered as participative and reasoned methods that, through the establishment of a common medium-long term vision among stakeholders, are 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 development of a SRA on animal health for the Mediterranean will support local and supranational authorities to perform long-term planning and to face the new challenges. Recipients of such agenda are to be considered both national research funding agencies (e.g. ministries and research centres), as well as international commissioning bodies (e.g. the European Commission and the OIE), and private companies being active on animal health research. The various sections of this report will be structured as to provide guidance to the different recipient bodies about how to better implement the identified actions.

Geographical scope

At geo-political level, the Mediterranean basin comprehends all countries that overlooks it . For the purpose of the FORE-Med project, the Mediterranean area was divided into two sub-areas, mainly based on geographical reasons: Northern Mediterranean South-eastern Mediterranean (*Figure 1*). A list of the countries belonging to each of the two sub-regions is provided in *Table 1*.





















Northern Mediterranean	South-eastern Mediterranean
 Albania	 Algeria
 Bosnia-Herzegovina	 Cyprus
 Croatia	 Egypt
 France	 Israel
 Greece	 Lebanon
 Italy	 Libya
 Malta	 Morocco
 Montenegro	 Syria
 Slovenia	 Tunisia
 Spain	 Turkey

Table 1: List of countries included in the Northern Mediterranean’ and ‘South-eastern Mediterranean’ sub-regions.



Figure 1: Geographical scope: the Mediterranean area. For the purpose of the study, countries in green were classified as ‘Northern Mediterranean’ while those in orange ‘South-eastern Mediterranean’.

FORE-Med overall structure

Three main phases are to be followed to carry on a foresight study, being the *analysis* of the current situation, the *formulation* of possible future scenarios and then the *implementation* of strategic choices (JRC, 2007; Horizon Scanning Centre, 2008).

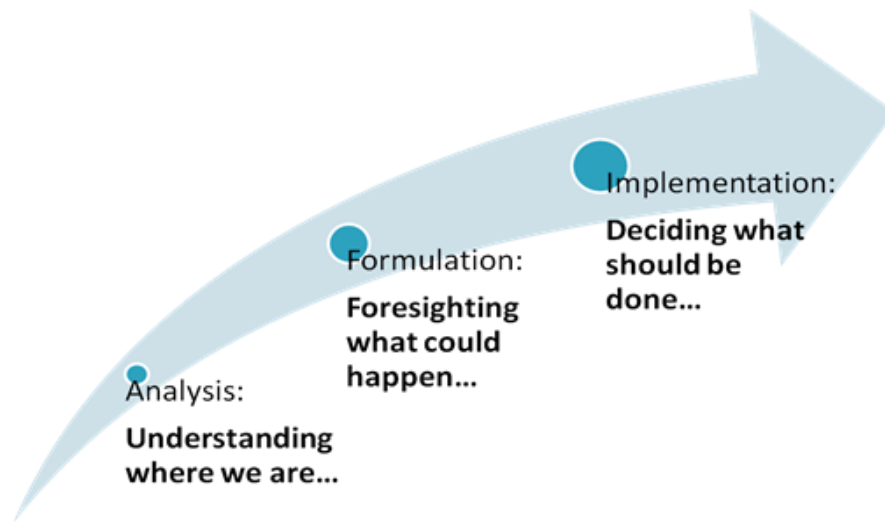


Figure 2: The three main phases of a provisional study.

Each of those phases can be carried out using one or more different techniques. In *Table 2* some of the possible options are listed.

Table 2: Main techniques to be applied for each foresight phase (adapted from Horizon Scanning Centre, 2008).

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

Those techniques can be combined in order to obtain the methodology being the most fitting for the given purpose of the study. The choice of the methods to be implemented, in fact, is critical to ensure a proper foresight. In *Figure 3*, the different techniques used for the implementation of the FORE-Med study are presented. The selection of the most appropriate methods was performed using a basis the ‘Inventory of foresight methodologies and studies’ (Nicolini & Bagni, 2012), developed in the framework of the STRA-IDAZ Global net on animal health.

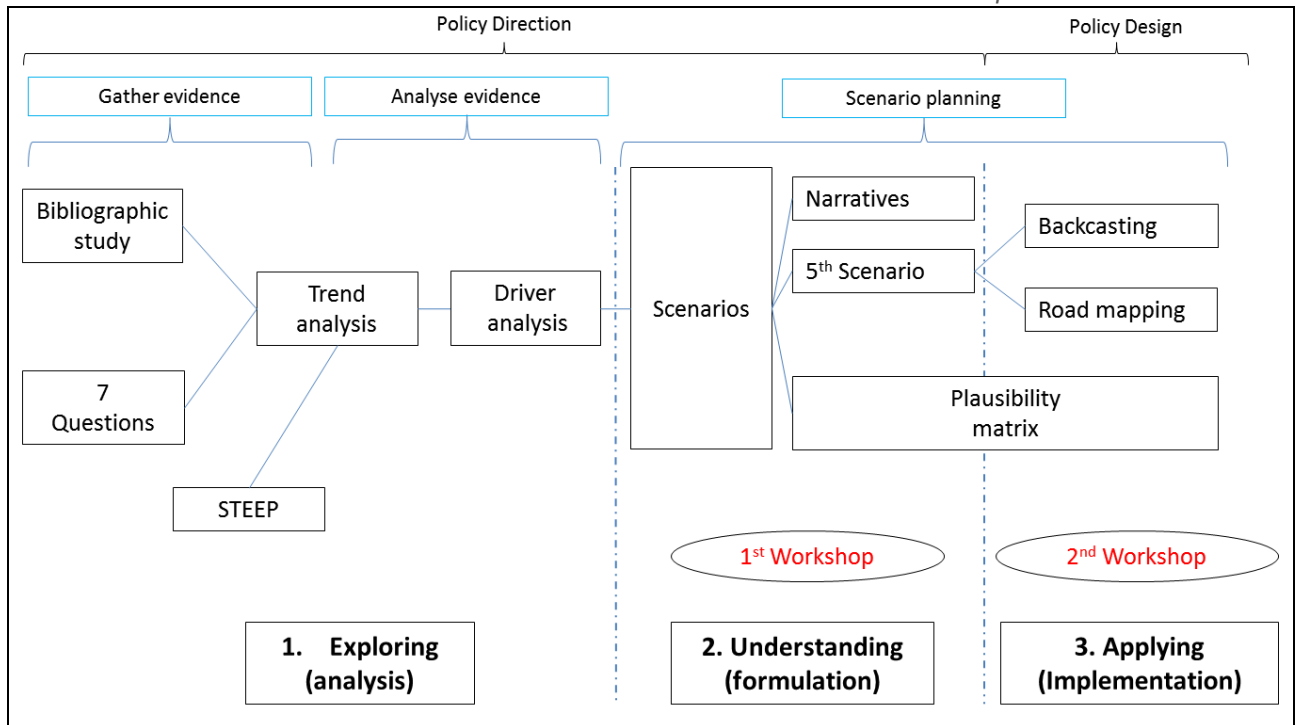


Figure 3: Breakdown of the techniques implemented in the FORE-Med study (adapted from Bhimji, 2009).

Main outcomes of the first phases of the project have been the scenarios (including the 5th one), the definition of a list of priority diseases (**Annex I**) and a preliminary identification of priority research areas on animal health for Mediterranean 2030. The first phases of the study have been presented already in the FORE-Med report “Animal health foresight for the Mediterranean”. Details about the third phase of the process (Implementation) are provided in the following sections of this report.

Overall, the FORE-Med project involved **100** experts, belonging to 11 countries in the Mediterranean area, to inter-governmental organisations (e.g. OIE, FAO), and to cutting-edge research centres, governmental agencies and stakeholder group from non-Mediterranean countries (e.g. the DEFRA, UK). The experts belonged to a range of different professional fields, including not only veterinary science but also climatology, social sciences, the industry, and policy.

Section II: the 2nd FORE-Med Workshop

The first phases of the project allowed the analysis of the current situation and the formulation of the possible futures. The last phase of a foresight should build on the previous one to deliver proposal of actions to be performed to solve/reduce future threats, shaping a desirable future.

This phase was implemented through a dedicated workshop, organised in Rome on the 3-4th of November 2014. Starting point of the work were the outcomes of the 1st FORE-Med workshop, that took place on the 20-21st March 2014 in Rome, which provided a 5th scenario for animal health in the Mediterranean and, backcasting from this, the identification of several macro-area research on animal health and aquaculture for the Mediterranean as a whole. The first phases of the project are described in detail and discussed in the FORE-Med report: Animal health foresight for the Mediterranean (Bagni et al., 2014).

Aims of this workshop were to provide:

1. Further details on priority research areas and topics;
2. Common research needs for Mediterranean as a whole vs. specific needs for the different sub-areas;
3. A weighting for the identified research needs;
4. A time schedule for the needed research.

Thirty-four experts from **11** Mediterranean countries were involved in the meeting. Also, one representative of the SCAR Collaborative Working Group (CWG) for Animal Health and Welfare Research took part in the meeting, in order to ensure the coordination of activities with other relevant initiatives carried out at EU level. The coordination of the meeting was held by four facilitator, being familiar with the fields involved in the study, with the role of and bridging and integrating concepts from the various experts and for supporting the establishment of a joint visions and the ownership of strategies.

Differently to the first workshop, where the range expertise was broader, in this case all experts belonged to the various animal health research fields. In fact, since while broader expertise were needed for the shaping of a preferred scenario being as much possible inclusive of all different aspects and for the selection of macro-areas of investigation, in this step an in-depth knowledge of the research areas was needed in order to identify up to dated and detailed research needs. Moreover, workshop participants were not only selected on the basis of their expertise but it was attempted to balance the group also on the basis of other aspects (e.g. age, gender, institutional affiliation), as suggested by Rasmussen et al. (2010). Group balance for age and gender is presented in *Figure 4*. Institutional assortment was ensured allowing the participation to a maximum of 4 expert per institution. A trade-off between researchers and policy makers/funders was ensured as well (62 vs 38% respectively).

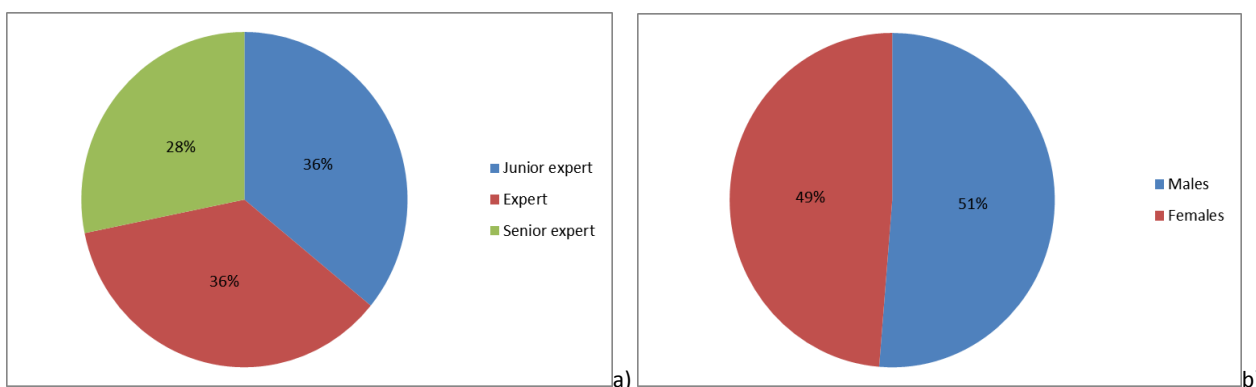


Figure 4: Balance of the participants to the second FORE-MED workshop per age (a) and gender (b).

The active participation of the experts in the foresight exercise is of paramount importance to heighten their sense of ownership and a desire for continued involvement (Robinson et al., 2011). In order to allow all participants to build familiarity around the FORE-Med exercise as a whole, a report containing the outcomes of the previous phase of the foresight has been sent to all experts available prior to the workshop, together with the workshop agenda (**Annex II**).

Workshop breakdown: backcasting

The first day of the workshop was dedicated to interactive exercises, built on the 5th scenario (*Mare nostrum*; **Annex III**). Interactive exercises are fundamental to promote mind openness toward possible future events as well as to favour dialogue and knowledge sharing between the specialists. Participants were divided into two groups, based on the geographical provenience (Northern Mediterranean and South-eastern Mediterranean), and were assigned a backcasting exercise.

In general, backcasting involves working backwards from a particular desirable future end-point to the present to determine the physical feasibility of that future and what measures are required to achieve the given future (Geurs & van Wee, 2004). This process involves considering barriers and enablers to the preferred future, and the consideration of possible pathway to meet the vision. The differences existing among the two sub-areas to-date, making the likeliness of having different enablers and barriers to get to the common preferred future very high, guided the decision of splitting the participants in geographical groups for this exercise.

In order to ensure harmonisation between the work of the two groups, some guidelines were provided to the participants, that were specifically asked to:

1. Define what elements are different between the given future and today situation (in the given Mediterranean sub-area);
2. Define which is the preferred future (identify an overall objective in a short definition) in the given Mediterranean sub-area.
3. Discuss both barriers and enablers within control and out of control.
4. Define which are the barriers to the achievement of the preferred future (and which are enablers that can contribute in tearing down/reducing the extent of such barriers).
5. Identify the strategies or 'pathways of action' important to improve *barriers within control* and those which can help optimise *enablers within control* factors.

During the morning of the second day, the outcomes of the two geographic groups were discussed in plenary. The lists of identified barriers and enablers were merged and each group was asked to attribute a scoring from 1-5 to each of the items (for both sub-areas), from a sub-area perspective. The most relevant barriers and enablers were identified for the Mediterranean sub-regions and an average score was calculated for the area as a whole. Also, experts were asked to define if the identified enabler/barrier was under control (i.e. if actions performed by the expert groups or by other having their professional role across the countries can affect it) or not. In case of disagreement among the two sub-groups judgement on this concern, consensus was reached discussion the issue in plenary, asking the expert to refer to the Mediterranean as a whole.

Workshop breakdown: research prioritisation

The remaining part of the second day of the workshop was fully dedicated to research prioritisation. The proposed exercise was specifically targeting the prioritisation of the identified research topics, and the proposal of a time of intervention for the different areas.

The participants were divided into three sub-groups:

- 1 Aquaculture
- 2 North-eastern Mediterranean
- 3 South-eastern Mediterranean

Group 1 included experts in the aquaculture domain from both Northern and South eastern countries, in order to be able to provide a regional perspective, while group 2 and 3 were asked to identify research priorities being peculiar for the given geographical area.

Each group was provided with the list of identified research areas and topics that emerged from the 1st FORE-Med workshop, to be used as a basis for the prioritisation exercise. Nevertheless, during the first part of the exercise, participants were asked to reconsider what was already listed, taking into consideration the identified enablers and barriers, and amend the list when need be. Group 2 and 3 were asked to provide separate prioritisation lists for infectious diseases and production ones, while these were merged in the aquaculture group.

Three main tasks were given to the expert for the implementation of the exercise:

- a) to weight animal health research area with identified criteria;
- b) to define priorities of research area;
- c) to identify specific topics or intervention area for each research area for both terrestrial animal/ aquaculture;
- d) To define a time of intervention (“urgency of intervention”)for the given research topics.

A three point scale was provided for the weighing of research topics (‘High’, ‘Medium’ and ‘Low’). All items that received no scoring were considered as being of ‘Low’ priority. In order to obtain further details for each of the selected topics, it was requested to identify infectious disease on which the selected research should focus (when applicable) and to detail the research activities to be carried out on the topic. Also, experts were asked to define a preferable time for the intervention on the selected research topic, being either ‘Short-medium’ or ‘Long’.

Section III: Workshop outputs

Result presentation

In this section are presented the main results of the second FORE-Med workshop. The section is divided into sub-chapters, in order to facilitate the retrieval of the desired information by recipients. The following section is intended to target several different stakeholders, both at national level (e.g. the national CVOs, the ministries of agriculture/health, national research centres) and at international one (e.g. the European Commission, OIE, private companies). A dissertation about how to best use the provided results can be found in the Section IV of this report.

In a first sub-section, all the most relevant barriers and enablers, as identified by the two expert groups separately, and then ranked in plenary during the second day of the meeting, are showed. The full list of the identified barriers and enablers, including the scores assigned by each of the sub-groups, is provided in **Annex IV** and **V** respectively.

The second sub-section regards the priority research areas that were identified during the workshop, and it is separated into **three sub-sections**. The first one will contain the priorities for both sub-areas and will include aquaculture, while the other ones will concern topics that were identified as top priority only in one of the sub-regions (Northern and South-eastern part of the Mediterranean).

Only research topics being ranked as either 'High' or 'Medium' priority will be included in the following chapter. Several other research areas and topics emerged during the workshop activities but will be excluded from the following dissertation due to the lower ranking these received. Nevertheless, for the sake of completeness, the full list of research topics that were mentioned during the workshop is provided in **Annex VI**.

Since the identified topics have a still relevant abstraction level, and might refer to broad research areas, further details concerning the High and Medium priority topics, of all degrees of urgency, are provided in **Annex VII**. For each of the topics, information is provided about the identified target for the proposed intervention (e.g. target disease or pathogen category) and the possible research activities to be carried out.

Barriers and enablers

Several barriers and enablers were identified and prioritised by each geographical groups during the workshop. In this section, only items having received an average score in the two sub-areas of 4 to 5 were included. Barriers and enablers **under control** are coloured in green, those **out of control** in red (Table 3 and 4).

Barriers	Relevance
Water pollution	5
Climatic changes	4,5
Economic crisis	4,5
Competition between funders, overlap of research and waste of financial resources	4
Cost of disease control tools	4
Cultural, political, religious differences	4
Lack of support to agriculture	4
Low quality of research	4

Barriers	Relevance
Social inequalities	4
Vaccine licensing process (i.e. duration and complexity)	4
Water competition	4

Table 3: Most relevant barriers to the implementation of the preferred future for the Mediterranean as a whole.

Enablers	Relevance
Availability of effective vaccines	5
Harmonisation and networking among veterinary services (VS) of neighbouring countries	5
Data sharing	5
Resources availability	5
Data quality	4,5
Development of expert networks	4,5
Education for citizens and stakeholders	4,5
Improvement of technology	4,5
Standardisation of disease control tools production/research/test validation	4,5
Study on natural resistance	4,5
Traceability	4,5
Validated diagnostic methods	4,5
Appropriate regulations (e.g. for the licensing of drugs, surveillance, trade control)	4
Development of water reuse systems	4
Encouraging the one health approach	4
Increase investment in "fundamental" research	4
Increase study /research in "other" animal species (e.g. camels, wildlife, pests)	4
Investments in genetic selection	4
Maintenance of the genetic biodiversity	4
Production and distribution of reference materials	4
Regionalisation of the approach (e.g. communication, control posts, vaccination strategies)	4

Table 4: Most relevant enabler favouring the implementation of the preferred future for the Mediterranean as a whole.

Research priorities

Mediterranean region

Common priorities emerged from the sub-regional working groups, and constitute the basis for this section of the report, together with the priorities identified by the aquaculture sub-group. Only research topics being ranked as either 'High' or 'Medium' for both sub-regional groups are mentioned here, excluding all of those being ranked as 'Low', or being not mentioned, for even one of the areas. Since the **aquaculture** group was working considering the whole Mediterranean area, all the priorities identified by the group area reported in this section, separately from the ones regarding terrestrial animals.

The identified research topics are presented in *Tables 6, 7 and 8*, divided on the basis of the urgency of intervention. Three different colours are used to characterise each topic on the basis of its relevance in both sub-regional areas (see *Table 5* for a key).

High relevance	topics identified as 'High' priority in both sub-regional areas (green)
Medium relevance	topics identified as 'High' priority in one sub-regional area and 'Medium' in the other one (yellow)
Lower relevance	identified as 'Medium' priority in both sub-regional areas (orange).

Table 5: Details about the colouring indicating topic relevance in both Mediterranean sub-regional areas.

A fourth list contains priority topics (both 'High' priority, in green, and 'Medium', in yellow) for aquaculture (Table 9). The list also contains indication about the suggested time of intervention.

Urgent topics (short time of intervention on both sub-regional areas)	
Definition and application of effective and harmonised control measures in all countries of the area	Infectious disease
Study on antimicrobial (and anti-helminthic) reduction strategies	Production diseases
Establishment of a network with human medicine	Infectious disease
Implementation of economic evaluation of interventions, to obtain sustainability	Infectious disease

Table 6: Urgent priority research topics on animal health for the Mediterranean region.

Medium term topics (short time of intervention in one sub-regional area and medium/long in the other one)	
Development of a laboratory network for information and technology exchange	Infectious disease
Development of new vaccines (e.g. DIVA, recombinants)	Infectious disease
Implementation of control and monitoring on vectors, also using new products	Infectious disease
Implementation of training and education with multidisciplinary approach	Infectious disease
Development of knowledge management systems allowing sharing and exchange of data	Infectious disease
Development of whole technology for rapid production and use of vaccines (e.g. antigen banks)	Infectious disease
Development of robust and cheap field tests (pre-screening)	Infectious disease
Development of re-utilisation systems for slurries and water recycling	Production disease

Table 7: Medium term priority research topics on animal health for the Mediterranean region.

Long term topics (medium/long time of intervention on both sub-regional areas)	
Development of animal and product identification and registration systems	Infectious disease
Study on strategies to manage the impact of intensive farming	Production disease
Evaluation of gut health using new feed sources	Production disease

Table 8: Long term priority research topics on animal health for the Mediterranean region.

Topics	Time of intervention
Identification of fish welfare indicators in traditional and organic farms	Short-med.
Improve the monitoring about enteric viruses in bivalves farmed in lagoon and off-shore	Short-med.
Investigation on presence of zoonotic parasites in farmed fish according to EFSA opinion	Short-med.
Study on the verification of the efficacy of vaccines	Short-med.
Development of a Mediterranean traceability system to exchange data	Long
Development of new vaccines for new diseases	Long
Harmonisation of diagnostic analysis	Long
Monitoring of the mortality of wild fish and shellfish.	Long
Development of legal framework to improve disease surveillance	Short-med.
Study on anti-parasite drugs	Short-med.
Study on atypical mycobacteriosis	Short-med.
Study on farmed fish technopathy	Short-med.
Study on new feed sources	Short-med.
Study on parasitosis on fish bred in sea cages	Short-med.
Study on photo-bacteriosis in marine fish	Short-med.
Development of prebiotics and herbal stimulants to improve a-specific immunity system	Long
Development of sustainable therapies	Long

Table 9: Priority research topics on aquaculture for the Mediterranean region.

Northern Mediterranean

Research topics being of High to Medium relevance for Northern Mediterranean area only are listed in the following tables. The first table ('Urgent topics', *Table 10*) includes topics being identified as having a short-medium term of intervention, while the second one (*Table 11*) includes those requiring long term interventions. Research topics having 'High relevance' are reported in green, those having 'Medium relevance' in yellow. Topics being identified as 'Low relevance' are not included in the following tables.

Urgent topics	
Definition of appropriate sampling strategies	Infectious diseases

Table 10: Urgent priority research topics on animal health for the Northern Mediterranean sub-region.

Medium term topics	
Development of mathematical and risk analysis models, also aiming at the development of contingency planning	Infectious diseases
Development of farm management systems aiming at optimisation and increase of production	Production diseases
Development of alternative food sources	Production diseases
Development of methods to forecast effect of weather and climate on animal health and welfare	Production diseases

Table 11: Medium term priority research topics on animal health for the Northern Mediterranean sub-region.

South-eastern Mediterranean

As for the previous section, only research topics being of High to Medium relevance for South-eastern Mediterranean area only are listed in the following tables. The first table ('Urgent topics'; *Table 12*) includes topics being identified as having a short-medium term of intervention, while the second one (*Table 13*) includes those requiring long term interventions. Research topics having 'High relevance' are reported in green, those having 'Medium relevance' in yellow. Topics being identified as 'Low relevance' are not included in the following tables.

Urgent topics	
Implementation of specific interventions on the territory to increase prevention	Infectious diseases
Integration of traceability systems for sharing information	Production diseases
Development of biosecurity systems aiming at optimisation and increase of production	Production diseases
Development of vaccines for extensive use	Infectious diseases
Production of new test or validation of existing test	Infectious diseases

Table 12: Urgent priority research topics on animal health for the South-Eastern Mediterranean sub-region.

Medium term topics	
Development of new feed sources	Production diseases
Identification of genetic types being resistant to main diseases	Production diseases
Sustainability studies of farms with the new feeding sources	Production diseases
Increase of diagnostic potential on bioterrorism potential agents	Infectious diseases
Widening of the range of biological samples	Infectious diseases
Study on the impact of the use of new areas for zootechnical purposes	Production diseases
Study on new vaccines for livestock (i.e. for production diseases)	Production diseases
Evidence based intervention on management and prevention of diseases, including evaluation methods for the interventions	Production diseases
Study on genetic types being adapted to evolving farming systems	Production diseases

Table 13: Medium term priority research topics on animal health for the South-Eastern Mediterranean sub-region.

Section IV: Lessons learnt and follow-up

The FORE-Med project represents the first structured attempt to build a common strategy to face future research challenges on animal health at Mediterranean level. The Mediterranean area was partially included already in the EMIDA SRA (EMIDA, 2011), that set different research priorities for four different European areas, one of which being the Mediterranean region. Nevertheless, since the EMIDA was focussing mainly on the European countries, in the view of the authors there was need for a deeper investigation on the area as a whole, since all countries are interlinked and influence one another (Zenetos et al., 2013). The implementation of the FORE-Med activities in Italy, and the strong commitment (both in terms of experts and of organisational efforts) of the Ministry of Health on the project, witness the recognition of the pivotal role that this country, due to its centrality on the basin, should play to support animal health in the Mediterranean area.

A large number of experts (**100**), having various background, participated in the study. Since, in the first phases of the process, some areas of the Mediterranean basin emerged as being underrepresented (e.g. Balkan area), in the last phases efforts were concentrated in increasing the involvement of such countries, with positive results.

Evidences suggest that the outcomes of participative foresights might be affected by the composition of the expert panel, as well as by "random" variation in panel behaviour, but that these issues can be solved by selecting a different mixture of participants in further panels (Jones & Hunter, 1995). Several changes were performed in the definition of the panel of expert in these last phases of the process, in an attempt to reduce the possibility of bias in the obtained results, as well as to obtain a more balanced geographical background.

The process allowed the identification of priority research areas and topics in the field of animal health, that will constitute the basis for the first Mediterranean SRA. The provision of indication for a temporal scale for the intervention will allow to draw a path to the preferred future, if the identified actions will be implemented.

The foresight methodology also represents an optimal network building opportunity, encouraging communication and opinion exchange among experts coming from different countries, institutions and backgrounds (Becker 2002). The network that was created during the FORE-Med project, that brought together animal health experts across the whole Mediterranean area, represents in itself an important added value in the framework of building a common pathway toward the coordination of the actions in the area. Also, this project made the experts to share a common strategic vision, and to have a sense of commitment toward it. This might represent an important driver in supporting the adoption of the recommendations derived from the FORE-Med.

Lastly, this exercise allowed the introduction of the participants to the "Foresight culture", showing them a new method for long-term planning of research and other activities, and the potential of such method. The instilment of these new ideas might stimulate the experts in embarking themselves, in their belonging institutions, in the creation of their own foresight activities and networks (Nicolini & Bagni, 2012), which will support a better prioritisation of research in the area as a whole.

What use for the identified barriers and enablers?

The FORE-Med project allowed the prioritisation and the setting of a time for intervention of research areas in the field of animal health, that will constitute the core of the Mediterranean SRA. Nevertheless, this should not be considered as the sole outcome of this experience. The backcasting exercise, in fact,

allowed the identification of both barriers and enablers to the plausible preferred future. Although these were already taken into account to shape the research needs, these can be considered an outcome already by their own.

In fact, although the suggested identified research areas were selected in a way of providing a way to overcome the identified barriers, or the implement the enablers, it is to be recognised that each local reality might need to select a specific strategy to tackle an issue depending on the local priorities and goals (Burch 2010). The identified barriers and enablers, then, might provide local agencies a basis to draw their own path, leading from the identified issue to a tailored solution.

While enablers provide a more direct indication of the action that should be performed to get to the preferred future, recent findings highlight as barriers themselves can be transformed into enablers of capacity, and then into action (Burch, 2010). It is interesting to notice how most of the top priority barriers that were identified by the working groups were identified as 'out of control', differently to what happened for the enablers, that were considered for the large majority as 'under control'. This might indicate a success of the experts (in most cases) in identifying, instead of a barrier that can be eliminated, a possible strategy for tearing it down. This might also explain the reason why the overall number of identified barriers is lower than the number of enablers, as can be noted both in the overall figure (26 vs 34; **Annex IV** and **V**) and more markedly in the most relevant ones (11 vs 21; *Table 3* and *4*).

How to implement and maintain the FORE-Med SRA

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). The acquisition of new scientific knowledge through research is a crucial element to be prepared for the future challenges.

To date, the FORE-Med provided all the elements that are needed for a **Strategic Research Agenda** for animal health in the Mediterranean for the next 15 years. In order to obtain rapid and efficient solutions to the identified challenges, the SRA should support the development of hypothesis-driven research programmes, with clear common goals and resources shared among the area. In fact, to ensure that the society will obtain a significant contribution from the proposed actions in the future, a long-term, multidisciplinary approach, going beyond national borders, is needed (Hinton et al., 2014).

The aim of the SRA is to provide animal health research funders in the Mediterranean area a framework toward which plan and coordinate future activities, in order to get prepared for future scenarios and best mitigate against likely future threats. As for the EMIDA SRA (EMIDA, 2011), its aim is not to dictate specify future research calls, but rather to provide relevant advice, that may be considered and acted upon in line with the funders' own priorities.

In order to ensure the SRA implementation, the gap between research funders and policy making bodies shall be filled. The dissemination of the proper information to the appropriate stakeholder will be paramount to allow this happen. For this reason, this report is structured in a way to target both profiles. Therefore, while the executive summary and the different report sections (I, III and IV in particular) are mainly targeting policy makers, the detailed information contained in **Annex VII** are meant to be already used by research funders for the inclusion in project calls and short to long term research agendas.

All funders will not be able to solve all the identified issues alone (EMIDA, 2011). Then, the alignment of the national (and supranational) research agenda shall be promoted. The Animal Health and Welfare CWG of SCAR might play an important role in supporting this alignment, promoting dialogue among the

interested parties, coordinating transnational research efforts and providing an adequate structure to ensure the maintenance of these actions.

Interestingly, most of the urgent top priority research topics identified are not “research topics” *sensu stricto*, but rather need for re-organisation or re-shaping of the veterinary system. It seems to suggest that the experts recognised that research, if not properly integrated in an effective system, will not suffice to guarantee the meeting of the goal of the preferred future. A similar situation emerged from the EMIDA project, and this supports to the robustness of the overall conclusions of this study (Wentholt et al., 2012).

An high ratio of the research topics being identified as priority are common to both Mediterranean sub-regions, although in a few cases their urgency is evaluated differently. In particular, the vast majority of priorities for the Northern sub-region appear to be common for the whole area, while the South-eastern region has a large number of additional priorities. This might be explained both by to the lower resources availability in the South-eastern region or to the fact that this latter represents the real frontier with both Asia and Africa, being the first in line to face new threats coming from these continents. Nevertheless, it should be noted that, while the quasi-totality of the common priority research regards infectious diseases, most of the ones pertaining only to the South-eastern area are production disease. This seems to suggest that lack of resources might be the main driver of these additional needs.

The indications provided regard both terrestrial and aquatic animals, and include animal health topics considered from a broad perspective, including both infectious and production diseases. Although animal welfare is somehow mentioned among the topics, is was not one of the main objective of the initiative, and should be considered as a component of animal health for the purpose of the FORE-Med project. This might imply that relevant aspects concerning animal welfare might not be included among the listed priorities.

As already stated in the first report, the FORE-Med does not end with the delivery of the SRA, but should instead be considered as a *continuous process*. The identified research areas and priorities will need to 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.

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Annex I: Priority diseases identified in the 1st FORE-Med workshop

Infectious diseases

*African Horse Sickness,
Anthrax,
Avian Influenza,
Brucellosis,
Congo-Crimean Haemorrhagic Fever,
Coronaviriosis (MERS),
Foot and Mouth Disease,
Glanders,
Leishmaniasis,
Orbiviriosis (Blue Tongue),
Peste des Petits Ruminants,
Lumpy Skin Disease,
Rabies,
Rickettsiosis,
Rift Valley Fever,
Sheep and Goat Pox,
Tuberculosis,
West Nile Disease.*

Production diseases








*Acute bovine pulmonary emphysema and edema (ABPEE),
Enzootic Pneumonia,
Lameness,
Laminitis,
Mastitis,
Metabolic disorder,
Milk fever,
Parasitic diseases,
Porcine Reproductive and Respiratory Syndrome,
Postpartum Dysgalactia Syndrome,
Post-weaning diarrhoea,
Post-weaning multisystemic wasting syndrome,
Puerperal toxæmia syndrome,
Tibial Dyschondroplasia.*

Aquaculture

*Alfavirus (salmonids),
Bacterial Kidney Disease,
Branchial disease,
Enteric Redmouth Disease,
Enteromyxosis,
Flavobacteriosis,
Furunculosis,
Herpesviriosis (OsHV-01),
Infection with Mikrocystos spp.,*

*Infectious Hematopoietic Necrosis (IHN),
Infectious pancreatic necrosis,
Lactococcosis,
Marine Velvet disease (Amyloodinium ocellatum),
Microcotyle infestation,
Mycobacteriosis,
Nutritional disorders (e.g. dismetaboly),
Pasteurellosis,
Perkinsus olseni infection,
Phycomycetes infection,
Red mark syndrome,
Sleeping disease,
Tenacibaculum infection,
Vibriosis (e.g. Vibrio aestuarianus),
Viral haemorrhagic septicaemia,
viral nervous necrosis (Betanodavirus),
White spot disease (Ichthyophthirius multifiliis),
Winter disease.*

Annex II: FORE-Med 2nd Workshop Agenda

 <p>In collaboration with</p>   <p>Segretariato generale - Ufficio II (ex obviE)</p>   <p>2nd FORE-Med Workshop: to build a SRA (Strategic Research Agenda) in animal health for the Mediterranean Area</p> <p>Ministero della Salute Via Ribotta, 5 - Roma Room G132 (1st floor, yellow sector) 3-4 November 2014</p>	<p>FORE-Med 3 November 2014</p>  <p>Day 1: Drivers prioritization and trend analysis</p> <table border="1"> <thead> <tr> <th>Time</th> <th>Item</th> <th>Output:</th> </tr> </thead> <tbody> <tr> <td>13.00 - 14.00</td> <td>Registration of participants</td> <td></td> </tr> <tr> <td>14.00 - 14.30</td> <td>Welcome address Ministero della salute</td> <td></td> </tr> <tr> <td>14.30 - 16.00</td> <td>Background to the exercise: - FOREMed results of the first workshop. - Moscow workshop results (STAR-IDAZ). - The Fifth Scenario "Mare nostrum". - Methodology.</td> <td>Focus on objectives for animal health research AGENDA Selection of drivers and trend for prioritization</td> </tr> <tr> <td></td> <td>Break out groups</td> <td></td> </tr> <tr> <td>16.00 - 16.15</td> <td>Coffee break</td> <td></td> </tr> <tr> <td>16.15 - 18.00</td> <td>- Exercise (2 groups) - List of barriers and enabling factors. - Back-casting.</td> <td></td> </tr> <tr> <td>19.00</td> <td>Social dinner</td> <td></td> </tr> </tbody> </table>	Time	Item	Output:	13.00 - 14.00	Registration of participants		14.00 - 14.30	Welcome address Ministero della salute		14.30 - 16.00	Background to the exercise: - FOREMed results of the first workshop. - Moscow workshop results (STAR-IDAZ). - The Fifth Scenario "Mare nostrum". - Methodology.	Focus on objectives for animal health research AGENDA Selection of drivers and trend for prioritization		Break out groups		16.00 - 16.15	Coffee break		16.15 - 18.00	- Exercise (2 groups) - List of barriers and enabling factors. - Back-casting .		19.00	Social dinner				
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<p>FOREMed 4 November 2014</p>  <p>Day 2: Building a Strategic Research Agenda for the Mediterranean area on animal health</p> <table border="1"> <thead> <tr> <th>Time</th> <th>Item</th> <th>Output:</th> </tr> </thead> <tbody> <tr> <td>9.00 - 10.00</td> <td>Plenary session: Presentation of groups' work.</td> <td>Focus on barriers and enabling factors for different regions of Med.</td> </tr> <tr> <td></td> <td>Break out groups</td> <td></td> </tr> <tr> <td>10.00 - 11.00</td> <td>- To continue identification of barriers and enabling factors.</td> <td></td> </tr> <tr> <td>11.00 - 11.30</td> <td>Coffee break</td> <td></td> </tr> <tr> <td>11.30 - 13.00</td> <td>- Weight animal health research area with identified criteria. - Define priorities of research area. - Identify specific topics or intervention area for each research area for both terrestrial animal/aquaculture</td> <td></td> </tr> <tr> <td>13.00 - 14.00</td> <td>Lunch</td> <td></td> </tr> <tr> <td>14.00 - 16.00</td> <td>- Continues working groups. - Presentation of results.</td> <td>To build a Mediterranean SRA</td> </tr> <tr> <td>16.00 - 16.30</td> <td>End of workshop. Conclusions.</td> <td></td> </tr> </tbody> </table>	Time	Item	Output:	9.00 - 10.00	Plenary session: Presentation of groups' work.	Focus on barriers and enabling factors for different regions of Med.		Break out groups		10.00 - 11.00	- To continue identification of barriers and enabling factors.		11.00 - 11.30	Coffee break		11.30 - 13.00	- Weight animal health research area with identified criteria. - Define priorities of research area. - Identify specific topics or intervention area for each research area for both terrestrial animal/aquaculture		13.00 - 14.00	Lunch		14.00 - 16.00	- Continues working groups. - Presentation of results.	To build a Mediterranean SRA	16.00 - 16.30	End of workshop. Conclusions.		<p>Coordination and organization:</p> <ul style="list-style-type: none"> • Marina Bagni, Ministero della Salute, SG, Ufficio II* • Romano Zilli, IZS del Lazio e della Toscana, Task leader ERAnet STARIDAZ • Antonio Petrini, IZS dell'Abruzzo e del Molise, Diseases manager (IZSAM - OIE/FAO) • 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 • Barbara Alessandrini, Uff. Formazione, IZS AM <p>* Viale Giorgio Ribotta, 5 - 00144 Roma tel. 06 5994 6129 - cell. 320 4078131 email: marina.bagni@sanita.it</p>  
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Annex III: 5th Scenario

“Mare nostrum”

The economic crisis is still impacting on the global markets. Globalisation of markets leads to a price policy being disadvantageous for the European context, in particular for the agricultural sector. Inside the European Union, the gap between northern 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. 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.

The partnership between Mediterranean countries is strengthened, in an attempt to exit the crisis situation. New trade flows grow in the Mediterranean area and trade barriers are tear down, decreasing the gap between north and south-east Mediterranean.

World population is increasing and immigrants fluxes (including the illegal ones) from outside the area increased in the Mediterranean basin. Different cultures and religions become 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.

The climatic situation deeply impact water availability. Dry periods and heavy sudden rains become usual, making water storage harder and decreasing the availability of arable lands. Water pollution becomes a serious issue. New contingency plans and water and land use strategies are developed. Zootechnical productions, being highly water consuming, become more costly and need to be reformed in a more sustainable way. A genetic shift in the animal population is observed, and local breeds tend to disappear.

Food demand increases under the pressure of population rise, making food security harder. Farm intensification is observed in several areas.

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. The higher temperatures 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.

Annex IV: Identified barriers

Barriers	Relevance N	Relevance SE	Tot	Under Control
Water pollution	5	5	5	N
Climatic changes	5	4	4,5	N
Economic crisis	4	5	4,5	N
Competition between funders, overlap of research and waste of financial resources	3	5	4	Y
Cost of disease control tools	4	4	4	Y
Cultural, political, religious differences	4	4	4	N
Lack of support to agriculture	3	5	4	Y
Low quality of research	4	4	4	Y
Social inequalities	4	4	4	N
Vaccine licensing process (i.e. duration and complexity)	4	4	4	Y
Water competition	4	4	4	N
Difficulty in border control	3	4	3,5	N
Intensive land use	3	4	3,5	N
International trade (e.g. for risk of disease introduction in r autochthon species)	4	3	3,5	Y
Short term policies	4	3	3,5	N
Trade barrier	3	4	3,5	N
Economical sustainability of farming	3	3	3	Y
Tourism (i.e. competition for water usage with aquaculture)	4	2	3	N
Lack of willingness of farmers to use disease control tools	2	4	3	Y
Conflict of interest between public funded applied research and private sector	2	3	2,5	N
Reluctance of pharmaceutical companies in developing new products	3	2	2,5	N
Ethical issues linked with genetic manipulation	1	3	2	Y
Industrialisation of agriculture	2	2	2	Y
Negative approach toward farming	3	1	2	Y
Euro-scepticism	2	1	1,5	N
Language issues	2	1	1,5	Y

Annex V: Identified enablers

Enablers	Relevance N	Relevance SE	Tot	Under Control
Availability of effective vaccines	5	5	5	Y
Harmonisation and networking among veterinary services (VS) of neighbouring countries	5	5	5	Y
Data sharing	5	5	5	Y
Resources availability	5	5	5	N
Data quality	5	4	4,5	Y
Development of expert networks	4	5	4,5	Y
Education for citizens and stakeholders	4	5	4,5	Y
Improvement of technology	5	4	4,5	Y
Standardisation of disease control tools production/research/test validation	5	4	4,5	Y
Study on natural resistance	4	5	4,5	Y
Traceability	4	5	4,5	Y
Validated diagnostic methods	5	4	4,5	Y
Appropriate regulations (e.g. for the licensing of drugs, surveillance, trade control)	4	4	4	Y
Development of water reuse systems	4	4	4	Y
Encouraging the one health approach	3	5	4	Y
Increase investment in "fundamental" research	3	5	4	N
Increase study /research in "other" animal species (e.g. camels, wildlife, pests)	4	4	4	Y
Investments in genetic selection	4	4	4	N
Maintenance of the genetic biodiversity	4	4	4	Y
Production and distribution of reference materials	3	5	4	Y
Regionalisation of the approach (communication, control posts, differences in vaccination strategies)	4	4	4	N
Association of local farmers	3	4	3,5	N
European investments in the study of pathogens presents in the Mediterranean area	4	3	3,5	Y
Lobbying from Mediterranean producers	3	4	3,5	N
Reduce impact of animal waste	4	3	3,5	Y
Sanitary control of new species	3	4	3,5	Y
Standardisation of international trade policy	3	4	3,5	N
Transparency	4	3	3,5	Y
Harmonised data language	4	2	3	Y
Research on alternative feed sources (AA and TA)	3	3	3	Y
Support of small scale production	2	4	3	Y
Tourism (i.e. attractiveness of land used for non-intensive production for 'green tourism')	2	4	3	N
Valorisation of local breeds	3	3	3	Y
Private investments in fundamental research	2	3	2,5	N

Annex VI: Research topics emerged during the 2nd FORE-Med workshop (overall)

Northern Mediterranean

Topics: infectious diseases	Relevance	Time of intervention
Definition and application of effective and harmonised control measures in all countries of the area	H	Short-med.
Establishment of a network with human medicine (One Health approach)	H	Short-med.
Implementation of control and monitoring on vectors, also using new products	H	Short-med.
Implementation of economic evaluation of interventions, to obtain sustainability	H	Short-med.
Development of a laboratory network for information and technology exchange	H	Long
Development of mathematical and risk analysis models, also aiming at the development of contingency planning	H	Long
Development of new vaccines (e.g. DIVA, recombinants)	H	Long
Definition of appropriate sampling strategies	M	Short-med.
Development of animal and product identification and registration systems	M	Long
Development of knowledge management systems allowing sharing and exchange of data	M	Long
Development of robust and cheap field tests	M	Long
Development of whole technology and methodology for rapid production and use of vaccines (e.g. antigen banks)	M	Long
Implementation of training and education with multidisciplinary approach	M	Long
Increase of diagnostic potential on bioterrorism potential agents	M	Long
Basic research on pathogens for better targeting of vaccines and therapeutics	L	Long
Development of “participative epidemiology” (i.e. using social networking as emergency management systems)	L	Long
Development of relegation systems for illegal movements	L	Long
Development of vaccines for extensive use (e.g. peptides, vegetal)	L	Long
Increase of the applicability of the products (i.e. increasing private-public sector cooperation to develop disease control tools)	L	Long
Research to improve quality of information provided (targeted communication)	L	Long
Research to map and make use of (and share) genetic data to improve disease resistance in livestock	L	Long
Standardisation of markers-measurements (i.e. comparable data for use internationally)	L	Long
Study of the epidemiology of “new pathogens”	L	Long
Study on the biology of vector insects to develop risk analysis and models	L	Long
Study on the epidemiological role of companion animals	L	Long
Understanding risk of disease introduction posed by invasive species (i.e. predict-identify risk pathways and control)	L	Long

Topics: production diseases	Relevance	Time of intervention
Study on antimicrobial (and anti-helminthic) reduction strategies	H	Short-med.
Development of farm management systems aiming at optimisation and increase of production	H	Long
Study on strategies to manage the impact of intensive farming	H	Long
Development of re-utilisation systems for system slurries and water recycle systems	M	Short-med.
Development of alternative food sources	M	Long
Development of methods to forecast effect of weather and climate on animal health and welfare	M	Long
Evaluation of gut health using new feed sources	M	Long
Development of management favouring animal health and welfare (i.e. development of AW indicators, reduction of the impact of technopaties)	L	Long
Evaluation and implementation of traceability system being equivalent for international exchange	L	Long
Evidence based intervention on management and prevention of diseases, including evaluation methods for the interventions	L	Long
Identification of genetic types being resistant to main disease	L	Long
Research on use of by-products (improve productivity and ensure safety)	L	Long
Research to improve quality of information provided (targeted communication)	L	Long
Research to make use of upcoming technologies for disease control and prevention (i.e. automation in farming practises)	L	Long
Study on genetic types being adapted to evolving farming systems	L	Long
Study on mucosal immunity (e.g. GI tract)	L	Long
Study on new vaccines for livestock (i.e. for production diseases)	L	Long
Study on the impact of the use of new areas for zootechnical purposes	L	Long
Sustainability studies of farms with the new feeding sources	L	Long
To support networks and systems to facilitate cooperation internationally	L	Long
Valorisation of biodiversity to develop local production	L	Long

Topics: aquaculture	Relevance	Time of intervention
Identification of fish welfare indicators in traditional and organic farms	H	Short-med.
Study on the verification of the efficacy of vaccines	H	Short-med.
Improve the monitoring about enteric viruses in bivalves farmed in lagoon and off-shore.	H	Short-med.
Investigation on presence of zoonotic parasites in farmed fish according to EFSA opinion	H	Short-med.
Development of new vaccines for new diseases	H	Long
Monitoring of the mortality of wild fish and shellfish.	H	Long
Development of a Mediterranean traceability system to exchange data	H	Long
Harmonisation of diagnostic analysis	H	Long
Study on new feed sources	M	Short-med.
Study on farmed fish technopathy	M	Short-med.
Study on anti-parasite drugs	M	Short-med.
Study on parasitosis on fish bred in sea cages	M	Short-med.

Topics: aquaculture	Relevance	Time of intervention
Study on photo-bacteriosis in marine fish	M	Short-med.
Study on atypical mycobacteriosis	M	Short-med.
Development of prebiotics, herbal stimulants to improve a-specific immunity system	M	Long
Development of sustainable therapies	M	Long
Experimental studies of phago and herbal therapy	M	Long
Health monitoring of wild fish	M	Long
Development of legal framework to improve disease surveillance	M	Long
Study on the interaction between cyanobacters, toxin production and mortality	L	Short-medium
Study on pathologies in off-shore shellfish farms	L	Short-med.
Study on gill disease in fresh water fish	L	Short-med.
Development of alternative breeding methods on systems already impacting the system	L	Short-med.
Study on Herpesvirosis in oysters	L	Short-med.
Development of GIS systems	L	Short-med.
Study on the vulnerability of wild fish to toxic pollutants, medicine residues (i.e oestrogens) and biological vulnerability.	L	Long
Genomic study for pathogen resistance	L	Long
Study on the prevention of the weakening of clams' byssus	L	Long
Monitoring of imported ornamental fish	L	Long
Development of protocols for the evaluation of organic farms terms of contract	L	Long

South-eastern Mediterranean

Topics: infectious diseases	Relevance	Time of intervention
Definition and application of effective and harmonised control measures in all countries of the area	H	Short-med.
Development of a laboratory network for information and technology exchange	H	Short-med.
Development of knowledge management systems allowing sharing and exchange of data	H	Short-med.
Development of new vaccines (e.g. DIVA, recombinants)	H	Short-med.
Development of robust and cheap field tests (pre-screening)	H	Short-med.
Development of whole technology for rapid production and use of vaccines (e.g. antigen banks)	H	Short-med.
Implementation of specific interventions on the territory to increase prevention	H	Short-med.
Implementation of training and education with multidisciplinary approach	H	Short-med.
Development of identification and registration systems being adapted to the local situation	H	Long
Implementation of control and monitoring on vectors, also using new products	H	Long
Development of vaccines for extensive use (e.g. peptides, vegetal)	M	Short-med.
Establishment of a network with human medicine	M	Short-med.
Implementation of economic evaluation of interventions, to obtain sustainability	M	Short-med.

Topics: infectious diseases	Relevance	Time of intervention
Production of new test or validation of existing test	M	Short-med.
Increase of diagnostic potential on bioterrorism potential agents	M	Long
Widening of the range of biological samples	M	Long
Basic research on pathogens for better targeting of vaccines and therapeutics	L	Long
Definition of appropriate sampling strategies	L	Long
Development of “participative epidemiology” (i.e. using social networking as emergency management systems)	L	Long
Development of mathematical and risk analysis models, also aiming at the development of contingency planning	L	Long
Development of relegation systems for illegal movements	L	Long
Increase of the applicability of the products (i.e. increasing private-public sector cooperation to develop disease control tools)	L	Long
Study of factors influencing vectorial competency of arthropods to pathogens	L	Long
Study of the epidemiology of “new pathogens”	L	Long
Study on the biology of vector insects to develop risk analysis and models	L	Long
Study on the epidemiological role of companion animals	L	Long

Topics: production diseases	Relevance	Time of intervention
Development of biosecurity systems aiming at optimisation and increase of production	H	Short-Med.
Integration of traceability systems for sharing information	H	Short-med.
Study on antibiotic reduction strategies	H	Short-med.
Development of new feed sources	H	Long
Evaluation of gut health using new feed sources	H	Long
Identification of genetic types being resistant to main diseases	H	Long
Sustainability studies of farms with the new feeding sources	H	Long
Development of re-utilisation systems for slurries and water recycling	M	Long
Evidence based intervention on management and prevention of diseases, including evaluation methods for the interventions	M	Long
Study of factors influencing vectorial competency of arthropods to pathogens	M	Long
Study on new vaccines for livestock (i.e. for production diseases)	M	Long
Study on strategies to manage the impact of intensive farming	M	Long
Study on the impact of the use of new areas for zootechnical purposes	M	Long
Study on genetic types being adapted to evolving farming systems	M	Long
Communication	L	Long
Development of management favouring animal health and welfare	L	Long
Development of methods to forecast effect of weather and climate on animal health and welfare	L	Long
Herd health management	L	Long
Improvement of technology	L	Long
Social support to farmers	L	Long
Valorisation of biodiversity to develop local production	L	Long

Annex VII: Proposal for a strategic action plan for the Mediterranean region

Mediterranean region: most urgent topics for terrestrial animals

Area: Infectious disease

Research topic/intervention area: Definition and application of effective and harmonised control measures in all countries of the area

Relevance: High

Time of intervention: Short

Target (diseases or diseases category): pandemic diseases, food-borne zoonotic diseases, parasitic diseases.

Research activities: development of contingency planning; development of surveillance plan; development of web-GIS systems; improved surveillance methodology.

Area: Infectious disease

Research topic/intervention area: Establishment of a network with human medicine

Relevance: Medium/High

Time of intervention: Short

Target (diseases or diseases category): zoonosis (especially MERS), rabies, AMR.

Research activities: studies on reservoir animals (livestock and wildlife e.g. zoonotic pathogens such as rabies); need to include research to address AMR as an issue across the medical and veterinary professions; surveillance and epidemiology research; improved diagnostics-typing; governance of medical and veterinary research (i.e. facilitating of closer working and social research); exchange of material; shared programmes/projects; serological surveillance.

Area: Infectious disease

Research topic/intervention area: Implementation of economic evaluation of interventions, to obtain sustainability

Relevance: Medium/High

Time of intervention: Short

Target (diseases or diseases category): endemic and production diseases (e.g. TB, Mastitis, bee disease)

Research activities: extend multidisciplinary approach, including economic area; investigate the importance of endemic and syndromic disease (economically); cost-benefit analysis; evaluation of the cost of current control tools.

Area: Infectious disease

Research topic/intervention area: Development of a laboratory network for information and technology exchange

Relevance: High

Time of intervention: Medium

Target (diseases or diseases category): highly contagious disease, transboundary diseases, zoonoses.

Research activities: support to collaborative research projects; development of new IT tools to manage large amount of epidemiological data; implementation of ring test and harmonised proficiency testing; support to personnel exchange; production/improved availability of reference material.

Area: Infectious disease

Research topic/intervention area: Development of new vaccines (e.g. DIVA, recombinants)

Relevance: High

Time of intervention: Medium

Target (diseases or diseases category): generic for infectious diseases; special focus on FMD, RVF, CCHF, leishmaniosis.

Research activities: research on elucidation of the mucosal immune mechanisms and on its induction (GI and respiratory tract); support DIVA and measure level of post-infection/post-vaccination immunity; development of new adjuvants; research on genetic engineering for the delivery of selected molecules; research on the modulation of the host immune response to improve the level of protection; research to develop thermo-stable vaccines; reduction of production costs; development of multispecies and multi-diseases/serotypes vaccines; investigation on new ways of administration of vaccines; development of new and specific strategies for rabies vaccination in wildlife; validation of existing vaccination protocols in minor/local species.

Area: Infectious disease

Research topic/intervention area: Implementation of control and monitoring on vectors, also using new products

Relevance: High

Time of intervention: Medium

Target (diseases or diseases category): WND, CCHF, RVF, orbivirosis (e.g. BT), simbu, leishmania, other protozoan/bacterial diseases.

Research activities: biological control of vector; prediction of movement of vectors (remote sensing) and mapping their movement; investigation of vector competence to transmit disease; diagnosis of disease in vectors; development of new/effective vaccines for vector borne diseases (RVF; CCHF); study of host-pathogen interaction; selection of genetic resistant vectors.

Area: Infectious disease

Research topic/intervention area: Implementation of training and education with multidisciplinary approach

Relevance: Medium/High

Time of intervention: Medium

Target (diseases or diseases category): all animal infectious diseases (more relevant to production diseases).

Research activities: interdisciplinary communication exchange; development of appropriate risk communication; application of social methodologies to communication/knowledge sharing; implementation of e-learning; knowledge transfer to farmers; improve post-graduate training; improve bio-security practise and welfare knowledge for farmers and veterinarians; improve training with respect to neglected diseases.

Area: Infectious disease

Research topic/intervention area: Development of knowledge management systems allowing sharing and exchange of data

Relevance: Medium/High

Time of intervention: Medium

Target (diseases or diseases category): all

Research activities: development of platform for data exchange; development of open access sources; improvements to existing networks and systems to support them.

Area: Infectious disease

Research topic/intervention area: Development of whole technology for rapid production and use of vaccines (e.g. antigen banks)

Relevance: Medium/High

Time of intervention: Medium

Target (diseases or diseases category): all; particular focus on FMD, AI, BT (some serotypes).

Research activities: development of alternatives to use of animal models for testing vaccine efficacy; concentration of antigens to allow vaccine production; development new technology to contain cost in maintaining banks.

Area: Infectious disease

Research topic/intervention area: Development of robust and cheap field tests (pre-screening)

Relevance: Medium/High

Time of intervention: Medium

Target (diseases or diseases category): generic screening of diseases (all); particular focus on FMD, AI, RVF and neglected diseases.

Research activities: development of tests to facilitate initial screening of disease, especially in support of field diagnosis in remote areas; indication of AMR; development of application for new information technology (e.g. use of smart-phone); in field validation for snap-tests; validation of existing tests for other species; validation of existing test for minor/local species.

Area: Production disease

Research topic/intervention area: Development of re-utilisation systems for slurries and water recycling

Relevance: Medium

Time of intervention: Medium

Target (diseases or diseases category): contaminant diseases, especially those resistant to the environment and treatment processes.

Research activities: research on use of by-products (improve productivity and ensure safety); research on the use and utility of waste (from agriculture) for animal feed.

Area: Infectious disease

Research topic/intervention area: Development of animal and product identification and registration systems

Relevance: Medium/High

Time of intervention: Long

Target (diseases or diseases category): n.a.

Research activities: development of technology to support ID and tracing that is applicable and flexible to meet the demands of local variations in livestock demographics; implementation of sustainable -cost effective methods; evaluation and improvement of existing systems-databases; development of identification and registration systems being adapted to the local situation.

Area: Production disease

Research topic/intervention area: Study on strategies to manage the impact of intensive farming

Relevance: Medium/High

Time of intervention: Long

Target (diseases or diseases category): n.a.

Research activities: research on sustainable intensification strategies. (recognising farming requirements in support of the revised CAP); implementation of structural requirements on farm to support intensive farming techniques, including waste management and mitigation of potential environmental impact; development of strategies to assure adequate welfare of the farmed animals; identify parameters to assess impact of intensive farming.

Area: Production disease

Research topic/intervention area: Evaluation of gut health using new feed sources

Relevance: Medium/High

Time of intervention: Long

Target (diseases or diseases category): n.a.

Research activities: research to support evaluation of new feed sources in respect of nutrition and gut health-physiology; study of pro and pre-biotics; studies on microbiota and microbiota changes.

Mediterranean region: most urgent topics on aquaculture

Area: Aquaculture

Research topic/intervention area: Identification of fish welfare indicators in traditional and organic farms.

Relevance: High

Time of intervention: Short

Target (diseases or diseases category): n.a.

Research activities: identification of morphological and biochemical indexes; research on the utilisation of thermography chamber.

Area: Aquaculture

Research topic/intervention area: Study on the verification of the efficacy of vaccines

Relevance: High

Time of intervention: Short

Target (diseases or diseases category): lactococcosis (rainbow trout).

Research activities: improvement of immunological induced protection; development of a new route of administration (i.e. oral).

Area: Aquaculture

Research topic/intervention area: Improve the monitoring about enteric viruses in bivalves farmed in lagoon and off-shore.

Relevance: High

Time of intervention: Short

Target (diseases or diseases category): Norovirus, HAV, HEV

Research activities: improve the monitoring about enteric viruses in bivalves (particularly oyster) farmed in lagoon and off-shore.

Area: Aquaculture

Research topic/intervention area: Investigation on presence of zoonotic parasites in farmed fish according to EFSA opinion

Relevance: High

Time of intervention: Short

Target (diseases or diseases category): Anisakis (marine fish), *Dyphyllobotrium* and *Opistorchis* (freshwater fish).

Research activities: implementation on research on presence of zoonotic parasites in farmed fish according to EFSA opinion.

Area: Aquaculture

Research topic/intervention area: Development of new vaccines for new diseases

Relevance: High

Time of intervention: Long

Target (diseases or diseases category): vibriosis of sea bass (i.e. *V. harveyi*), flavobacteriosis, virosis (i.e. Herpes virus in cyprinids).

Research activities: development of new vaccines.

Area: Aquaculture

Research topic/intervention area: Monitoring of the mortality of wild fish and shellfish.

Relevance: High

Time of intervention: Long

Target (diseases or diseases category): all (special focus on nodaviriosis).

Research activities: building of a data collection network for Mediterranean countries.

Area: Aquaculture

Research topic/intervention area: Development of a Mediterranean traceability system to exchange data

Relevance: High

Time of intervention: Long

Target (diseases or diseases category): n.a.

Research activities: development of a traceability system at Mediterranean level for data exchange; exchange data on both production, diseases, and environmental conditions.

Area: Aquaculture

Research topic/intervention area: Harmonisation of diagnostic analysis

Relevance: High

Time of intervention: Long

Target (diseases or diseases category): infectious diseases.

Research activities: harmonisation of diagnostic analysis for fish infectious diseases; development of rapid and robust test; development of tests being suitable for on-farm use.

Area: Aquaculture

Research topic/intervention area: Study on new feed sources

Relevance: Medium

Time of intervention: Short

Target (diseases or diseases category): n.a.

Research activities: substitution of fish meal/oils with different animal or vegetables sources; studies of the consequences of usage of new feed sources on animal health, production performances, and flavour of the fish (e.g. consequence on the taste for consumers).

Area: Aquaculture

Research topic/intervention area: Study on farmed fish technopathy

Relevance: Medium

Time of intervention: Short

Target (diseases or diseases category): winter diseases in sea bream, red mark syndrome and gill disease in rainbow trout.

Research activities: research on strategies to reduce farmed fish technopathy.

Area: Aquaculture

Research topic/intervention area: Study on anti-parasite drugs

Relevance: Medium

Time of intervention: Short

Target (diseases or diseases category): Ichthyophthius (rainbow trout), Monogenean and crustacean (farmed fish), Oodinium (seawater fish).

Research activities: development of new drugs (e.g. against); research on Ivermectine efficacy.

Area: Aquaculture

Research topic/intervention area: Study on parasitosis on fish bred in sea cages

Relevance: Medium

Time of intervention: Short

Target (diseases or diseases category): Microcotyle and Enteromyxidium in mariculture.

Research activities: research on host-pathogen interaction.

Area: Aquaculture

Research topic/intervention area: Study on photo-bacteriosis in marine fish

Relevance: Medium

Time of intervention: Short

Target (diseases or diseases category): *P. damsela*.

Research activities: research on host-pathogen interaction (*P. damsela* sub. *piscicida*); research on pathogenic role (*P. damsela damsela*); research on the interaction between marine farmed fish and wild fish, cetaceans, turtles and bivalve molluscs.

Area: Aquaculture

Research topic/intervention area: Study on atypical mycobacteriosis

Relevance: Medium

Time of intervention: Short

Target (diseases or diseases category): *M. terrae*, *M. gordonae*.

Research activities: study on pathogenic impact (in particular on sturgeon and sea bass).

Area: Aquaculture

Research topic/intervention area: Development of prebiotics and herbal stimulants to improve a-specific immunity system

Relevance: Medium

Time of intervention: Long

Target (diseases or diseases category): bacterial and parasitic diseases in fish (

Research activities: study on the effect of of betaglucans, oil extracts, etc.. on specific immunity in fish.

Research topic/intervention area: Development of sustainable therapies

Relevance: Medium

Time of intervention: Long

Target (diseases or diseases category): all

Research activities: experimental study on phagotherapy and herbal therapy (e.g. rosemary, garlic).

Research topic/intervention area: Development of legal framework to improve disease surveillance

Relevance: Medium

Time of intervention: Long

Target (diseases or diseases category): all infectious diseases.

Research activities: development of a framework including all the stakeholders on aquatic animals diseases surveillance.

Northern Mediterranean region: specific most urgent topics

Area: Infectious disease

Research topic/intervention area: Definition of appropriate sampling strategies

Relevance: Medium

Time of intervention: Short

Target (diseases or diseases category): n.a.

Research activities: research to support cost effective surveillance strategies that facilitate and assure disease detection (e.g. risk based surveillance); development of new systems for data collection.

Area: Infectious disease

Research topic/intervention area: Development of mathematical and risk analysis models, also aiming at the development of contingency planning

Relevance: High

Time of intervention: Long

Target (diseases or diseases category): infectious disease (special focus on vector-borne and OIE listed diseases).

Research activities: research aiming at the identification of factors that indicate risk; development of improved parameterisation of models.

Area: Production disease

Research topic/intervention area: Development of farm management systems aiming at optimisation and increase of production

Relevance: High

Time of intervention: Long

Target (diseases or diseases category): respiratory, GI, parasitic, endemic, multi-factorial.

Research activities: research to develop and advise on good farming practices to improve livestock health (i.e. also in relation to AMR and reduction of anti-microbial use); development/implementation of tailored farming advise, suiting the environment-region in which it is applied (and the associated risks).

Area: Production disease

Research topic/intervention area: Development of alternative food sources

Relevance: Medium

Time of intervention: Long

Target (diseases or diseases category): Safety of novel food sources and any pathogen associated. (human and animal health).

Research activities: investigation about the acceptance of novel food sources with respect to consumers, acknowledging food safety and cost (efficient production); implementation of social science studies regarding public perception of GMO technologies in food production, also with respect to food production with minimal impact on the environment; development of novel food systems with respect to nutritional value.

Area: Production disease

Research topic/intervention area: Development of methods to forecast effect of weather and climate on animal health and welfare

Relevance: Medium

Time of intervention: Long

Target (diseases or diseases category): n.a.

Research activities: research into farming infrastructure (and livestock genetics and physiology-nutrition) requirements to accommodate for climatic impacts; research to better understand the risk presented to livestock health from changing climatic conditions; research on the adaptability of farming to climate changes.

South-eastern Mediterranean region: specific most urgent topics

Area: Infectious disease

Research topic/intervention area: Implementation of specific interventions on the territory to increase prevention

Relevance: High

Time of intervention: Short

Target (diseases or diseases category): WND, lumpy skin, FMD, paratuberculosis, other highly contagious disease and transboundary diseases.

Research activities: development of contingency planning; development of rapid diagnostic tests (FMD, RFV, CCHF); development of early warning systems (PPR, Lumpy skin, poxviruses).

Area: Production disease

Research topic/intervention area: Integration of traceability systems for sharing information

Relevance: High

Time of intervention: Short

Target (diseases or diseases category): n.a.

Research activities: collection of production data; implementation of I&R; training to farmer on traceability (i.e. to support the understanding of the usefulness of I&R); identification of new techniques for species identification of food AO.

Area: Production disease

Research topic/intervention area: Development of biosecurity systems aiming at optimisation and increase of production

Relevance: High

Time of intervention: Short

Target (diseases or diseases category): IBR, BVD, brucellosis, parasites, anaplasmosis, piroplasmosis.

Research activities: development of biosecurity systems; determination of biosecurity plan for each farm; implementation of risk analysis at local level; development of new disinfectants; development of SOPs.

Area: Infectious disease

Research topic/intervention area: Development of vaccines for extensive use

Relevance: Medium

Time of intervention: Short

Target (diseases or diseases category): WND, rabies; brucellosis, TB.

Research activities: research on the use of new vaccines(e.g. using peptides and vegetal derivate).

Area: Infectious disease

Research topic/intervention area: Production of new test or validation of existing test

Relevance: Medium

Time of intervention: Short

Target (diseases or diseases category): MERS

Research activities: research on production of new test or validation of existing test for other species (e.g. camels, wildlife).

Area: Production disease

Research topic/intervention area: Development of new feed sources

Relevance: High

Time of intervention: Long

Target (diseases or diseases category): n.a.

Research activities: identification of new feed sources; research on genetic manipulation of plants (e.g. adaptation to climate); development of synthetic bioprocessing; studies on feed supplementation for farmed animals (e.g. use of pro/prebiotics, use of by-products).

Area: Production disease

Research topic/intervention area: Identification of genetic types being resistant to main diseases

Relevance: High

Time of intervention: Long

Target (diseases or diseases category): main animal diseases.

Research activities: research aiming at the identification of genetic types being resistant to diseases; identification of resistance being adapted to specific areas.

Area: Production disease

Research topic/intervention area: Sustainability studies of farms with the new feeding sources

Relevance: High

Time of intervention: Long

Target (diseases or diseases category): adenomatosis, PPR, mastitis, mycoplasma, tick diseases.

Research activities: identification of genetic markers for diseases; fundamental research on genetics; research on immunocompetence factors; research on environment interaction with genes expression.

Area: Infectious disease

Research topic/intervention area: Increase of diagnostic potential on bioterrorism potential agents

Relevance: Medium

Time of intervention: Long

Target (diseases or diseases category): bioterrorism potential agents

Research activities: increase availability of reagents; development of synthetic reagents.

Area: Infectious disease

Research topic/intervention area: Widening of the range of biological samples

Relevance: Medium

Time of intervention: Long

Target (diseases or diseases category): all

Research activities: investigation on the use of e.g. milk/saliva instead of blood sampling; validation of new samples; coupling of field investigation and lab testing.

Area: Production disease

Research topic/intervention area: Study on the impact of the use of new areas for zootechnical purposes

Relevance: Medium

Time of intervention: Long

Target (diseases or diseases category): n.a.

Research activities: identification of parameters to assess differences between current system and new ones.

Area: Production disease

Research topic/intervention area: Study on new vaccines for livestock (i.e. for production diseases)

Relevance: Medium

Time of intervention: Long

Target (diseases or diseases category): production diseases parasites, bacterial (e.g. anaplasmosis).

Research activities: development of vaccines for parasites; development of insects/arthropods vaccines; study of factors influencing vectorial competency of arthropods to pathogens.

Area: Production disease

Research topic/intervention area: Evidence based intervention on management and prevention of diseases, including evaluation methods for the interventions

Relevance: Medium

Time of intervention: Long

Target (diseases or diseases category): piroplasmosis, anaplasmosis, rickettsiosis.

Research activities: ecological/behavioural research on vectors; research on biological cycle (reproduction) of vector; research on host (vector)-pathogen interaction; development of rapid system to identify infected vectors; establishment of colonies (breeding) of vectors for research purposes.

Area: Production disease

Research topic/intervention area: Study on genetic types being adapted to evolving farming systems

Relevance: Medium

Time of intervention: Long

Target (diseases or diseases category): n.a.

Research activities: research aiming at the identification of genetic types and factors of adaptability to new farming system.