EUROPEAN COOPERATION IN SCIENCE & TECHNOLOGY

Brussels, 25 May 2021

COST 043/21

DECISION

Subject: Memorandum of Understanding for the implementation of the COST Action “Biosecurity Enhanced Through Training Evaluation and Raising Awareness” (BETTER) CA20103

The COST Member Countries will find attached the Memorandum of Understanding for the COST Action Biosecurity Enhanced Through Training Evaluation and Raising Awareness approved by the Committee of Senior Officials through written procedure on 25 May 2021.

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MEMORANDUM OF UNDERSTANDING

For the implementation of a COST Action designated as

COST Action CA20103
BIOSECURITY ENHANCED THROUGH TRAINING EVALUATION AND RAISING AWARENESS (BETTER)

The COST Members through the present Memorandum of Understanding (MoU) wish to undertake joint activities of mutual interest and declare their common intention to participate in the COST Action, referred to above and described in the Technical Annex of this MoU.

The Action will be carried out in accordance with the set of COST Implementation Rules approved by the Committee of Senior Officials (CSO), or any document amending or replacing them.

The main aim and objective of the Action is to reduce the risk of infectious disease introduction and spread by improving the implementation of biosecurity measures in animal production systems. This will be achieved through the specific objectives detailed in the Technical Annex.

The present MoU enters into force on the date of the approval of the COST Action by the CSO.

OVERVIEW

Summary
Biosecurity is of paramount importance to prevent the introduction and spread of pathogens and, consequently, to preserve the health of farmed animals. Healthier animals result in better animal welfare, better sustainability of animal production systems and less antimicrobial use. Despite these benefits, biosecurity is limited by different factors: i) lack of knowledge on ways for improvement, especially in extensive systems or settings with low resources; ii) shortage of adequate ways to enhance communication; iii) diversity of methodologies to assess and measure the implementation of biosecurity measures and their cost-effectiveness and iv) low number of trained professionals. To approach these challenges, the Action will evaluate how biosecurity is currently used and will use participative approaches to understand motivators and barriers for biosecurity implementation. Knowledge generated through them will act as the baseline upon which to develop adequate communication and training on biosecurity. The Action will also perform a comparison of existing methods used to evaluate biosecurity. Exploiting these tools will promote the development of tailored options in farms based on the evaluation of their risks, on the feasibility of selected biosecurity measures and on their economic benefits. Moreover, the Action will identify training needs through the evaluation of existing training materials and will develop new courses, increasing therefore the number of trained professionals. Finally, the Action will recommend priority research areas for future biosecurity improvement in animal production systems. The Action objectives will be achieved through a transdisciplinary group where Early Career Investigators will play a key role in their attainment.

Areas of Expertise Relevant for the Action	Keywords
● Animal and dairy science: Prevention and treatment of infection by pathogens (e.g. vaccination, antibiotics, fungicide) ● Veterinary science: Veterinary medicine (miscellaneous) ● Health Sciences: Epidemiology	● Biosecurity ● Animal Health ● Diseases ● Animal Production Systems

Specific Objectives
To achieve the main objective described in this MoU, the following specific objectives shall be accomplished:

Research Coordination
● To map the implementation of biosecurity measures in animal production systems and in animal transport, and to inventory the current training and existing research projects in biosecurity in Europe and neighbouring countries (WG1 and WG4).
● To identify biosecurity measures that could be realistically implemented in extensive animal production systems (including transhumant) and settings with low resources such as backyard production in a cost-effective and sustainable manner (WG1).
● To identify the main knowledge gaps in biosecurity in the different cattle, pig and poultry production systems in Europe and the ways for improvement (WG1).
● To identify the factors – barriers and motivators - influencing decision making in the process of implementing biosecurity measures (WG2).
● To understand the perceptions, attitudes and demands of general public on biosecurity in relation to their expectations of livestock production as well as their knowledge about disease spread and the role that they can have (WG2).

● To provide guidelines and good practices for innovative evidence-based communication strategies for reducing knowledge gaps, increase positive attitudes and confidence of stakeholders in relation to adopting biosecurity measures (WG2 and WG4).
● To evaluate the existing methods for quantification of biosecurity and/or the risk of disease introduction together with the economic and health benefits of the implementation of biosecurity measures (WG3).
● To evaluate the effectiveness of the different existing biosecurity improvement programs (WG3).

Capacity Building
● To create a sustainable network for the promotion of research, education and application of biosecurity measures in European countries (All WGs).
● To improve the communication and information sources related to biosecurity aimed at veterinarians, farm advisors, farmers' associations and official authorities (All WGs).
● To strengthen the links between different stakeholders and funding agencies within and outside Europe to promote research and education on biosecurity (All WGs).
● To disseminate the knowledge generated in the Action through the creation of a European Biosecurity Portal (WG4).
● To organize workshops and training schools on biosecurity (WG4).

TECHNICAL ANNEX

1. S&T EXCELLENCE

1.1 Soundness of the Challenge

1.1.1 DESCRIPTION OF THE STATE-OF-THE-ART

Biosecurity is defined by the World Organisation for Animal Health (OIE) as “a set of management and physical measures designed to reduce the risk of introduction, establishment and spread of animal diseases, infections or infestations to, from and within an animal population”. In the last few years, several studies have described the biosecurity measures applied in European farms. These studies have shown that the biosecurity standards were highest for poultry operations, followed by pig farms, but were much lower for farming of other species. These studies also reflect differences in biosecurity levels between farming systems and countries. However, the few publications comparing different countries were mostly descriptive without any further analysis about the reasons for such heterogeneity. In addition, most of these studies were conducted in commercial holdings in Western Europe and, therefore, information about other production systems or countries is lacking. This is also the case for backyard holdings. They might be unlikely to transmit disease to a large number of farms but when they sell and buy animals in the local or regional markets, they may have a role in disease spread and maintenance. The African Swine Fever (ASF) epidemic evidenced the importance of this type of production system in disease spread, as several outbreaks in domestic pigs affected backyard and small-scale farms. Moreover, extensive production systems are exposed to spill over of transmissible diseases from wildlife. Examples include the interaction of wildlife with domestic cattle for bovine tuberculosis and with pigs for Aujesky’s Disease and Hepatitis E infection. This is in addition to the ASF transmission between wild boars and traditionally free-ranging domestic pigs in backyard farms or the interaction between avian influenza-infected wild birds and domestic poultry. Also, the environmental impact of the livestock sector in terms of use of agricultural land, gas emissions, water consumption and pollution of water resources has highlighted the need to develop environmentally, socially, and economically sustainable livestock production systems. Moreover, one of the challenges that livestock farming is currently facing is the acceptability of the production methods by consumers; some parts of society have a preference for more extensive production systems. Consequently, there has been an increase in livestock rearing carried out in extensive, pasture-based, low-input and/or organic systems. There are no studies documenting the possible biosecurity measures applicable in the extensive production systems or in settings with low resources, characterized by scavenging or swill feeding with little supplementary feeding, low productivity, domestic use of products or local marketing (i.e., backyard production). Livestock transports can also play a key role in disease spread between farms. Transmission can occur via infected transported animals if cleaning and disinfection prior to transport has not been carried out appropriately or via the contamination of the vehicle, or the clothing or footwear of the driver. Despite cleaning and disinfection of transport vehicles being an important biosecurity measure to prevent disease spread, different constraints such as lack of technical equipment, time constraints, lack of awareness or adequate facilities have been reported.

The implementation of biosecurity measures is important in private veterinary practice in order to reduce the risk of spread of endemic diseases that affect productivity; but it is also important for animal health authorities to combat diseases with high morbidity and substantial impact on animal trade (mainly exotic diseases). Biosecurity has been perceived by some as a set of measures imposed by the official services “against” farmers instead of measures that are beneficial for all stakeholders. Managing biosecurity depends not only on science and knowledge on how diseases spread but also on what people do and believe. In the last few years, different studies have focused on the factors influencing decision-making in biosecurity. Commonly, farmers declare that the costs of the measure’s implementation, its perceived usefulness, the resulting increase in workload and the lack of proven effectiveness of certain biosecurity measures to be applied are the main perceived constraints for the actual implementation of biosecurity plans. Moreover, several studies have shown that previous knowledge and experience are important determinants of the attitude of farmers regarding biosecurity. These studies have identified some motivators and barriers affecting the implementation of biosecurity measures. However, at present, it is impossible to generalize those determinants and to identify differences between countries or stakeholders.

Different methods have been developed to measure farm biosecurity including web-based applications. Some of them use checklists to assess if the farm achieves specific standards (for example the one developed by the Australian Pork Industry Quality Assurance Program; www.apiq.com.au) or to support the development of on-farm biosecurity plans (https://www.farmbiosecurity.com.au). In other examples, the focus has been on scoring the level of implementation of biosecurity measures in the farm for a

specific pathogen or measures that are common to the transmission of different types of infectious agents such as Biocheck.UGent™ or PorcProtect. Other authors developed methods using the framework of risk analysis taking into account the epidemiological connections of a farm and the biosecurity measures most relevant for a specific disease. State-of-the-art technology has also been used to measure daily practices and the effect that they can have in the spread of diseases within the farm. For example, the use of cameras in poultry farms to evaluate biosecurity compliance or the use of a movement-tracking device which correlated staff movements within pig farms with disease spread.

Finally, the current Animal Health Law (Regulation (EU) 2016/429 on transmissible animal diseases) states that biosecurity is a prerequisite for efficient animal health management and that professionals should acquire knowledge about biosecurity through formal education. However, such offers of formal education and associated risk communication strategies are still scarce and, for example, biosecurity is not explicitly included in the EU directive regulating veterinary studies in Europe (2005/36/CE). Moreover, evidence-based guiding principles and good practices have not been established for such education and communication activities, in order to drive behavioural change of different stakeholders to reach a higher and more effective implementation level of biosecurity measures. By engaging different stakeholders in biosecurity training, such education will have impact on their behaviour, and will increase the compliance with biosecurity measures.

1.1.1. DESCRIPTION OF THE CHALLENGE (MAIN AIM)

The **overall aim** of the Action is to reduce the risk of infectious disease introduction and spread by improving the implementation of biosecurity measures in animal production systems. This challenge is highly relevant as biosecurity is of paramount importance to preserve the health of farmed animals. Healthier animals result in better animal welfare, better sustainability of livestock systems and less antibiotic usage. These three aspects are priorities for the immediate future of animal production systems but also for society. In addition, biosecurity may have a key role in preventing the introduction and spread across Europe of Transboundary Animal Diseases with devastating socio-economic consequences such as African Swine Fever, Avian Influenza or Foot and Mouth Disease.

The challenge is also timely as in the last few years' European animal health authorities have embarked on joint efforts in order to enhance biosecurity. This is reflected in the new regulation on Animal Health (Regulation (EU) 2016/429 on transmissible animal diseases) that considers that biosecurity is one of the key tools to prevent disease introduction and spread across the continent and encourages the promotion of higher biosecurity standards. A meeting of the Council of the European Union held in June 2019 emphasized the key role of biosecurity in managing risks associated with the spread of different transboundary animal diseases across Europe. Conclusions of this council stressed that the enhancement of biosecurity demands an integrated approach, with the involvement and cooperation of all stakeholders. Additionally, the Council highlighted the need for more professional training as well as the identification of ways to enhance communication and awareness aimed at stakeholders. The present action is organised in accordance with those lines.

The first challenge of the present Action will address how biosecurity measures are applied in Europe and neighbouring countries, and will identify ways for improvement, especially in production systems where there is a lower level of implementation or in settings where biosecurity is more challenging to carry out. This first challenge is highly relevant as it maps the implementation of biosecurity measures in Europe, thus allowing efforts to be joined up to come up with realistic, cost-effective, and sustainable practices to reduce the spread of diseases. Moreover, the challenge is also timely due to the increasingly important role played by both extensive production systems and backyard production in the recent ASF epidemic in some parts of Europe.

In the **second challenge,** the Action aims to scale-up the knowledge and experience of different types of stakeholders (i.e., end-users of biosecurity and general society). This is highly relevant as any training or communication strategies for end-users should be based not only on science but also on the understanding of why stakeholders behave the way they do. Gathering evidence on their perceptions and potential knowledge gaps between stakeholders and experts with regard to biosecurity, together with a deep understanding of their motivations and barriers for implementing biosecurity measures, will enable the development of adequate communication strategies. In addition, comparing perceptions, attitudes, knowledge, and other relevant variables between experts, stakeholders, and lay people (the public) in relation to livestock production systems and prevention measures is also highly relevant. On one hand, it will contribute to the development of communication strategies for consumers in order to align livestock production systems with prevention measures and evolve along with societal demands. On the other hand, it may raise awareness of the important role that some specific population groups can have in diseases spread, such as hunters or the general public visiting the countryside or through international travels (in the case of ASF).

The **third challenge** will focus on identifying the existing methods used to evaluate biosecurity. At present, methodologies are diverse and have not been compared comprehensively. Such methods can be useful as educational tools and for developing skills in risk-based prioritisation as well as to provide quantitative goals and benchmarks which can be used to position the farm with respect to others. A discussion should be set up on how tailored options can be applied in different farms based on the evaluation of their risks, the feasibility of selected measures and its economic benefits. Moreover, several authors have identified the importance of demonstrating the benefits of the implementation of biosecurity measures as a key factor for a rational adoption of good practices by farmers. In a context in which biosecurity is increasingly important, it is highly relevant and timely to have tools to assess and measure biosecurity's impact while raising awareness about it.

The **fourth challenge** aims to increase the number of professionals, such as veterinarians and farmers, trained in biosecurity and to develop guidelines and good practices for evidence-based effective communicative strategies for different stakeholders (including the public). This is a relevant challenge due to the lack of formal education on this issue. It will be approached through the evaluation of existing training materials about biosecurity and its comparison with the training needs at different levels (i.e., graduate, postgraduate and professional training). It will also develop new and innovative ways to raise awareness and to develop positive attitudes towards biosecurity. This is especially relevant as different studies have evidenced that the lack of uptake of biosecurity measures is not always linked to a lack of knowledge. New and innovative ways to enhance communication effectiveness to increment knowledge and positive attitudes are urgently needed as this may provide the basis for a higher acceptance of biosecurity measures.

Nowadays, health and welfare, safety and sustainability are crucial elements for ensuring the future of livestock production. Biosecurity aims to prevent the introduction and spread of pathogens within and between farms and, consequently, results in better welfare, increased food safety and better sustainability. In addition, biosecurity measures act as a barrier against the periodic emergence of transboundary diseases. The present Action is supported by the growing interest for biosecurity but also based on the increased number of research projects on these aspects. Although there is an increasing number of groups working on different aspects related to biosecurity, their level of collaboration and networking is relatively low and, therefore, a better communication and coordination mechanism is needed between the different groups in order to give a common voice to those in the field (i.e., farmers, veterinarians, traders, decision makers and the general population).

1.2 Progress beyond the state-of-the-art

1.2.1 APPROACH TO THE CHALLENGE AND PROGRESS BEYOND THE STATE-OF-THE-ART

The main axes of the approach are: transdisciplinary, collaborative work involving all possible stakeholders and the use of state-of-the-art technologies and methodologies. In the Action, Early Career Investigators will play a key role by using the following innovative approaches:

Working with a holistic view in a coordinated and extensive network: the transdisciplinary nature of the network will result in an increased capacity for analysis and understanding of the different components involved in the rational assessment of biosecurity, design of biosecurity plans and their actual implementation. Based on the One Health principles, the participation of specialists from the veterinary sciences area together with others from social sciences such as sociology, psychology, and economics in combination with producers and other stakeholders, will significantly increase the chances of producing evidence-based results. The interaction with researchers as well as different types of organizations and industry representatives from different countries will allow to complete the picture on how biosecurity measures are implemented in different livestock farms and to further understand the heterogeneity of biosecurity measures that are implemented. In addition, identification of measures that can be implemented in particularly challenging scenarios such as extensive animal production systems and/or backyards will be possible. Moreover, the training needs for the different stakeholders will be more adequately defined. All of these will significantly advance the state of the art in the field of biosecurity.

Using a participatory approach: the use of this approach will provide an innovative way for raising awareness about biosecurity. Innovation Labs are collaborative structures that operate in a local context to co-identify and co-create transdisciplinary and multi-stakeholder innovations and solutions related with specific challenges. Therefore, they provide an excellent model for finding collaborative solutions. Scaling-up knowledge, experience and needs of all stakeholders by using a bottom-up approach will play a central role in the Action. This will contribute to the dialogue with general society about livestock production systems and the needs of producers in terms of biosecurity. In addition, they will contribute

to advancing the understanding of which factors influence decision-making in biosecurity and will provide an innovative approach to develop training and communication activities thus increasing the probability of a behavioural change towards the implementation of biosecurity measures.

Exploiting new technology: different innovative methods for the evaluation of biosecurity have been developed in the last few years. The Action aims to critically review those methods and explore strategies in which all of them can contribute to biosecurity improvement. Moreover, the potential of methods for analysis of huge amounts of data, such as machine learning, will be evaluated to assess the economic and health benefits resulting from the implementation of biosecurity measures. Such methods will contribute to the development of tailored options for biosecurity improvement as well as an increase in biosecurity awareness by evidencing the benefits of its implementation.

1.2.2 OBJECTIVES

1.2.2.1 Research Coordination Objectives

- To map the implementation of biosecurity measures in animal production systems and in animal transport, and to inventory the current training and existing research projects in biosecurity in Europe and neighbouring countries (WG1 and WG4).
- To identify biosecurity measures that could be realistically implemented in extensive animal production systems (including transhumant) and settings with low resources such as backyard production in a cost-effective and sustainable manner (WG1).
- To identify the main knowledge gaps in biosecurity in the different cattle, pig and poultry production systems in Europe and the ways for improvement (WG1).
- To identify the factors – barriers and motivators - influencing decision making in the process of implementing biosecurity measures (WG2).
- To understand the perceptions, attitudes and demands of general public on biosecurity in relation to their expectations of livestock production as well as their knowledge about disease spread and the role that they can have (WG2).
- To provide guidelines and good practices for innovative evidence-based communication strategies for reducing knowledge gaps, increase positive attitudes and confidence of stakeholders in relation to adopting biosecurity measures (WG2 and WG4).
- To evaluate the existing methods for quantification of biosecurity and/or the risk of disease introduction together with the economic and health benefits of the implementation of biosecurity measures (WG3).
- To evaluate the effectiveness of the different existing biosecurity improvement programs (WG3).

1.2.2.2 Capacity-building Objectives

- To create a sustainable network for the promotion of research, education, and application of biosecurity measures in European countries (All WGs).
- To improve the communication and information sources related to biosecurity aimed at veterinarians, farm advisors, farmers' associations, and official authorities (All WGs).
- To strengthen the links between different stakeholders and funding agencies within and outside
- Europe to promote research and education on biosecurity (All WGs).
- To disseminate the knowledge generated in the Action through the creation of a European Biosecurity Portal (WG4).
- To organize workshops and training schools on biosecurity (WG4).

2. NETWORKING EXCELLENCE

2.1. Added value of networking in S&T Excellence

2.1.1. ADDED VALUE IN RELATION TO EXISTING EFFORTS AT EUROPEAN AND/OR INTERNATIONAL LEVEL

Most of the existing research on biosecurity is done by groups through national projects or specific contracts with companies, governing bodies, or international organizations. Nowadays, the collaboration between these groups is limited since it is an emerging field and there is a clear need for a coordination mechanism to join efforts in this area. At the moment, the applicants do not know of any other research project or network in Europe or elsewhere aimed at improving the implementation of biosecurity

measures in the livestock sector with a broad international, transdisciplinary and holistic approach. However, there are ongoing research projects and networks with which the Action will establish connections in order to add value to their efforts.

The '**DEFEND'** consortium aims to control the African Swine Fever and Lumpy Skin Disease epidemics in Europe and neighbouring countries by understanding the drivers of emergence and the development of diagnostic tools and vaccines. Several synergies can be established with this network as biosecurity is one of the key components to reduce the spread of these diseases. Results on how to improve biosecurity in settings with low resources will be of special interest for the **DEFEND** consortium.

The '**HealthyLivestock'** consortium aims to reduce antimicrobial use in the pig and broiler industries in China and Europe by improving animal health and welfare. One of their four strategies to achieve such a goal is the improvement of biosecurity through zoning-based health and welfare plans. Therefore, the methods for measuring biosecurity and the ways to enhance communication and awareness will be relevant for them. '**SusAn'** is a consortium which aims to promote joint European research coordination on Sustainable Animal Production. As biosecurity has a key role in preserving the health of farmed animals and therefore, the sustainability of livestock systems, synergies with this consortium will also be established. Connections with other consortia such as '**SmartCow'** which aim to help the cattle sector facing the challenge of sustainable production, '**LIVERUR'** that promotes the use of Innovation Labs in rural regions or the recently established consortium named '**ROADMAP',** which aims to foster prudent antimicrobial use will also be established. Results from the Action can clearly add value to their activities. In addition, in the consortium '**DISARM'** the focus is on disseminating best practices from innovative farms and research on how to reduce antibiotic resistance in livestock farming. Biosecurity measures are, among other actions, key in these solutions. Through the members of the Action and the **DISARM** network, a clear collaboration is assured.

In relation to other existing COST Actions, there are two with which synergies and collaborations can be developed. The Action '**SOUND'** aims to harmonise the outputs for non-regulated cattle diseases in order to support the implementation of the Animal Health Law. Biosecurity plays a central role in Animal Health Law to ensure a safer animal trade. Another Action with which synergies can be established is '**ENOVAT',** that aims to reduce antimicrobial resistance. Since biosecurity can have a great impact in reducing the use of antimicrobial agents, contacts with this Action will be established.

Other existing efforts to tackle the challenge addressed in the present Action are those made by governing bodies to promote the use of biosecurity. The Action will therefore support the conclusions on biosecurity adopted by the Council of the European Union on June 2019 (Council conclusions, 2019) and the requirements on biosecurity included in the Animal Health Law (Regulation (EU) 2016/429 on transmissible animal diseases).

2.2. ADDED VALUE OF NETWORKING IN IMPACT

2.2.1. SECURING THE CRITICAL MASS AND EXPERTISE

The Action is composed of 101 proposers from 26 COST country institutions of which 13 are Inclusive Target Countries (ITC). In addition, 2 Near-Neighbour Country Institutions and 4 International Partner Countries are also participating. The number of people involved in the Action together with their different backgrounds and the wide geographic distribution provides an excellent opportunity to achieve the objectives of the Action as they will enable the contact with stakeholders across an extensive area.

The present Action involves a multidisciplinary team encompassing the expertise needed to solve the identified challenges. This team includes:

Economists: demonstrating the economic benefits of implementing biosecurity measures in farmed animals is key to increase awareness. Experts from this field will contribute to assessing which methods can most effectively achieve the desired outcomes.

Epidemiologists: their expertise is needed to assist with the collection of data about biosecurity measures, the evaluation of existing methods on how to measure it and the benefits of implementation.

Evidence synthesis experts: compilation and synthesis of information will play a central role in the Action.

Infectious diseases and animal production experts: biosecurity measures are based on the understanding of infectious diseases and also on the understanding of the particularities of each livestock production system, therefore, their expertise is much needed.

Sociologists, psychologists, and communication experts: their expertise in risk perception and communication will be of paramount importance to scale-up knowledge and experiences of the different stakeholders, experts, and the general public, understand the barriers/motivators in decision-making for implementing biosecurity measures and for providing scientific evidence to sustain the development of new and innovative communication strategies.

Wildlife experts: understanding management systems and dynamics of wildlife populations are needed to identify possible measures to be implemented in different livestock productions systems.

The Action will actively seek new experts to enrol in the network. Particular efforts will be targeted towards the recruitment of early career investigators, for example by the organization of specific meetings or by inviting young researchers to workshops and training actions. Experts outside the Consortium will be invited to participate in meetings and workshops as well. In addition, experts from other livestock sectors (such as small ruminants) and from aquaculture will also be contacted in order to expand the network among these animal species.

2.2.2. INVOLVEMENT OF STAKEHOLDERS

The following stakeholders have been identified as the most relevant ones for the Action:

Government bodies: they are responsible for the control of animal diseases. Knowledge on the efficacy of biosecurity measures and how those measures can be improved is of great importance. Moreover, the Animal Health Law encourages the development of plans to improve biosecurity and empowers the Member States to promote higher standards on biosecurity. Therefore, official veterinary services have the commitment to promote biosecurity in their respective countries.

Industry: pharmaceutical companies, agri-food groups, dairy companies, transport companies, to name a few, are highly relevant due to their influence in the application of biosecurity measures. Industry is interested in having a high standard of biosecurity in order to prevent the spread of diseases and therefore can play a key role in their promotion. In addition, industry can contribute to the sustainability of the Action's activities through their support and could be a potential reservoir of employment opportunities contributing to its promotion and career development.

International organizations such as FAO: these types of organizations are engaged in the prevention and control of animal diseases and therefore they are interested in promoting the improvement of biosecurity measures.

Producers and veterinary associations/organisations: as end-users of biosecurity their participation in the Action is of paramount importance.

Universities and research organisations: science will play an important role in the Action in order to provide evidence-based information to the different stakeholders and to promote education in this area.

Representatives from general public: livestock farming is facing a challenge to maintain its acceptability in a society increasingly concerned about animal welfare, food safety, sustainability and the spread of infections from animal populations to humans. Therefore, it is very relevant to establish a dialogue on the demands of society and how these can be harmonised with the needs of the producers. In addition, it is highly relevant that the general public carrying out activities in nature such as hunting, and hiking are aware of the risk of spreading diseases due to their activities.

Representatives of all the stakeholders described above, with the exception of 'representatives from the general public', are already included in the proposed network. Nevertheless, the Action, through the different meetings, workshops and dissemination and communication activities will actively search for more representatives in the different countries in order to expand the network and outreach activities. Specific time during the project will be devoted within each working group to identify and contact more representatives in order to expand the network.

Representatives from general public associations such as consumer groups, hunters' associations or hiking groups will be involved from the beginning of the project through an active search for them by the members of the Action; they will be invited to engage in the discussions held in the Innovation Labs.

2.2.3. MUTUAL BENEFITS OF THE INVOLVEMENT OF SECONDARY PROPOSERS FROM NEAR NEIGHBOUR OR INTERNATIONAL PARTNER COUNTRIES OR INTERNATIONAL ORGANISATIONS

Proposers from Non-COST countries have also been involved. At the moment, researchers from four International Partner Countries (three from Latin America and one from Australia) and two Near Neighbour Countries (one from Jordania and the other from Ukraine) are proposers of the Action. There are several mutual benefits for their involvement:

- Marta Hernández-Jover, from the Graham Centre for Agricultural Innovation of the Charles Sturt University (Australia): Australia has long-standing experience with high standards of biosecurity. Moreover, extensive work has been performed in this centre in relation to psycho-social factors and smallholders. Their knowledge and experience will greatly support the different planned activities. They will also benefit from outputs and deliverables from the project, especially in the areas of further research needs.
- Laura Valeria Alarcón, from Facultad de Ciencias Veterinarias - Universidad Nacional de La Plata (Argentina): this country is the world leading country in cattle production. A substantial part of this sector is in an extensive production system and therefore they are very interested in biosecurity measures that can be implemented in such systems. Their experience in cattle health and production systems will be very beneficial for the project. In addition, pig production in the country is growing and they have a need for biosecurity improvement.
- Patricio Retamal and Pedro Ábalos, from Universidad de Chile - Facultad de Ciencias Veterinarias y Pecuarias (Chile): Chile is also an important livestock country, and they require an improvement in the application of biosecurity measures. The group has extensive experience in working with producers and therefore an interchange of experiences in this field will be of mutual benefit.
- Jorge Ron-Román and Cristina Cholota-Iza, from Universidad de las Fuerzas Armadas ESPE (Ecuador): this university implements several research projects in biosecurity in order to support their animal production sector and ensure a better animal health and food quality. Their experience with backyard production systems will support the project activities.
- Ehab Abu-Basha, from Jordan University of Science and Technology (Jordania): this country has mainly an extensive and backyard animal production system, so results from the Action will be of interest for them. In addition, this country can be a portal of diseases entry into Europe as it is a neighbour country located in the Middle East.
- Maryna Galat, Vitali Nedosekov and Valeriya Zvorygina, from National University of Life and Environmental Sciences (Ukraine): this country needs to improve their biosecurity capacities as a European trading partner and neighbour, where important diseases, such as African Swine Fever, are circulating and can act as the gateway for disease spread to other European countries. Therefore, their inclusion will be of mutual benefit.

In relation to other organizations, Daniel Beltrán-Alcrudo, from the Food and Agriculture Organization of the United Nations (FAO) Regional Office for Europe and Central Asia is part of the proposal. Their role will be of utmost importance to expand the network, especially of the official veterinary services, universities, and associations from Near Neighbour Countries from the northern part of Africa and the Caucasus. Moreover, their participation will also be key in the dissemination of the activities of the Action, and it will be a great support in order to share and disseminate the projects results. This organization will greatly benefit from the knowledge transfer generated during the project. The European Food Safety Authority (EFSA) and the World Organisation for Animal Health (OIE) have indicated their interest in participating in the Action.

3. IMPACT

3.1. IMPACT TO SCIENCE, SOCIETY AND COMPETITIVENESS, AND POTENTIAL FOR INNOVATION/BREAK-THROUGHS

3.1.1. SCIENTIFIC, TECHNOLOGICAL, AND/OR SOCIOECONOMIC IMPACTS (INCLUDING POTENTIAL INNOVATIONS AND/OR BREAKTHROUGHS)

In the **short term**, the Action will have several scientific, technological, and socio-economic impacts. It will:

- Generate an extensive international working group in biosecurity where young and gender balanced researchers have a leading role, which in turn will increase scientific and technical knowledge in this area.

- Establish strong, dynamic, and effective links between science and end-users of biosecurity such as veterinarians (both public and private), farm advisors, companies, farmers' associations and official authorities related to biosecurity which will result in an increased awareness of professionals trained.
- Foster the development of methodologies to measure biosecurity and the health and economic benefits of its implementation and develop new communication strategies that maximize the impact of the behavioural change in relation to biosecurity by the end-users.
- Establish tailored biosecurity programs taking into account the production system and socio-economic and psychological determinants in decision making.
- Promote positive attitudes, knowledge, and other relevant variables to increase acceptance of biosecurity measures.

In the **long term**, the Action will have major impacts in society, science, and competitiveness. It will:

- Contribute to a better implementation of biosecurity measures which in turn will reduce the risk of endemic and exotic disease introduction and spread, will improve the health and welfare of animals and humans, reduce antimicrobial use and increase safety of trade with regard to transmission of diseases. All of this will have a great impact on the competitiveness and sustainability of the livestock sector.
- Increase the competitiveness of stakeholders from the animal health sector thanks to a higher number of professionals trained in biosecurity together with a higher awareness.
- Contribute to the incorporation of professionals in the market through new jobs derived from the need of advice in biosecurity.
- Contribute to the development of the European Research Area through the identification of the research needs in different animal production systems and socio-economic contexts.
- Establish the basis for future collaborations between the research groups more focused on the needs of the stakeholders.
- Contribute to the alignment of the expectations of the general public in relation to animal production systems and biosecurity needs.

3.2 MEASURES TO MAXIMISE IMPACT

3.1.2. KNOWLEDGE CREATION, TRANSFER OF KNOWLEDGE AND CAREER DEVELOPMENT

Action aims to have a substantial role in knowledge creation, transfer of knowledge and career development. In relation to **knowledge creation**, the Action is made up of academic and research institutions, government agencies/offices, producers' and veterinary associations and other stakeholders involved in animal health from a wide geographic area. This network provides a unique opportunity to create and standardize competences as well as for identifying knowledge gaps in biosecurity and the ways to fill them. It will point out possible solutions for those production systems where biosecurity is more challenging, understanding behaviour in relation to biosecurity measures, identify the advantages and disadvantages of existing methodologies on biosecurity and training and research needs. New communication strategies will be proposed. This knowledge creation will benefit from the transdisciplinary composition of the proposers but also the combination of young researchers, such as Early Career Investigators, and more experienced researchers. This mixture will maximise the creation of knowledge by sharing of experience and capacities through their participation in the Working Group meetings or the realization of Short-Term Scientific Missions. In addition, the Action will inform the European Commission about research needs in biosecurity which might lead into a future project proposal to be submitted to the Horizon Europe framework and/or other funding opportunities.

Participative actions through Innovation Labs planned in the Action will provide an excellent environment not only to create new knowledge but also to **transfer this knowledge** to different stakeholders, especially to farmers. In addition, training schools will be organized by the Action to provide in-depth training on biosecurity and its implementation by taking into account the sociological and psychological conditions of the different farms and production systems. Training needs across Europe will also be transferred to relevant stakeholders, such as to veterinary education through graduate or post-graduate training programs but also through specific dissemination activities such as publications, conferences, and personal contacts.

The Action will also foster **career development.** With that purpose, young researchers, especially Early Career Investigators, will have a leading role in the different working groups in order to empower and boost their research career.

3.2.2 PLAN FOR DISSEMINATION AND/OR EXPLOITATION AND DIALOGUE WITH THE GENERAL PUBLIC OR POLICY

The communication strategy will be based on the guidelines for the communication, dissemination and exploitation of COST Actions results and outcomes. Accordingly, we will target the scientific community but we will also devote special efforts to communicate our results to the audience outside the scientific community. Indeed, we will provide evidence-based information to the end-users of biosecurity, society and policymakers.

Due to the importance of an adequate communication strategy to maximise the impact of the results of the Action and the involvement of relevant stakeholders in the network, different communication tools will be developed. In addition, a member of the Action will be responsible for coordinating this strategy. The Action will develop the following specific communication tools:

- **Open website of the Action (i.e., Biosecurity Portal)**: through this channel ongoing activities such as meetings, conferences or training will be communicated. In addition, the Action aims to develop this website into a portal for obtaining information about biosecurity. Therefore, a repository of general (i.e. non-disease-specific) and disease(s)-specific existing documents in different countries, languages, and organizations, related to biosecurity measures will be created in order to share and spread all relevant information.
- **Training schools:** education and training materials for different stakeholders will be developed based on the inputs received from the activities performed in the Action. This material will be included in the open website of the Action. Moreover, at least one training course will be organized by the Action at the end of the project for each of the livestock farming production systems (i.e., dairy cattle, beef cattle, pig, poultry and backyard production) in two different regions of Europe (i.e. west and east).
- Innovation **Labs**: participative actions performed in this environment where the end-user has a central role will be an important component of the communication strategy of the Action. This channel will have special relevance for some stakeholders such as general public, farmers or field veterinarians. At least three Innovation Labs, one for each group, will be organized in the Action in two different regions of Europe (i.e., west and east).

In addition, **social media tools** such as Facebook, Twitter, LinkedIn or Instagram will also be used to disseminate ongoing activities and main achievements. Moreover, on-going activities such as the organization of conferences or the promotion of training, workshops or short scientific missions organized by the Action will be disseminated through email discussion lists or scientific societies. The scientific community will be targeted through the organization of a **scientific conference** and the publication of papers in peer-reviewed journals. At least one international conference will be organized by the Action at the end of the project.

In addition, and to enhance dialogue about biosecurity with different end-users such as industry, farmers, official veterinary services and policy makers, an active interaction with the different stakeholders will be fostered by inviting them to participate in different workshops and meetings organized by the Action.

4. IMPLEMENTATION

4.1. COHERENCE AND EFFECTIVENESS OF THE WORK PLAN

4.1.1. DESCRIPTION OF WORKING GROUPS, TASKS AND ACTIVITIES

Working group 1 (WG1): Mapping biosecurity measures applied on farms and transport across Europe.

This working group will address the challenge of understanding how biosecurity measures are applied in the different cattle, pig and poultry production systems across Europe in order to identify existing knowledge gaps and ways for improvement.

The first objective of this working group will be to map the implementation of biosecurity measures in livestock holdings and in animal transport. In order to achieve this objective, the following tasks will be addressed:

- Task 1.1: Review of biosecurity measures applied on cattle, pigs and poultry farms and on animal transport across Europe.
- Task 1.2: Online survey for selected experts on biosecurity measures that are applied on cattle, pigs and poultry farms and animal transport across Europe.

The second objective of WG1 will be to identify which biosecurity measures can be implemented in a realistic, cost-effective and sustainable manner in extensive livestock systems and settings with low resources, such as backyard production. This objective will be approached through the following tasks:

- Task 1.3: Review of biosecurity measures implemented in extensive livestock systems and on backyard production.
- Task 1.4: Workshop about biosecurity measures that could be implemented in extensive livestock systems and on backyard production.

Working group 2 (WG2). Scaling-up the knowledge and experience of stakeholders and of the general public.

This working group will address the second challenge of the Action which is to scale-up the knowledge and experience of end-users of biosecurity and of the general society.

The first objective of this working group will be to understand what the expectations are of the general public on biosecurity in relation to livestock production systems, their attitudes towards biosecurity, and finally what their own knowledge on disease spread and their opinions on their role in stopping it. This will be achieved by the following task:

- Task 2.1.: Participative actions through Innovation Labs with the general public.

The second objective of WG2 will be to identify factors – barriers and motivators – that influence the decision-making for the implementation of biosecurity measures. The third objective will be to gather evidence, develop guidelines and good practices to promote innovative communication strategies to increase awareness and confidence in biosecurity adoption. Both objectives will be achieved through the following tasks:

- Task 2.2: Review of social, economic and psychological factors affecting the decision-making of biosecurity measures by cattle, pig and poultry farmers, veterinarians and traders.
- Task 2.3: Implement participative actions through Innovation Labs with cattle, pig and poultry farmers, veterinarians and traders, aimed at promoting increased knowledge and positive attitudes towards biosecurity measures, to facilitate their societal acceptance.

Working group 3 (WG3). Methods for evaluation of biosecurity and benefits of its implementation.

The challenge of WG3 will be to address the heterogeneity of the existing methods to evaluate and promote biosecurity. In order to do so, the objective of WG3 will be to evaluate the existing methods to quantify the biosecurity level and/or risk of disease introduction together with the economic and health benefits of its implementation. The following tasks will be performed:

- Task 3.1: Review of methods for assessing the level of biosecurity and/or the risk of disease introduction.
- Task 3.2: Review of methods for determining the economic and health benefits of implementing biosecurity measures.
- Task 3.3: Online survey to identify existing biosecurity improvement programs.
- Task 3.4: Evaluation of the different approaches of the existing biosecurity improvement programs and how effective they have been.

At the end of this WG a specific workshop will be performed to discuss the heterogeneity of the existing methods:

- Task 3.5: Workshop to discuss advantages and disadvantages of the reviewed methods and brainstorming on new approaches.

Working group 4 (WG4). Training and dissemination

This working group will address the challenge of increasing the number of professionals trained in biosecurity and the development of communicative strategies with a high impact amongst the different

stakeholders. The first objective of this working group will be to disseminate knowledge generated in the Action through the creation of a European Biosecurity Portal. This will be the website of the Action and is intended to be the reference place to obtain information about biosecurity.

- Task 4.1: Development of the website.
- Task 4.2: Setting up and maintaining the European Biosecurity Portal website.

The second objective of WG4 will be to map the existing training in biosecurity and current research projects. In order to do so the following tasks will be performed:

- Task 4.3: Online survey about existing training and research projects on biosecurity. This survey will be sent to the veterinary schools, veterinary associations, research centres, agricultural colleges and government bodies.
- Task 4.4: Participative actions through the Innovation Labs (in cooperation with WG2) to identify the training needs of the different stakeholders.

The third objective of WG4 will be the development of training schools which will be achieved through the following task:

- Task 4.5: Design of a training course for veterinarians and farmers (in collaboration with all the WGs) focused on each animal production system (i.e., beef cattle, dairy cattle, pigs, poultry and backyards).

Moreover, the Action will organize the following activities that will run parallel to the tasks planned in the working groups:

Action meetings: two meetings will be organized every year in order to ensure networking and facilitate work progress of the different working groups. During these meetings, specific workshops will be planned in some of the working groups for in-depth discussion of some topics.

Conference: one scientific conference will be organized by the Action in order to disseminate results of the different tasks. All stakeholders with an interest on biosecurity, from within and outside Europe, will be invited to participate.

Core group meetings: this group will meet every three months in order to monitor progress of the different planned activities and to promote new ideas and activities. They will also be in charge of organizing the Short-Term Scientific Missions, the different Action Meetings and conferences.

Expanding the network: all the working groups will actively search for relevant stakeholders not involved in the proposal but whose participation will enrich the discussion and results of the action.

Management committee meetings: with the exception of the first meeting, the rest will be organized in the framework of the different Action meetings in order to optimize resources.

Short-Term Scientific Missions: they will be organized based on the working needs of each of the working groups.

Training: all the working groups will participate in the organization of training courses, one in each region of Europe (i.e., west and east). Therefore, the Action aims to teach at least two biosecurity courses at the end of the Action.

Final workshop: all the working groups will participate in a final workshop to identify main biosecurity gaps and brainstorming on ways for improvement.

4.1.2. DESCRIPTION OF DELIVERABLES AND TIMEFRAME

Action deliverables and timeframe are described in the following table.

Deliverable number	Month	WG	Deliverable description
D1	3	WG4	Action website creation
D2	12	WG2	Publication about general societal expectations on livestock production and biosecurity needs of producers
D3	30	WG1	Publication on biosecurity measures applied in livestock farms and transport

D4	30	WG3	Publication of methods to evaluate biosecurity and economic and health benefits of its implementation
D5	33	WG4	Publication on training needs of different stakeholders
D6	36	All WGs	Design of training courses
D7	45	WG1	Publication on feasible biosecurity measures on production systems where the implementation is more challenging
D8	45	WG3	Publication on the effectiveness of the approaches of the existing biosecurity programs
D9	48	All WGs	Report on recommendations on how to improve biosecurity
D10	48	All WGs	Training schools on biosecurity
D11	48	All WGs	Report on future research priorities on biosecurity
D12	48	WG2	Publication on factors affecting the decision-making on implementing biosecurity
D13	48	WG4	Publication on the usefulness of participative actions to increase awareness on biosecurity

4.1.3. RISK ANALYSIS AND CONTINGENCY PLANS

The main identified risks and solutions to mitigate them are:

Lack of time of the Action members (moderate): there is a risk that members of the project do not have enough time to work in the different activities which consequently leads to a delay on the different tasks and deliverables. In order to minimize this risk, the Action will do the following:

- Encourage Early Career Investigators to lead the different working groups: these researchers need to foster their research career and therefore are the best positioned to actively promote the working group activities.
- Have co-working group leaders in each working group: this person will be in charge of supporting the working group leader, Early Career Investigators will also be encouraged to occupy this position.
- Involve young researchers in the Action: the participation of PhD students and MSc students will be encouraged in order to support or lead the achievement of the different tasks.

Few participants in the participative actions (moderate): there is a risk of lack of interest and /or time of general public, farmers and veterinarians to participate in the participative actions planned in the project. Measures to mitigate this risk will be:

- Extensive network of contacts: proposers of the Action do have large experience in conducting participatory activities and therefore there is an already existing number of stakeholders that could participate. Efforts will be performed to clearly explain the aim of the Action and to motivate their participation.
- Expand the network of contacts: in order to reduce the likelihood of having few participants in these activities, specific time within each working group will be devoted to expanding the network with farmer and veterinary associations together with associations of general society.

Lack of communication within and between the working groups (low): there is a possibility that communication within the Action is not adequate. We already have established a structure where this should not happen as there will be bi-yearly meetings together with different specific communication channels (i.e., action website, social networks, etc). Nevertheless, if the core group detects any weakness in the communication between the members of the Action, the following mitigation measures will be conducted:

- Implementation of specific meetings with management committee members to brainstorm communication solutions.
- Specific meetings with affected people to establish a more active and dynamic communication strategy.

Restrictions due to Covid-19 situation (moderate):

- We expect that the health situation has improved when the Action begins its activities. In case there

are still movement restrictions, remote tools will be used to perform the different activities planned in the Action.

4.1.4. GANTT DIAGRAM

	First year				Second year				Third year				Fourth year			
MEETINGS	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**
Kick-off meeting																
Management Committee meetings																
Cost meetings																
Core Group meetings																
Final conference																
TASKS																
ALL WORKING GROUPS																
Identification of relevant stakeholders																
Organization of training																
Workshop to identify main biosecurity gaps and brainstorming on ways for improvement																
WORKING GROUP 1																
Task 1.1.: Reviews about biosecurity in Europe																
Task 1.2.: Online survey for selected experts																
Task 1.3.: Review of biosecurity on extensive and backyard production																
Task 1.4.: Workshop: biosecurity measures in extensive and backyard production																
WORKING GROUP 2																
Task 2.1: Participative actions with general public																
Task 2.2: Review on psycho-social factors																
Task 2.3: Participative actions with farmers and veterinarians																
WORKING GROUP 3																
Task 3.1: Review on methods to evaluate biosecurity																
Task 3.2: Review on methods to determine the economic and health benefits																
Task 3.3: Online survey to identify existing biosecurity improvement programs																
Task 3.4: Evaluation of the effectiveness of existing biosecurity improvement programs																
Task 3.5: Workshop to discuss pros and cons of reviewed methods and brainstorm on new approaches																
WORKING GROUP 4																
Task 4.1: Development of the website																
Task 4.2: Maintenance and support of the European Biosecurity Portal website																
Task 4.3: Online survey about existing training and research projects on biosecurity																
Task 4.4: Participative actions to identify training needs of the different stakeholders																
Task 4.5: Design of a training course																