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MOOD

Monitoring Outbreak events or Disease surveillance in a data science context

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RE Restricted to a group specified by the consortium (including the Commission Services)			
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Project Information				
Project Acronym	MOOD			
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Cirad Project scientific leader (name, RU, e-mail)	Elena ARSEVSKA, ASTRE, <u>elena.arsevska@cirad.fr</u>			
Project goals	 MOOD aims at using state of the art data mining and data analytical techniques of disease data, Big data, and contextual data originating from multiple sources to improve detection, monitoring, and assessment of emerging infectious diseases (EID) in Europe. MOOD will establish a platform for mapping and assessment of epidemiological and genetic data in combination with environmental and socio-economic covariates in an integrated inter-sectorial, interdisciplinary, One health approach. More precisely, MOOD will develop: 1. The epidemic Intelligence community of practice to identify user needs of end-users i.e. national and international human and veterinary public health organizations; 2. Data mining methods for collecting and combining heterogeneous Big data; 3. A network of disease experts to define drivers of disease emergence; 4. Data analysis methods applied to the Big data to model disease emergence and spread; 5. Ready-to-use online platform tailored to the needs of the-end users and complimented with capacity building and network of disease experts to facilitate risk assessment of detected signals. MOOD outputs will be co-constructed with end-users at public health agencies to assure their routine use during and beyond project duration. They will be tested and fine-tuned on a set of air-borne, vector-borne, multiple-transmission route diseases, including anti-microbial resistance and disease X. Extensive interactions with end-users, studies into the barriers to data sharing, dissemination and training activities and monitoring disease and monitoring of the impacts and innovations of MOOD outputs will support future sustainable use. 			
Key words	Infectious diseases, big data, epidemic intelligence, one health, impact, environmental changes, climate changes, user needs, socio-technical innovation			
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Executive Summary

Tick-borne diseases have devastating health consequences on both humans and animals worldwide. In temperate regions of Europe, tick-borne diseases, such as Lyme borreliosis and Tickborne encephalitis, are considered the largest vector-borne disease burden as case incidence and tick presence continue to increase throughout the continent. Due to the zoonotic nature of tickborne diseases, there is a strong need for interaction and collaboration between human and animal health systems, including data exchange and identifying novel data sources to improve disease detection, management and prevention at various scales (local, national, international and global). Disease transmission occurs at the local scale where tick-pathogen-host dynamics are complex and particularly sensitive to environmental and climatic changes at both macro and microhabitat scales. Additionally, social factors including human behaviour influence human-tick and domestic animal-tick contact and subsequently, tick bite opportunities. This case study aims to explore local actor engagement in tick-borne disease risk detection, prevention and management by implementing a social-ecological systems framework to foster transdisciplinary collaboration amongst researchers and a diverse group of local actors to better understand local actor perspectives, needs and priorities for improved tick-borne disease detection, prevention and management. Such a methodological framework supports local-level, multi-actor participation to co-construct a shared representation of tick-borne disease risk, promote individual and collective action and identify socially and ecologically relevant risk indicators for future surveillance efforts.

Keywords

collective action; One Health; participatory approaches; social-ecological systems; tick-borne disease; transdisciplinarity

Date	Revision	Comment	Author/Editor	Affiliation
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Document History

Context

The Problem

Tick-borne diseases are zoonoses that can have devastating consequences on both human and animal health worldwide. Amongst the known (re)-emerging infectious diseases, those transmitted through tick bites represent a significant and growing problem, making ticks one of the most important disease vectors for human and animal health. In Europe, tick-borne diseases, such as Lyme borreliosis and Tick-borne encephalitis, are considered the largest vector-borne disease burden as case incidence and tick presence continue to increase throughout the continent. Due to the animal origin of tick-borne pathogens, it is argued that there is a strong need for interaction and collaboration between human and animal health systems, including data exchange and identifying novel data sources to improve disease detection, management and prevention at various scales (local, national, international and global).

Despite improvements in tick-borne disease prevention and surveillance activities, disease emergence events are increasing. It is argued that this is due to a lack of extensive epidemiological data within diverse social and ecological contexts, leading to significant gaps in our understanding of complex systemic nature of tick-borne disease risk. Indeed, a multitude of interconnected social, environmental and ecological (i.e., social-ecological) variables act as drivers for tick-borne disease (re)-emergence at the human-animal-environment interface by influencing domestic animal-wildlife interactions, as well as increasing human-tick contact opportunities. These drivers include rapid human population growth, increasing trade and travel, intensified livestock production, biodiversity loss and climate change, all of which occur at various scales. Tick-pathogen-host dynamics are particularly sensitive to environmental and climatic changes at both macro and microhabitat scales; additionally, changes in human behavior and domestic animal management influence human-tick and domestic animal-tick contacts as humans and domestic animals only become hosts "accidentally" by entering tick habitats. These social-ecological factors therefore vary disease risk across temporal (e.g., seasonal) and spatial (e.g., landscape) scales, making tick-borne disease risk heterogenous and dependent on the social and ecological context (i.e., the social-ecological system) in question.

In Europe, it has been shown that tick-borne disease risk heterogeneity is evident across and within countries; however, disease burden estimated at the continental and national levels may

not accurately depict true burden at local-levels within different social-ecological systems due to differing surveillance systems and public health policies between countries, as well as incomplete epidemiological data within countries. The social-ecological context surrounding tick-borne disease risk is therefore a particularly challenging issue for public and animal health risk detection, prevention and management and it is argued that until novel surveillance programs are developed, the most effective strategies to combat tick-borne disease risk are small scale, individual tick bite prevention actions.

The One Health paradigm has been suggested as an appropriate integrated health framework for vector-borne disease risk as it prioritizes the interconnectedness of the health of humans, animals and the ecosystems in which they live and bridges the gap between human and animal health sectors. However, the lack of insistence on ecology and environmental sciences integration, as well as the behavioral and political factors of disease (re)-emergence through social sciences paints an incomplete picture of the complexity of many vector-borne diseases, and therefore limits the One Health approach's operationalizability. A recent master's level study explored the importance of a One Health inspired stakeholder network regarding vector-borne disease surveillance in Finland and found that prominent actors in vector-borne disease research and surveillance expressed the need for a formalized network that expands disciplinary and sectoral collaborations, extending to neglected fields of study, such as social sciences and lower-level stakeholders, such as NGOs and local communities, to enhance data management and information sharing. However, the potential operationalization of such an integrated health framework for stakeholder collaborations remained a major question.

Using the tick-borne disease risk model, the current case study aims to propose an operational framework for multi-actor collaboration by exploring local actor engagement in disease risk detection, prevention and management within a social-ecological context. By framing tick-borne disease risk through a social-ecological systems lens, we can better understand the linked societal and biophysical drivers of tick-borne disease risk within specific social-ecological dimensions (e.g., political, cultural, economic, environmental, ecological). Further, exploring local-actor engagement places the focus on the local level where pathogen transmission occurs and prevention measures are most important. Finally, the case study proposes using transdisciplinary research approaches to integrate local actors who are not only confronted by the tick-borne diseases on the ground but who may also play an integral role in knowledge-sharing and building In collaboration with a diversity of actors implicated in risk detection,

prevention and management, including academic experts, practitioners, politicians, business professionals and the general public, amongst other stakeholders affected by or interested in understanding tick-borne disease risk within the spatiotemporal boundaries of a relevant socialecological system. A combination of these health frameworks guided by transdisciplinarity and actor participation has the potential to foster relevant interdisciplinary, multi-sectoral and multilevel collaborations capable of identifying social-ecologically relevant tick-borne disease risk indicators and implement surveillance actions for public and animal health policy.

The Case Study

This case study aims to explore local actor engagement in tick-borne disease risk detection, prevention and management by implementing a social-ecological systems framework to foster transdisciplinary collaboration amongst researchers and a diverse group of local actors to better understand local actor perspectives, needs and priorities for improved tick-borne disease detection at the local-level within a co-defined social-ecological system. Such a methodological framework supports local-level, multi-actor participation to identify socially and ecologically relevant risk indicators, co-construct a shared representation of the tick-borne disease risk at stake and promote individual and collective action.

The southern region of France, Occitanie was chosen as a relevant case study to explore a socialecological systems approach to tick-borne disease risk detection, prevention and management through the engagement of local actors due to the current and potential tick-borne disease risks, the environmental landscapes and the socio-economic stakes tick-borne disease risk presents. Occitanie is known for its diverse climatic conditions and landscapes that provide an agricultural and touristic richness unique to this French region. In terms of tick-borne disease risk, important tick species for both human and animal health are present throughout the region: *Ixodes ricinus*, responsible for Lyme borreliosis and Tick-borne encephalitis, amongst other zoonoses and *Hyalomma marginatum*, a recently established species in this region responsible for potential Crimean-Congo Hemorrhagic fever virus emergence as well as other important disease for domestic animals. Collaborations between an interdisciplinary research team and diverse local actors (e.g., livestock farmers and breeders, veterinarians and environmental educators) currently exists in certain departments in which local actors, however such collaborations primarily involve tick specimen collections and are punctual and informal.

Presentation of the methodological approach

This transdisciplinary, social-ecological systems for tick-borne disease risk detection, prevention and management mobilizes social science research methods and participatory approches and follows an iterative process (Annex 1). Such a methodological framework supports local-level, multi-actor participation to identify socially and ecologically relevant risk indicators, co-construct a shared representation of the tick-borne disease-related issues at stake and promote individual and collective action.

The process began by a preparatory phase which includes identifying a biophysical zone that encompasses specific economic, ecological, ideological and political dimensions ("territoire" in French and which will serve as the SES within which tick-borne disease risk is relevant. Once the geographic parameters of the SES were delineated (e.g., an administrative unit, a geographic zone, a protected area), a preliminary SES diagnosis was used to contextualize tickborne disease risk within the social (i.e., cultural, institutional, political dimensions) and ecological (i.e., environmental, biophysical dimensions) systems. We then identified constitutive elements of the SES through participatory tools and methods including expert consultations, participant observation, serious role-playing games and actor interaction diagrams. These elements were (1) actors and stakeholders: individuals, organizations or institutions that are directly or indirectly affected by tick-borne disease risk, and who may positively or negatively contribute to prevention and management efforts and (2) environmental factors that may influence the enzootic and zoonotic cycle of tick-borne diseases. Through these participatory approaches, actor typologies were created according to how each actor confronted with tick-borne disease risk, as well as the nature of their current or possible interventions regarding detection, prevention and management strategies. In particular, a serious role playing game, Go Ticks!, developed in 2020 as a research tool to foster local actor collaboration to confront tick-related risks, was used to identify four fundamental actor typologies that applied to this task. These actor typologies were then supplemented with participant observation data to supplement secondary data with a first-hand understanding of how each actor type is confronted with and manages the tick-borne disease problem. The preparatory phase concluded with the identification of specific individuals who are representative of their respective actor typology and could be contacted to participate in the second phase.

The second phase consisted of identifying local actor needs, priorities and perceptions regarding tick-borne disease detection, prevention and management (both within the actors' shared SES,

as well as in a global sense) and co-constructing a shared representation of the problem defined by the local actors themselves. Individual semi-structured interviews were used during this phase with the help of an interview guide (produced based on the data collected during the first phase and adapted to each actor typology), as an open framework allowing the actor to express themselves freely and providing information that may not be accessible in a more structured context. For convenience reasons, local actors were first identified as having previously participated in tick-related research activities with known tick specialists and contacted to participate in an interview. Subsequent local actors were identified either through the snowball method (in which each interviewe voluntarily suggests other potential local actors to contact and interview) or independent research using online directories. Finally, qualitative thematic analysis of anonymized interview transcripts was used to determine the collective and individual needs, priorities and perceptions of the local actors' citations, problem tree analysis was used to identify the interconnected needs, priorities and perceptions amongst the actors and provide a visualization tool to facilitate co-constructed solutions in the participatory workshops.

The data collected from the semi-structured interviews were then used to organize participatory multi-actor workshops, with the presence of at least one representative from each actor typology from the previously interviewed local actors to collectively discuss the shared needs, priorities and perceptions regarding tick-borne disease risk management with the social-ecological system. Participatory workshops were led by a moderator who, with the help of participatory tools and methods, guided collective participant discussions. The workshops culminated in the co-creation of a shared representation of current tick-borne disease risk, referencing socially and ecologically relevant risk indicators, as well as a desired tick-borne disease risk detection, prevention and management strategies.

The workshops aimed to ensure that each actor gained an awareness of the individual and collective actions possible to better manage tick-borne disease risk within the shared social-ecological system. Based in an iterative process, the social and ecological elements of the system are constantly being identified with each participatory intervention, as each participant's (i.e., actor's) contribution helps redefine and re-contextualize the SES. The workshops therefore serve as a baseline for further collective action development.

Outcomes

Actor identification

In 2021, four fundamental actor typologies were identified and described as important to locallevel tick-borne disease risk detection, prevention and management efforts due to the direct and/or indirect consequences of tick-borne disease risk on themselves or their animals or their ability to implement improved tick-borne disease risk policy. These actor typologies included:

- Research/Health: academics and researchers from various disciplines, in addition to actors from the human and veterinary medical field who have expert knowledge related to tick-borne disease epidemiology. These actors include infectiologists, acarologists, research technicians, environmental consultants, veterinarians.
- Administration: institutional representatives at local or regional levels who utilize expert knowledge to put in place and mobilize public policy. These actors include regional health and environmental offices, local and regional government agencies, local public interest federations.
- Environmental management: professionals who are either particularly at risk of tick bites due to their professional activities in tick-friendly environments or whose professional activities advertently or inadvertently modify the environment in tickfriendly or tick-adverse ways. These actors include forest rangers, environmental technicians, zookeepers or wildlife keepers, public park maintenance workers, professional gardeners, farmers.
- Education: educators who use expert knowledge to transmit relevant information to the general public, as well as accompany and facilitate communication between different groups of actors and individuals. These actors include teachers and professors, activity leaders and instructors within outdoor activity clubs, association members.

Study Site Selection

Throughout 2022, field visits within the Occitanie region with the ASTRE (CIRAD) tick expert group, coupled with participant observations, allowed us to more precisely delineate the case study's social-ecological system based on a combination of administrative geographic divisions, the presence of each actor typology, socio-economic stakes regarding tick-borne disease risk and ecological factors influencing tick-borne disease risk. Based on these socialecological aspects, the Hérault department was chosen as the social-ecological system to explore local actor engagement in tick-borne disease risk detection, management and prevention.

In Hérault, the ecological system is characterized by a Mediterranean climate flavoring a relatively homogeneous environment of low scrubland toward the Mediterranean coastline with a gradual transition to temperate forested ecoregions toward the northern and western boundaries. This environmental transition corresponds to the presence of important tick species for human and animal health: *Ixodes ricinus* toward the north-west boundary and *Hyalomma marginatum* toward the south-east boundary (Annex 2). Socially, economic concerns regarding tick-borne diseases in and near Hérault have been anecdotally recorded thanks to ongoing collaborations between ASTRE tick experts and local actors, primarily farmers, livestock and equestrian owners, outdoor activity leaders and local health authorities.

While Lyme borreliosis, Mediterranean spotted fever and various pathogenic tick-borne diseases affecting domestic animals have been documented in Occitanie, overall human tick-borne disease cases are relatively low in Hérault compared to more affected regions in north-eastern France. However, because of environmental changes on tick-borne disease dynamics, the threat of Crimean-Congo hemorrhagic fever virus emergence in regions such as Hérault where *Hyalomma marginatum* is present is a major public health concern requiring prevention and early detection.

Semi-structured interviews

Between May and December 2022, semi-structured interviews with local actors, accompanied by an interview guide adapted to each actor typology, were conducted with the purpose of better understanding individual local actor perceptions, priorities and needs regarding tick-borne disease risk. The interview guide consisted of three major themes: (1) participant introduction, (2) tick and tick-borne disease perceptions and knowledge and (3) collective action within a social-ecological system for improved tick-borne disease risk (Annex 3).

The majority of the interviews were conducted in person (71%) at the actor's place of work, unless the CIRAD research office was preferred, however six interviews were conducted by telephone or videoconference. All actors received a consent form (Annex 4) by email upon confirmation of an interview date which was signed in person by both parties the day of the interview. Each interview was conducted in French and audio recorded; the latter was used post-interview to create interview transcripts used for interview analysis. Each interview lasted

between 34 minutes and 2 hours and 41 minutes with an average interview duration of 1 hour and 10 minutes.

A total of 21 interviews were conducted during this period, of which two consisted of married couples and one was conducted with a group of three professional colleagues. The actors interviewed were identified as livestock and equestrian owners/farmers (29%), health educators/outdoor club leaders (29%), human and animal health professionals (19%), environmental health agents (19%) and public health officials (4%). More than half of the actors interviewed were women (64%), while the rest were male (36%). In terms of age, the majority were between 30-60 years old (76%), while 12% were older than 60 and 4% were under 30. One actor's response could not be collected.

Based on the interview data analysis, it was confirmed that tick-borne disease risk for both human and animal health is a concern for the actors interviewed and therefore improved tickborne disease detection, prevention and management at the local scale can be considered a longterm priority. A problem tree (Annex 5) was created including five categories identified as major changes needed to achieve the long-term priority including changes in:

(1) a holistic understanding of tick-borne disease risk (e.g., tick ecology, tick-borne disease epidemiology, tick bite prevention),

- (2) access to knowledge,
- (3) tick-borne disease diagnostics,
- (4) multi-actor interactions, and
- (5) the role of environmental changes

Foreseeable solutions resulting from changes in these categories include:

- (1) co-constructed, useful risk information relevant to the social-ecological system
- (2) symmetrical, multi-actor interactions, and
- (3) a "One Health"-inspired understanding of tick-borne disease risk,

Participatory multi-actor workshops

The results of the problem tree were then mobilized to organize participatory multi-actor workshops to collectively discuss the needs, priorities and perceptions of each actor regarding tick-borne disease risk create a shared representation of risk detection, prevention and management within the social-ecological system. All actors interviewed were invited to participate in the workshops that each took place at the CIRAD office and was scheduled for a three-hour timeslot. According to the availability and actor typology of the those who confirmed their participation, two workshops were organized (March 9, 2023, and March 13, 2023) with two separate groups to ensure that at least one actor representing each actor type was present. No actor representing administration or institutional bodies were available to participate in the workshops. All participants signed a consent form before leaving the workshop (Annex 4).

The first workshop consisted of nine (9) participants, including researchers (2), equestrian owners (3), an infectiologist, a veterinarian, an environmental association educator and an environment protection agent. Five of the participants were men, while 4 were women. Collective discussions and participatory tools guided the actors to respond to the overarching question: "who needs to do what differently?" to arrive at the solutions previously identified from the interviews and confirmed by the workshop participants. The workshop successfully concluded in the co-creation of an interaction diagram that visually responded the question, identifying the actors that should be implicated, along with the resources and interactions necessary to collectively improve tick-borne disease risk detection, prevention and management (Annex 6).

The second workshop only consisted of four (4) participants due to last minute absences, including a researcher, an environmental consultant, a public health risk association director and an environment protection agent. As the participatory workshop activities were not easily adaptable to such a small group, the participants instead provided comments and additional actors and resources to the interaction diagram developed by the first group.

Guidelines and recommendations

With the growing need for alternative approaches to manage increasing tick-borne disease risk throughout Europe, the current study sought to better understand the role of local actors engagement in tick-borne disease detection, prevention and management using the southern French context as a case study.

This investigation of a social-ecological systems approach to explore local actor engagement in tick-borne disease detection, prevention and management revealed that:

1. Tick-borne disease risk is a concern for a diversity of actors, however perceived risk, risk level and the social-ecological factors contributing to risk differs

according to each actor. On this basis, future research should focus on measuring how each actor perceives tick-borne disease risk and the social-ecological factors that actors collectively attribute to such risk in order of importance. This should reinforce acknowledgement for the important social-ecological dimensions of tick-borne disease risk for all actors.

- 2. A formalized multi-actor organizational system that connects local actors can be an effective tool to (1) share and build social-ecologically relevant knowledge necessary for early disease detection, (2) transmit important tick-bite prevention measures and (3) adapt management strategies to the context in question. This study provided an operational framework for a diverse group of local actors to create a common vision of tick-borne disease risk and to reflect on a multi-actor networking system that could improve risk detection, prevention and management within their shared social-ecological system. A future study should be dedicated to continuing to building on the criteria for this multi-actor network system and put in place an action plan to test the advantages of such a network system, as well as the flow of information between the local, regional and national levels.
- 3. Local actors believe that developing an organizational system that fosters and maintains multi-actor collaborations can improve knowledge-sharing and building regarding social-ecologically relevant tick-borne disease detection, prevention and management, however such a system cannot be disconnected from regional and national level institutions. As this study focused on a more bottom-up approach to local actor integration in tick-borne disease risk detection, prevention and management, future research should focus on the top-down vision and investigate how regional and national level institutional actors envision incorporating local actors into surveillance dynamics. Further, participatory workshops should be organized to bring together local, regional and national level actors to discuss a shared vision of tick-borne disease risk at its various scales.
- 4. All actors have some knowledge of tick bite risk and prevention measures, however more knowledge is desired regarding tick ecology and tick-borne disease epidemiology within the specific social-ecological context. The level of tick-borne disease risk knowledge amongst the actors should be measured using standardized questionnaires. Pre- and post-intervention questionnaires could also be used to analyze the effects of local level multi-actor workshops on tick-borne disease risk knowledge in terms of collective knowledge sharing and building.

5. While research actors participate in non-academic collaborations, public and animal health actors are considered relatively siloed, environment management actors remain poorly integrated and institutional actors are difficult to solicit for participation in tick-borne disease risk discussions. Participatory approaches facilitate multi-actor interaction by providing an opportunity for diverse actors to interact outside of their normal working context. However, in the case of public and animal health actors, lack of collaboration seems to be due to systemic barriers and the advantages of intersectoral collaborations should be emphasized and incentivized. Likewise, institutional actors should be contacted in advance and incentivized to participate in multi-actor discussions, and when impossible, their contribution on the subject should be collected and integrated into the multi-actor discussions in an iterative fashion. In the case of environment management actors future research should reinforce the understanding of the effects of ecosystem transformation and the environmental stakes related to tick-borne disease risk beyond the public and animal health consequences.

Perspectives

Although we focused on tick-borne diseases, these guidelines can be applied to various vectorborne infectious diseases, as they all involve complex vector-host-pathogen dynamics that are dependent on interconnected social and ecological variables. Like the study conducted in Finland with national level vector-borne disease stakeholders, local actors in Hérault are motivated to participate in multi-actor initiatives to continue reflecting collectively on how to improve tick-borne disease risk detection, prevention and management; however, participation requires resources, primarily time and dedication, which can be a hinderance when attempting to operationalize collaborative networks, as was revealed in Finland study. The future of this research should aim to test potential implementation of a local level multi-actor network for tick-borne disease risk knowledge sharing and building, as proposed during the participatory workshops in this current study and determine how this network could permit local actors to measure social-ecologically relevant disease risk indicators and successfully integrate into multi-level (i.e., regional, national) tick-borne disease risk surveillance efforts.

Annex 1: Research methodology plan



Annex 2: Map of climatic and environmental shit in the Occitanie region (red: Mediterranean climate, pink: altered Mediterranean climate, light blue: semi-continental; black circle: proportion of *Ixodes Ricinus*, yellow circle: proportion of *Hyalomma marginatum*) (Unpublished Climatick Projet Report, 2021 https://hal.inrae.fr/hal-353 02789712v1)



- Collectes de tiques sur chevaux (taille selon la densité estimée de tiques)
 Proportion de H. marginatum
 Proportion d'I. ricinus
 - Aucune tique H. marginatum ou I. ricinus
- ▲ Collectes de tiques au drap (taille selon la densité estimée de tiques)

Annex 3: Interview Guide page 1 and 2 (in French)

Volet 1 : Introduction de l'interviewée				
1.1 - Information sociodémosraphique/socionordessionnelle				
	1.1a - Histoire dans le territoire & parcours professionnelle			
Questions	Questions de rebond	Justification		
1. Pauvez-vaus vaus présenter, ainsi que votre structure ?	Comment vous êtes-vous installé dans le territoire? Pouvez-vous décrire vos activités?	QR1; informations de participant (genre, tranche d'âge, localisation géographique, vie professionnelle, formation scolaire) et informations la structure		
	Volet 2 : Perceptions et Connaissances des tiques et du risque tique			
	2.1 - Perception des tiques et du risque tique			
	2.1a - Perception des tiques			
Questions	Questions de rebond	Justification		
2. Pouvez-vous citer ce qui vous vient à l'esprit quand vous entendez le mot « tique » ?	Vous pouvez citer des mots, des expressions, des sentiments, des emotions, etc.	QR1, QR2; perception des tiques et du rique tique, niveau d'importance risque		
	2.1b - Perception de risque en lien avec une experience personnelle			
 Pouvez-vous expliquer comment êtes-vous confronté par la problématique? 	Pouvez-vous raconter les interactions que vous avez eu avec des tiques? Dans quels situations vous-êtes vous foit piquer par une tique?	QR1, QR2; perception des tiques et du rique tique, niveau d'importance risque		
 D'après vous et vos experiences, quels risques accordez-vous aux tiques ou à une pique de tique ? 	À votre avis, comment est-ce que ces risques pourraient varier selon la santé animale ou la santé humaine?	QR1, QR2; perception des tiques et du rique tique, niveau d'importance risque		
	2.1c - Pratiques face au risque tique	-		
5. En parlant de vos protiques et vos habitudes, que faites-vous pour prévenir une piqûre de tique sur vous? Sur vos animaux? (Ou: Que feriez-vous afin de prévenir une éventuelle piqûre de tique?)	Dans quels contextes réflechissez-vous dans cette manière?	QR1, QR2; perceptions des tiques et du risque tique, connaissances de tiques et du risque tique, indicateurs du risque tique qui informent comportement		
6. Que faites-vous quand vous constatez une tique ou une piqure de tique sur vous? Sur vos animaux? (ou: Que ferte-vous si vous constatiez une tique ou une piqure de tique?)	Combien de temps est-ce que cela vous est arrivé? Que pensez-vous de ces pratiques (pour limiter le risque de piqûre de tique?)	QR1, QR2; perceptions des tiques et du risque tique, connaissances do tiques et du risque tique, indicateurs du risque tique qui informent comportement		
	2.2 Connaissance des tiques et du risque tique			
	2.2a - Facteurs d'exposition au risque tique			
Questions	Questions de rebond	Justification		
 À votre avis, quels facteurs naturels (environnmentaux, écologiques) pourraient influencer la présence des tiques (dans un territoire)? 	Quels facteurs pourraient diminuer la présence des tiques? Sur quels sources d'information basez vous?	QR1, QR2; perceptions des tiques et du risque tique, connaissances de tiques et du risque tique, indicateurs du risque tique		
 Selon vous, quelles activités humaines pourraient influencer la présence des tiques (dans un territoire)? 		QR1, QR2; perceptions des tiques et du risque tique, connaissances de tiques et du risque tique, indicateurs du risque tique		
 Qu'est-ce que vous faites à votre niveau, seul ou avec d'autres personnes, pour diminuer le risque de piqûre ou d'éviter une maladie? 		QR1, QR2; perceptions des tiques et du risque tique, connaissances d tiques et du risque tique, indicateurs du risque tique, importance d'ur stratégie de gestion		

Volet 3 : Approches par le système-socio-écologique et action collective pour une meilleure gestion					
3.1 - Santé du système socio-écologique					
3.1a - Santé du territoire					
Questions	Questions de rebond	Justification			
10. Comment decrivez-vous un territoire ?		QR3; définition du territoire, indicateurs du système socio-écologique			
 Et maintenant, pourriez-vous décrire ce qui vous vient à l'esprit quand vous pensez à un territaire en bonne santé ? 	Ou bien, un territaire en mauvaise santé ?	QR3; indicateurs du système socio-écologique, représentation de l'equilibre dans un système socio-écologique			
	3.1b - Relfexion sur un système socio-écologique	anno an stateme sono conditiat			
	Ert en nun elect uninversent lich à der Aldmante biologique au en lien avec la				
12. Selon vous, qu'est-ce qui determine l'état d'un territoire (de la nature, de l'écosystème) ?	nature? Est-ce qu'il y a aussi une influence des activités humaines?	QR3; indicateurs du système socio-écologique, représentation de l'equilibre dans un système socio-écologique			
13. Qu'entendez-vous par le concept "une seule santé"?		QR3; indicateurs du système socio-écologique, représentation de l'equilibre dans un système socio-écologique			
 Qu'est-ce que vous faites à votre niveau (seul ou avec d'autres personnes) pour améliorer l'état du territoire sur lequel vous vivez? 		QR2; importance d'une gestion locale, motivations pour une action collective			
15. Quels liens font-vous entre les tiques et la santé du territoire (sur lequel vous vivez au en général)?		QR3; représentation du risque tique dans un territoire, représentation du risque tique en lien avec la santé d'un système socio-écologique			
	3.2 - Basolas nour une meilleure gestion du risque tique				
Questions	Questions de rebond	Justification			
	3.2a - Besoins pour une meilleure gestion				
16. De quoi auriez-vous besoin pour mieux prévenir des piqûres de tique ou pour	Queis type de ressources ou outils?	QR1, QR2; besoins des acteurs locaux, motivations pour participer dans une			
mieux gerer le risque autour de chez vous r	Avec queis autres personnes aimeriez-vous interagir r	action collective, multi-acteur interactions			
	3.20 • Perception Vis-a-Vis the action collective				
17. À votre avis, quel est l'importance d'interagir avec d'autres personnes vivant sur le même territoire que vous dans une (dynamique collective) sur la question des tiques ?	Agirez-vous déjà dans ce sens ? Avec qui ? et comment ?	QR2, QR3; motivations pour participer dans une action collective, multi- acteur interactions, représentation équilibre dans un système socio- écologique			
	3.2c - Perception de son propre rôle dans une action collective				
18. Comment vous voyez-vous participer dans ce genre d'action collective avec	Qu'est-ce que vous pourriez apporter (connaissance, ressources) ? Qu'est-ce que vous viendriez chercher dans ce type d'action ?	QR1,QR2, QR3; besoins des acteurs locaux, motivations pour participer dans une action collective, multi-acteur interactions, représentation équilibre			
d'autres personnes vivant sur le même territoire que vous?	Qu'est-ce que vous en attendez ?	dans un système socio-écologique			
3.2d - Ouverture aux approches participatives					
19. Que pensez-vous des réunions participatives organisées pour permettre une échange autour de la problématique du risque tique entre différentes personnes vivant sur votre territaire?	Quels autres personnes devraient être présentes ?	QR1,QR2, QR3; besoins des acteurs locaux, motivations pour participer dans une action collective, multi-acteur interactions, représentation équilibre dans un système socio-écologique			
20. Comment ressentez-vous de l'utilisation d'un jeu de carte (qui met en situations d'exposition aux piqures de tiques) pour r	Est-ce que ceci est le genre d'initiative/activités auxquelles vous seriez motivé à participer dans le cadre de cette étude ?	QR1,QR2, QR3; besoins des acteurs locaux, motivations pour participer dans une action collective, multi-acteur interactions, représentation équilibre dans un système socio-écologique			
Conclusion: pistes d'autres acteurs à intégrer					

Annex 4: Information and Informed consent form provided to each interviewee and workshop participant (in French). *Information form*: page 1-2 explain the scientific and institutional framework of the research, why the participant was invited to participate and the freedom of the participant to redact their participation at any time, page 3 explains the ethical responsibility of the researcher and requires a signature from the researcher and the participant. *Informed consent*: concisely explains the nature of the study and rights of the participant with and allows the participant to accept or decline, followed by the signature of the researcher and participant. *Sociodemographic information*: The information and informed consent form conclude with a questionnaire composed of two questions that the participant can respond to regarding gender and age range.









votre territoire. Pour rappel, l'objectif de l'étude est d'identifier, à travers une enquête participative les manières de mieux impliquer les acteurs locaux dans la surveillance épidémiologique. Votre participation nous aidera à avoir une meilleure compréhension de la problématique sur votre territoire et d'identifier vos besoins et priorités afin d'améliorer la gestion locale des risques associés aux tiques.

Engagement du participant : l'enquête va consister à poser des questions en lien avec cette étude, dans le cadre d'entretiens semi-directifs et d'ateliers participatifs. La participation de l'interlocuteur est complétement volontaire.

<u>Liberté du participant :</u> le consentement pour poursuivre la recherche peut être retiré à tout moment sans donner de raison et sans encourir aucune responsabilité ni conséquence. Les réponses aux questions ont un caractère facultatif et le défaut de réponse n'aura aucune conséquence pour le sujet.

<u>Information du participant :</u> le participant a la possibilité d'obtenir des informations supplémentaires concernant cette étude auprès de l'investigateur principal, et ce dans les limites des contraintes du plan de recherche.

<u>Investigateurs principaux (nom des étudiants, année d'étude)</u>: Iyonna Zortman (doctorante en sociologie, Université de Montpellier et UMR ASTRE-CIRAD)

<u>Sous la direction de</u> : Thomas Pollet (directeur de thèse, ASTRE-INRAe, Montpellier), Aurélie Binot (encadrante de thèse, ASTRE-CIRAD/Directrice adjointe à la Maison de l'Homme-Sud, Montpellier), Wim Van Bortel (Leader WP1 : *Interface with stakeholders for Innovation*, Projet H2020 MOOD, Institute of Tropical Medicine, Belgium)

<u>Promoteur et financeur du projet :</u> Projet européen H2020 MOOD (*MOnitoring Outbreak* events for Disease surveillance in a Data science context) – coordonné par le CIRAD (*Centre* de coopération internationale en recherche agronomique pour le développement) et l'Unité Mixte de Recherche ASTRE (*Animal, Santé, Territoires, Risques, Écosystèmes*)







<u>Engagement de l'investigateur principal</u> : en tant qu'investigateur principal, elle s'engage à mener cette recherche selon les dispositions éthiques et déontologiques (cité ci-dessous), à protéger l'intégrité physique, psychologique et sociale des personnes tout au long de la recherche et à assurer la confidentialité des informations recueillies.

<u>Déontologie et éthique</u> : le promoteur et l'investigateur principal s'engagent à préserver absolument la confidentialité et le secret professionnel pour toutes les informations concernant le participant ainsi que le contenu partagé lors de l'enquête. En cas de publication et de présentation des résultats dans les rencontres scientifiques, les citations utilisées ne seront rattachées ni au participant, ni à la structure qu'il/elle représente.

Je soussigné(e) ______ déclare accepter, librement, et de façon éclairée, de participer comme sujet à l'étude intitulée : « *L'exploration de l'engagement des acteurs locaux dans la gestion des risques associés aux tiques et aux maladies à tiques, à travers une analyse de la mise en place d'une action collective dans un cadre socio-écologique* »

Fait le : à :

Le participant (nom, prénom) : _____

Signature :

L'enquêteur(s) (nom, prénom) : _____

Signature :

3







<u>Formulaire de consentement</u> pour la participation aux entretiens de la thèse : « L'*exploration de* l'engagement des acteurs locaux dans la gestion des risques associés aux tiques et aux maladies à tiques, à travers une analyse de la mise en place d'une action collective dans un cadre socioécologique »

(à signer avec <u>la fiche d'information</u>)

- Je confirme avoir lu et avoir eu suffisamment du temps pour comprendre les informations fournies dans la fiche d'information de la thèse « L'exploration de l'engagement des acteurs locaux dans la gestion des risques associés aux tiques et aux maladies à tiques, à travers une analyse de la mise en place d'une action collective dans un cadre socio-écologique » dans le projet MOOD. On a répondu à toutes mes questions.
- 2. Je comprends que ma participation est volontaire et que je suis libre de me retirer à tout moment sans devoir fournir une raison et sans conséquence négative.
- Je suis satisfait(e) avec les réponses reçues concernant les activités planifiées. Je suis conscient(e) de mon droit à accéder, supprimer et rectifier les informations en contactant l'investigateur principal.
- Je consens à ce que mes opinions soient enregistrées sur papier et/ou sous format numérique. Ces opinions seront stockées et détruites en accord avec les modalités expliquées dans la fiche d'information.
- 5. Je suis conscient(e) que ma contribution pourrait être utilisée dans les publications scientifiques futures.
- 6. Je permets les membres de l'équipe du projet d'avoir accès à mes opinions anonymisées. Je comprends que toutes les informations concernant mon identité, ainsi que la structure à laquelle je suis rattachée resteront anonyme et non-identifiable en cas de publication et de présentation des résultats dans les rencontres scientifiques.
- 7. Je suis d'accord pour participer à la recherche du projet MOOD et je reçois une copie de ce formulaire de consentement.
- 8. Je suis conscient(e) de pouvoir contacter l'investigateur principal, lyonna Zortman (<u>iyonna.zortman@cirad.fr</u>) et mes réponses resteront confidentielles.

J'accepte tout Oui / Non

Nom de participant

Nom de l'enquêteur

Signature

Signature

1

Date

Date







Questions sociodémographiques

Genre M 🗌 F 🔲 Autre 🗔

Tranche d'âge <30 ans □ 30–60 ans □

30–60 ans > 60 ans

2

Annex 5: Problem Tree (blue: long-term priority, pink: solutions resulting from major changes, yellow: major changes needed to achieve long-term priority, purple: obstacles, green: strategies)



Qui doit faire quoi autrement?

Annex 6: Actor interaction diagram (participatory workshops) (blue: actor, yellow: resource, arrow: action (from actor to receiver), green: overarching objective)

